



# MedSense: The Development of a Gamified Learning Platform for Undergraduate Medical Education

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**Abstract.** Educational technology offers compelling educational possibilities for learners and educators: providing access to online databases, enabling simulation, and facilitating collaborative learning. Technology is rapidly being incorporated within traditional teaching methods to engage the millennial learners accustomed to technology-enhanced learning. Following the success of gamification strategies in medical education such as SonoGames in educating Emergency Medicine residents about the use of point-of-care ultrasound, we aimed to create a gamified learning platform for undergraduate medical education. MedSense is a collaborative gamified learning platform, where students can trial faculty-vetted case-based simulations and share interesting cases with their near-peers. The application is designed to benefit the learning of students and curriculum development by educators based on student performance. Amongst its key features are the case upload panel, game element, free response marking algorithm, recommendation panel and the analytics dashboard. MedSense is currently a prototype under development, which has been well-received by users. Given the success of gamification in other settings, we hope to reiterate the benefits of this education strategy with the development of MedSense.

**Keywords:** Gamified learning platform · Personalised feedback  
Collaborative learning

## 1 Pedagogical Background

The advancement of education technology tools offers to educators and students an extensive variety of educational possibilities. Current technology allows learners today to access a vast amount of knowledge in online databases and electronic textbooks, enables simulation of real-life scenarios to provide a safe environment for the practice of skills and facilitates collaborative learning using online sharing platforms. Technology is rapidly being incorporated within traditional teaching methods to engage the millennial learners accustomed to technology-enhanced learning [1].

Gamification refers to the concept of applying game design elements to traditionally non-game contexts [2]. Gamification strategies are increasingly being utilised in traineeship programs of various specialties, both surgical and medical. [3] For instance, SonoGames [4] is an annual event held during the Society of Academic Emergency Medicine meeting, which is a game-based event to educate residents about the use of point-of-care ultrasound and to boost their confidence in using such technology in clinical practice. Additionally, games designed for medical education have also been developed. Microbe Invader is one such example: a role-playing game designed to teach clinical microbiology. [5] With multiple success stories in the application of gamification strategies in medical education, we aimed to create a gamified learning platform for undergraduate medical education.

## 2 Technical Solution and Complexity

### 2.1 Application Overview

MedSense is a collaborative gamified learning platform where students can trial faculty-vetted cases and share interesting cases with their near-peers. It is hosted on Amazon Web Services and accessible via the domain <https://www.themedsense.com>.

MedSense is designed to assist students in making a smooth transition to clinical attachments by enabling them to practise clinical reasoning using case-based simulations. It also helps them to understand their personal strengths and weaknesses through analytic dashboards and encourages learning in a relaxed and fun environment. For educators, it provides valuable information on common weaknesses amongst students to guide course planning.

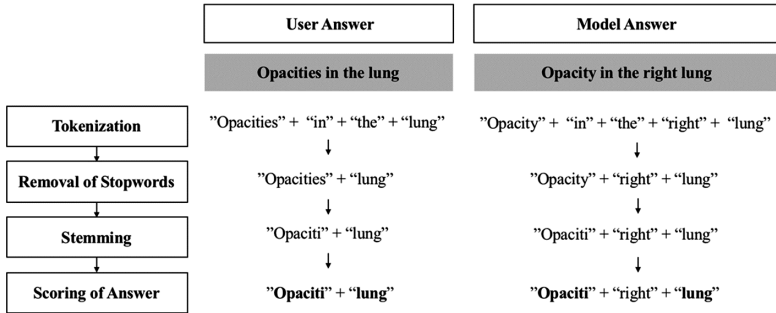
### 2.2 Application Features

**Case Upload.** MedSense features an intuitive case upload page, accessible by both students and educators. Cases uploaded by students will be vetted by faculty members to ensure factual accuracy. As a form of incentivisation, titles are conferred to all contributors and top contributors are featured on the contributor leader board.

