

# Critical thinking, empathy and problem solving using a modern board game

A learning experience valued by physical therapy students

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## ABSTRACT

This study aimed at understanding how physical therapy students recognize a modern board game experience as an opportunity to train socioemotional skills. Thirteen physical therapy students participated in a learning experience using the Magic Maze board game and were assessed in terms of critical thinking, empathy, and problem-solving perceived experience. The facilitator's perceptions were also registered. Students showed to be goal oriented focusing on choosing different solutions and reflecting critically on the most suitable one. Magic Maze was classified as a relevant learning method for other serious purposes.

## CCS CONCEPTS

• Professional topics; • Adult education; • Informal education;

## KEYWORDS

Socioemotional skills, Learning, Health Students, Education

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## 1 INTRODUCTION

Game-based experiences have been highlighted as an efficient strategy to develop crucial socioemotional skills in healthcare contexts [1]. Game-based tools are considered innovative learning

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approaches in the higher education field, even though studies are still scarce [2, 3]. However, using games as a tool to support the development of socioemotional skills has already shown its potential to train future health professionals, since it allows to stimulate collaborative learning experiences, using simulation scenarios [2, 4].

Herein, current study programs focus on technical skills and do not prepare students to workplace challenges, despite the importance of non-academic skills in real labor contexts and clinical settings [5]. Previous studies support that the development of socioemotional skills, such as critical thinking, empathy, and real problem-solving stimulation, increases positive peer relationships, collaborative teamwork, and quality in health practices [1, 7–9]. Training critical thinking requires students to use problem solving skills and intuition, in order to formulate reliable decisions and make appropriate medical decisions [7, 8].

Problem-solving skills are essential in health contexts, since they promote faster solutions in response to patients needs and problems [9, 10]. Empathy is an important communication skill that allows understanding the personal experience of patients, increasing treatment adherence and clinical outcomes. Studies indicated that health professionals with high levels of empathy are more efficient, since patients feel safer and more secure to express their problems and thoughts [6, 7, 10, 11].

Critical thinking, problem solving and establishing empathic relationships are linked to the ability of decision-making and are some of the most important indicators for interprofessional and multidisciplinary efficient work in health teams [12]. In fact, being able to make the right decisions at the right time is a crucial part of leadership. However, sometimes making decisions under pressure in health contexts can be very challenging, so assertiveness should be worked, in order to avoid stressful situations that can lead to labor stress [13].

Moudatsou et al. [9] observed in their study that a significant percentage of health professionals have difficulty in adopting an emphatic relationship with their patients. Some of the reasons mentioned were the high number of patients and the shortage of time, the focus on therapy and the lack of education on empathy skills. Hence, developing socioemotional skills should be an underlying objective in health higher education programs, but also the subject of the lifelong and continuous education of professionals.

The development of these skills will allow health professionals to identify and prioritize problems, provide appropriate and efficient solutions, and develop mutual understanding, and confident therapeutic building. Hence, in health care contexts it is important to develop these socioemotional skills since they predict higher levels of job performance, adequate job attitudes and an efficient team performance [14].

Therefore, this study aimed at understanding how physical therapy students perceive a modern board game experience as an opportunity to train socioemotional skills, such as critical thinking, empathy and problem-solving.

## 2 METHODOLOGY

An exploratory study using self-report questionnaires was performed with a convenience sample of 13 physical therapy students recruited at the School of Health Sciences of Polytechnic Institute of Leiria. Participants were included if they were: >18 years old; physical therapy students and if they agreed to voluntarily participate in a Modern Board Game (MBG) play session. The game session resulted from playing and reflecting on the behavior and learning game outcomes, supported by a teacher that acted as a game facilitator to teach the game and conduct the debriefing stage after playing the game by selecting a MBG (Sousa & Bernardo) that fostered collaboration experiences we expected to engage students in a fun and learning experience. Respondents who refused to participate or joined in other similar activities were excluded. Of the sixty-six students initially interested, 36 declined to participate due to difficulties in school scheduling or because they do not consider it as a significant learning experience for the clinical practice.

