

## **Escape Rooms in Nursing Education: How GPA, Collaborative Problem Solving, and Gameful Experience are related**

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**Abstract:** This study investigates students' experience in escape rooms in nursing education, focusing on the difference between the gameful experience and collaborative problem solving (CPS) score based on students' GPA. 68 first-year nursing students participated in four different types of escape rooms in teams of two or three. Utilizing natural language processing data analysis, their conversations were processed to calculate CPS scores. The results revealed that the students generally found the escape rooms to be entertaining and educational. Students in the low GPA group found the experience more challenging and felt less guided, performing worse in rooms where they had to thoroughly collect available information and reflect on what they knew to reach a conclusion. The research addresses a critical gap in existing literature by employing NLP to delve into students' conversations and provides practitioners with insights for designing a meaningful and engaging learning experience.

### **Introduction**

Originally conceived as recreational games, escape rooms have evolved into an integration of entertainment and an innovative educational tool. The principles of experiential learning and social-constructivist approaches underpin the design of escape rooms, offering learners opportunities to construct knowledge through hands-on experiences and collaborative efforts (Fotaris & Mastoras, 2019). Escape rooms have been especially explored in nursing education, considering the inherent parallels between escape room features and the demanding conditions nurses face in their professional practice. Nursing, as a profession, demands a unique set of skills, including strong leadership, effective teamwork, and clear communication. These attributes are vital for ensuring patient safety and minimizing medical errors, often caused by lapses in communication (Valdes et al., 2021). The integration of escape rooms into nursing education provides a simulated yet realistic environment for students, through which nursing students can foster the development of essential skills (Edwards et al., 2019).

Numerous studies have been conducted to evaluate the effectiveness of escape rooms as an educational tool in nursing. These investigations consistently highlight the potential of escape rooms to nurture team-building and collaboration skills, which are essential attributes for nurses in their professional roles (Valdes et al., 2021). While existing research has primarily focused on the design of escape rooms and students' positive perceptions, how students interact in the escape room to practice clinical decision making remains relatively unexplored. Recognizing the potential of escape rooms as a formative assessment tool, the present study aims to explore the variations in escape room design and assess students' conversations within the escape rooms. Specifically, the study endeavors to answer the following research question: What is the difference between high GPA and low GPA groups in terms of perception of the escape rooms and collaborative problem solving performance?

### **Literature review**

#### **Escape rooms and collaborative problem solving**

Escape rooms have been highlighted for their educational potential for several years (Fotaris & Mastoras, 2019) and implemented in diverse disciplines. Nursing education is one of the fields that escape rooms can synergize with (Valdes et al., 2021). The characteristics of escape rooms afford critical features needed for nursing education. For example, having a time limit to escape the room can simulate urgent situations in a patient room where a quick but accurate decision should be made to save a life. Having to collaborate with other people to escape the room is also an effective way to enhance teamwork for nursing students (Reinkemeyer et al., 2022). In light of the potential of using escape rooms in nursing education, there have been several studies where escape rooms were designed for nursing students. While the initial response to the pilot projects was positive in general, there is still a lack of empirical evidence on how effective escape rooms are in terms of establishing nursing students' positive professional attitudes.

#### **GPA and collaborative problem solving skills**

GPA has been a representative measure for predicting students' academic success and excellence. In nursing education, Madjid et al. (2023) reported that GPA is a valid predictor for predicting nursing students' clinical competency. However, this contradicts the findings of Karacabey et al. (2022), as they found no significant difference between GPA and the level of clinical decision-making.

The mixed results on the relationship between nursing students' GPA and clinical abilities call for a new approach to investigate the difference in nursing students' professional behaviors according to their GPA. In addition, nurses work in a collaborative environment, where their clinical decision making should also be an output of a collective discussion. Little is known about the relationship between nursing students' teamwork and GPA. Taking an educational data mining perspective, delving deeper into the conversations of nursing students in the escape rooms to reach a clinical decision and discussing it with regard to GPA will provide us with new insights on nursing education for educators and practitioners.