**Gamification.** MedSense introduces an element of fun and friendly competition to learning. As students attempt cases, they gain experience (XP) and level up. The leveling system is based on the popular board game “Dungeons and Dragons” [6], which is a common reference in the development of many gaming platforms. Students level up by obtaining a set amount of XP and for each increasing level, the amount of XP required increases based on an exponential function. In this way, the game continues to remain challenging yet rewarding. Top players are featured on the player leader board.

Mechanisms have been instituted to prevent students from exploiting the game mechanics to gain levels unfairly. The total amount of XP gained is halved for each subsequent gameplay for the same case. In other words, if 4 XP were awarded for the first attempt, 2 XP will be awarded for the next and so on. Fundamentally, this prevents students from levelling up quickly by repeatedly playing the same case.

**Marking Algorithm.** MedSense differentiates itself from existing online platforms with the ability to perform automated marking of free response answers. The capability to do so is attributed to the use of Natural Language Processing (NLP)<sup>1</sup> techniques. The marking algorithm is a four-step process, as shown in Fig. 1.



**Fig. 1. MedSense Marking Algorithm.** The algorithm analyzes the answers in a four-stage process and generates a score. In this example, a score of 66% is awarded.

First, the student’s answer is broken down into individual words. Stop words, which are commonly used words like “and” and “the”, are identified and removed. Stemming is subsequently applied using the Porter’s Algorithm<sup>2</sup>, reducing the remaining words to their base forms. Finally, the remaining words are compared with the processed model answer. The score is derived by dividing the number of matched words by the total number of words in the processed model answer.

To test the reliability of the marking algorithm, the scores generated by the system are compared with the scores derived from manual scoring. On average, the accuracy of the system scoring is evaluated to be about 70%.

**Recommendation System.** Another feature of MedSense is its ability to provide recommendations individualized to the students’ needs on their respective homepages. The algorithm takes into account various factors in providing its recommendations.

First, it evaluates the performance of the student in the cases he or she has attempted in the various specialties and prioritizes cases in the specialty he or she has not performed well in. This is meant to encourage the student to attempt more cases in that particular specialty so that he or she can improve in his or her area of weakness. Recommendations are also based on the academic year the student is in: beginner cases for the pre-clinical students and advanced cases for the more senior. Finally, MedSense recommends cases by popularity based on the frequency of attempts by all users. Cases which are more frequently played are presumed to be more useful for users and are hence prioritized in the list of recommended cases.

<sup>1</sup> NLP is a form of artificial intelligence, enabling computers to analyze, understand and derive meaning from human language in order to later organize into structured knowledge [7].

<sup>2</sup> Porter’s stemming algorithm is first described by Porter et al. in 1979 as a process for removing common suffixes from words in English [8].

**Analytics Dashboard.** The analytics dashboard provides students with a broad overview of their performance in the cases they have attempted thus far. The dashboard provides useful infographics, breaking down students' scores by question and offering a comparison with the global average score of all other students who have attempted the same case. Alternatively, students may view their performance scores by specialty and subspecialty, enabling students to better understand their weaknesses and to spend more time and effort in improving their knowledge in these areas.

### 3 Case Demonstration

The case demonstration features a case titled "A Good Samaritan". We invite the audience to trial the case to experience timed case-based simulation. Special attention should be paid to (a) the types of question featured in the case – multiple choice questions, extended matching questions and free response questions, with or without image attachments; (b) the immediate feedback and score provided by the marking algorithm; and (c) the summary of their performance at the end of the case and in their respective analytic dashboard. Thereafter, making use of real-time information gathered through the attempts made by the audience, we will demonstrate how students and educators may utilize the analytic dashboard to enhance learning.

### 4 Conclusion

MedSense is a prototype of a multi-phase project. Moving forward, we intend to enhance the element of simulation by designing a role-playing platform, where users will play as medical students, and later doctors, to tackle various admissions to the hospital. Their decisions will lead to different outcomes, ranging from a debilitated patient who may not make it to a satisfied and well patient on his or her way to discharge. Through simulation, we hope to equip medical students with the ability to make critical decisions in time-sensitive settings and better prepare them for clinical practice.

In summary, given the success of gamification in other educational settings, we developed a gamified learning platform for undergraduate medical education. We hope to reiterate the benefits of this education strategy.

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