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Botanical Adventure in Pharmacy Education: Implementing an Escape Game for Quality Control Training

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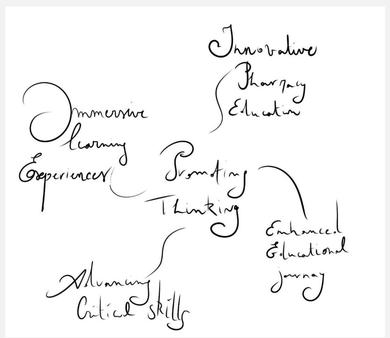
Pharmacy education is evolving to meet the demands of a dynamic pharmaceutical landscape. Innovative methods are crucial to engaging students and ensuring they are well-prepared for their future careers. One such method is the integration of escape games into the curriculum. Our project introduces an escape game designed for third-year pharmacy students, focusing on quality control in herbal drugs. By emphasizing the analysis of mint leaves and essential oils in accordance with European Pharmacopoeia standards, we aim to provide an immersive and engaging learning experience. This approach not only enhances knowledge retention but also fosters critical thinking and teamwork, essential skills for future pharmacists.

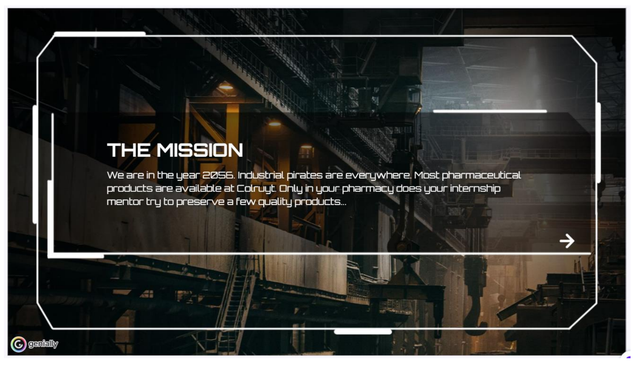


2 Objectives & strategies

- **•Microscopy Analysis**: Students compare peppermint leaf powder under a microscope, recognizing elements described in the monograph.
- **•Essential Oil Content Assessment**: Using a distillation apparatus, students calculate the percentage of essential oil in the raw material.
- **•Character Analysis**: Students assess the sensory properties of essential oils.
- **•Gas Chromatography Analysis**: Students interpret chromatograms, calculating the percentages of specific constituents through normalization.

Understand quality control processes in phytomedicines

- Apply practical skills (pharmacognosy technics in Eur.Ph)
- Develop critical thinking and problem-solving abilities
- Enhance teamwork
- Improve knowledge retention



A futuristic setting was simulated where students, organized into groups of 15, analyze peppermint essential oils and leaves to determine quality. The escape game involved several laboratory stations, each corresponding to specific quality control points. Using Genially and an interactive whiteboard, students had to click to systematically proceed to the next step. They were given 1 hour to complete the tasks and exit the game.

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Comparison of student performance between 2022 and 2023 using Gaussian distribution curves created in Excel. Consistent practical activities, such as the essential oils practical and the screening of medicinal plants, allowed for comparison and evaluation of pedagogical impact.
Gaussian curves were plotted in Excel to visualize the distribution of student grades. A two-tailed t-test was conducted using Excel's T.TEST function to assess the significance of differences in student performance, with a significance level set at $\alpha = 0.05$.

Fig. 1: Photo of the laboratory space hosting the escape game. The image depicts (1) the raw material quality control station for identification through microscopic analysis, (2) the raw material quality control station for quantification by calculating essential oil content, (3) the finished product quality control station assessing essential oil characteristics, and (4) the finished product quality control station conducting GC chromatogram analysis and quantification through normalization, and (5) rest area with mint and lemon juice.

The primary aim was to determine whether the immersive and interactive escape game experience had a discernible impact on student comprehension and proficiency in quality control concepts related to herbal drugs, as outlined in the European Pharmacopoeia. The 2023 cohort displayed a reduced dispersion of grades, with no student scoring below 8/20. This suggests an overall enhancement in performance and a more concentrated clustering of students around higher-grade ranges. Additionally, the student average in 2022 was 14.45 ± 2.34, while in 2023 it increased to 15.61 ± 2.40

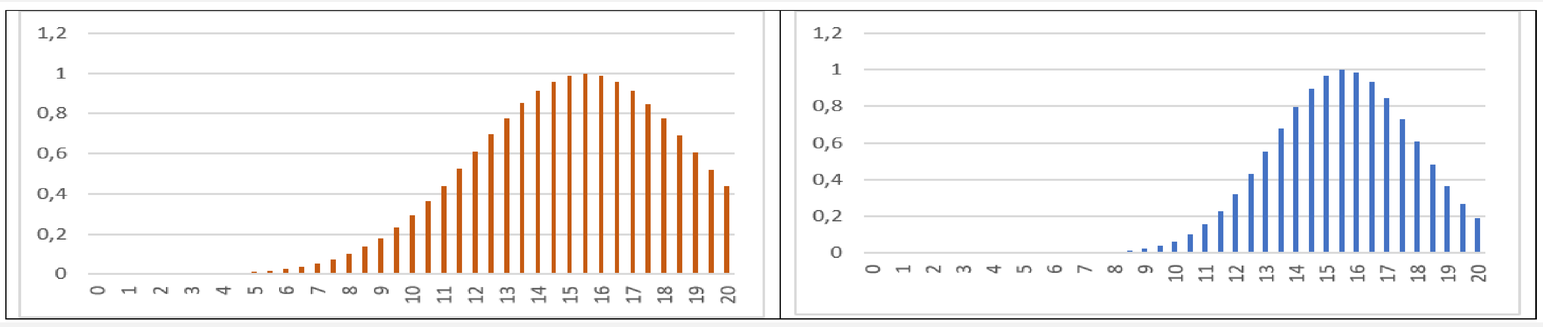

Fig. 2: Gaussian Distribution Based on Expression. The orange curve represents the 2022 results for the Essential Oils practical (TP HE) with n=97 students, yielding an average score of 14.45 ± 2.34 out of 20. The blue curve represents the 2023 results for the Essential Oils practical (TP Essential Oils) with n=83 students, resulting in an average score of 15.61 ± 2.40 out of 20.

The comparison of another assignment with similar modalities showed no significant difference in performance between 2022 and 2023, suggesting that the improved grades in the 2023 cohort for the essential oil practical can be attributed to the escape game rather than inherent skill enhancements.

Fig. 3: Preview of students' engagement in an immersive learning experience

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The significant improvement in grades and reduced dispersion in 2023, coupled with the high level of student engagement, suggest that the introduction of the escape game positively impacted student understanding and retention of quality control concepts. These findings highlight the potential of innovative pedagogical approaches to enhance educational outcomes in pharmaceutical education. Continued evaluation is necessary to confirm these trends and assess the long-term impacts across diverse educational contexts.

Aknowledgments

We extend our heartfelt thanks to all the students who participated in this project. Although our primary focus is on isolating natural compounds and other pharmacognosy topics***, teaching allows close collaboration with students, who represent the most fascinating subject of research due to the human complexity they bring. This is the true essence of a university—combining research and teaching to explore the depths of knowledge and human potential. Thank you for being a part of this enriching journey.

*** See posters P18, P89, P141, P201, P236, P264

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