## Sentiment analysis in nursing education

Sentiment analysis has been widely used for multiple purposes in educational research (Zhou & Ye, 2023). As emotion is a crucial but often neglected side of learning analytics, sentiment analysis affords a novel opportunity to explore learners' emotions without the need to wear bodily and physiological sensors, thus being more cost efficient. Zhou and Ye (2023) conducted a systematic review based on forty-one studies using sentiment analysis in the field of education and reported that the current literature mainly uses sentiment analysis to investigate learners' satisfaction or attitude. This detects a salient gap, which calls for well-designed educational research using a machine learning approach to go beyond analyzing learners' attitudes and explore the relationship between learners' sentiment and academic achievement.

## Methods

### Data collection

#### Escape rooms for nursing education

The escape room for this study consists of four rooms. The whole process of the intervention was supervised by the instructors. Participants had fifteen minutes for each room to escape, and they could ask any of the staff technical questions. The staff refrained from giving direct answers in escape rooms but facilitated students' progress by prompting the patient's assessment or checking their understanding and background knowledge. Each escape room comes with a card explaining the context and what the students are expected to look for in each room. Students were provided with a scorecard, a pencil, and a stethoscope. Two to three students were paired as a team to solve the escape room and teams rotated every 15 minutes to experience all four escape rooms. The themes of the escape rooms were medication administration, safety and security, low blood sugar, and sepsis, respectively.

#### Participants

The participants are first-year nursing students taking a simulation-based introductory course in nursing. A total of 69 students at a public university located in the southern United States were selected. The participants agreed to the audio and video recordings of their escape room experience and collected their academic performance records. The study went through internal IRB approval.

### Data analysis

Three types of data were collected for this study. First, we recorded the escape room activities. There were 70 nursing students in 32 teams of two or three people. As every team went through four escape rooms, a total of 128 conversation files were transcribed into text files using an AI-powered transcription tool. The conversation files were later analyzed to determine the CPS score using sentiment analysis in Python.

Next, we collected questionnaire responses from students after they finished the escape rooms. A gameful experience questionnaire (Högberg et al., 2019) was adopted to explore students' perceptions about the escape rooms. 68 students submitted a full response. As the escape rooms in this study did not have any competitive treats, the questionnaire adapted for this study consisted of 47 items under six categories; accomplishment, challenge, guidance, immersion, playfulness, and social experience. The questions were on a 7-point Likert scale and included an open space for students to express their opinions about escape rooms. Finally, we collected students' grade point average (GPA). The average GPA of the participants was 3.482. 17 groups with lower average GPA than 3.482 were labeled as low GPA groups.

In the data analysis phase of our research, we employed a Python script to conduct sentiment analysis on a collection of text files containing transcriptions of collaborative conversations. The script utilizes the Hugging

Face Transformers library, specifically the GPT-2 language model, for sentiment analysis. The sentiment analysis function, `analyze_sentiment`, tokenizes the conversation text using the GPT-2 tokenizer and calculates the CPS score based on the model's prediction of positive sentiment. We connected the concept of the positive sentiment to CPS as negative sentiments such as conflicts, frustration, and miscommunication are anti-indicators of CPS.

## Results

### Difference in CPS scores

There was a statistically significant difference in CPS scores for Rooms 1 and 4 (See Table 1). High GPA groups collaborated better in Rooms 1 and 4 compared to low GPA groups.

**Table 1**

*Results of Independent Samples T-test and Effect Sizes from the CPS Score ( $p < .05^*$ )*

Room types	T statistics	P value	Cohen's d	Hedges' g	Glass's delta
Room1	-2.197	.032*	-.549	-.543	-.443
Room2	.827	.412	.207	.204	.257
Room3	1.285	.204	.321	.317	.564
Room4	-2.460	.017*	-.615	-.607	-.454

### Differences in gameful experience

Students generally enjoyed the escape rooms, regardless of their GPA. The responses were generally positive (See Table 2) and statistically significant difference was not found in any constructs (See table 3) However, there was a slight difference in the effect sizes. In Table 3, we can see that low GPA groups felt slightly less guided ( $d = -.083$ ) and more challenged ( $d = .092$ ) and playful ( $d = .117$ ) in the escape rooms.

**Table 2**

*Results of Independent Samples T-test and Effect Sizes from the Questionnaire*

Constructs	Mean (SD)	T statistics	P value	Cohen's d	Hedges' g	Glass's delta
Immersion	4.31 (1.18)	.072	.943	.018	.018	.017
Playfulness	4.79 (1.00)	.469	.640	.117	.116	.108
Social Experience	4.75 (1.11)	.027	.978	.007	.007	.006
Guidance	4.73 (1.16)	-.333	.740	-.083	-.082	-.073
Challenge	4.84 (1.05)	.370	.713	.092	.091	.083
Accomplishment	5.25 (0.80)	.195	.846	.049	.048	.048

## Discussion

This study offers valuable insights at the intersection of student achievement, gameful experience, and the administration of escape rooms, drawing from experiential learning and social-constructivist approaches. By integrating sentiment analysis, it brings a fresh level of rigor to nursing education and learning science.

While this study limits itself by incorporating self-reported data on gameful experience, The findings corroborate prior research, demonstrating that students generally find escape room experiences enjoyable, consistent with Edwards et al. (2019). However, a nuanced understanding emerges when considering the interplay between student GPAs and their experiences within these activities.

Specifically, students with lower GPAs reported feeling more challenged and less supported during escape room activities. This underscores the importance of adaptive design in escape room experiences, recognizing the diversity of academic performance among participants. Additionally, managing escape rooms effectively becomes paramount. Assigning facilitators to each room, as suggested by Reinkemeyer et al. (2022), could enhance participant experiences by providing more tailored guidance.

Moreover, the relationship between GPA and performance in rooms featuring plot twists introduces an intriguing dimension to the discussion. Higher GPAs were associated with better performance in these scenarios, echoing the studies reporting GPA's influence on clinical competency (Madjid et al., 2023), academic resilience (Delshad et al., 2023), and critical thinking (Romeo, 2013) in nursing students. This finding informs the design of escape rooms in the future to include Eureka factor and ingenuity, as stated by Michalewicz and Michalewicz (2008). Of particular interest is the thin line between frustration and resilience observed in the study. While a weak correlation with GPA was identified, the factors influencing students' ability to demonstrate resilience or succumb to frustration remain unclear. This underscores the complexity of student responses to challenges within the escape room setting, suggesting that GPA alone may not fully explain these dynamics.

To delve deeper into these nuanced dynamics, future research could adopt a qualitative approach, examining instructors' interactions in various contexts, such as differing levels of GPA or teamwork. This would facilitate a deeper understanding of how learning support varies based on these factors, contributing to a more comprehensive understanding of the escape room learning experience.

Additionally, it is important to critically discuss the limitations of relying solely on self-reports and sentiment analysis to investigate escape room activities, considering potential biases and subjective interpretations. Furthermore, connecting the findings to different types of escape rooms and elaborating on how these results can inform the design and application of escape room methodologies would enrich the discussion and provide practical implications for educators and designers alike.

## Conclusion

This study aimed to investigate differences in gameful experience and CPS scores among students in escape room activities based on their GPAs. Findings indicated that while escape rooms were generally perceived as both entertaining and educational, the low GPA group faced more challenging experiences, felt less guided, and performed poorly in rooms requiring comprehensive information gathering and critical thinking.

Future research suggestions included expanding investigations to include additional variables beyond GPA, diversifying settings by involving students from various medical care disciplines, and exploring alternative research methodologies like Epistemic Network Analysis and qualitative approaches for a more comprehensive understanding of the educational impact of escape rooms in nursing education.

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