Eligible students received detailed information about the procedures and an online link to access the questionnaires by email. All electronic data collection procedures were delivered using Google Forms. All the procedures performed in this study complied with the ethical standards of the 1964 Helsinki Declaration and the Institution Ethical Committee.

### 2.1 Maze protocol – a learning experience

Magic Maze is a real-time cooperative board game where players control four character pawns [15, 16] there is a limited time and restricted communication among players. Each player can only perform a specific action, like moving a character in a particular direction or discovering new tile actions. The game is modular. It is possible to add more complexity to increase the challenge. The Magic Maze game can be played from 3 to 8 players in about 15 minutes.

For the serious game approach, the research team adapted Magic Maze to deliver a serious game experience to physical therapy students. The mudding approaches were adopted, in order to profit from the playable dimension of existing modern board games and tweak the game to deliver specific goals [17–19]. In the case of the Magic Maze game, the adaptation was minor. The research team simplified the rules, allowed players time to discuss during the hourglass activation square, and established a sequence of several plays of the same game. By playing Magic Maze, players should be able to identify what was necessary to foster collaboration. A facilitator taught the game and conducted a final debriefing [20, 21].

Debriefing allowed students to reflect on their experiences and on how the game helped them frame the necessary conditions to foster collaboration in a project or activity. The facilitator divided students into 4 and 5 player teams. Students played the game several times. In each new play, the facilitator increased the difficulty and added new rules. Players could discuss the game strategy for one minute when they paused the game. Players could stop the game by moving into a red hourglass square if they wished.

Each hourglass space had one-time use. The facilitator controlled the pause time and added the tile that marked the used action space. Just one exit was used for all character pawns. All the other maze tiles, with the multiple exits and special challenges, were removed. A process of 3 steps of play was established. The first step was playing to learn the game. Then, each team played again with the portals and changing place when the time paused. The final step transformed the collaborative experience into a competitive championship, one team versus another team. In this third step of play, the facilitator recorded the time each team spent finishing the challenge. Before every new round, teams could gather to discuss playing strategies to improve their performance. The two-hour class was enough to prepare the game introduction and the three-step game dynamic. That was possible because we used several copies of magic maze, allowing simultaneous play.

### 2.2 Magic Maze protocol – An analog serious game process

The adopted process to transform Magic Maze into a serious game followed a three-step process that have the potential adapted to other game-based approaches. The objective was to deliver a collaborative experience where players felt empowered to express critical thinking, empathy, and problem-solving. In Step 1 the facilitator explained the game rules and the options players had to achieve goals. During the first step, the game complexity was to the minimum possible, and each team of players explored the game at their rhythm. In Step 2 each team tried to play as efficient as possible, still supported by the facilitator. Stage 3 created a competition where each team tried to do better than the other. After the three steps, the facilitator conducted a debriefing stage to reflect on the playing experience and learning outcomes [22].

### 2.3 Instruments to assess the game-based learning experience

There was a gaming experience survey to be fulfilled by students (i.e., players) and a game observation survey to be fulfilled by the facilitator. Both instruments were created based on Bandura's instructions on how to build instruments to assess game-based experiences, as no prior survey existed, specifically in this field [23]. Players' experience survey was previously created by the research team to evaluate the socioemotional players' experience regarding critical thinking, empathy and problem solving.

Each of these questions received a quotation from 1-5 with a minimum of 5 points and a maximum of 25 points. The facilitator used a survey to register students answers about what the necessary conditions to foster collaboration are, with a quotation from 1-2 (slight % time session); 3-4 (moderate % time session) and 5-7 points (strong % time session).

**Table 1: Socio-emotional subdomains characterization in physical therapy student**

Items	M± SD
Empathy (5-25)	<b>17.4±3.3</b>
Interpersonal relationship with other group members	3.1±1.4
Type of communication	3.1±1.4
Active listening	2.9±1.6
Significant behaviors (enthusiasm; competitiveness)	4.4±0.7
Positive reinforcement towards other group members	3.4±1.0
Critical thinking (5-25)	<b>16.8±2.8</b>
Logic of performance in the game itself	3.8±0.9
Logic of performance in the game of other players	3.9±0.8
Sharing doubts and uncertainties	3.5±1.0
Clarity of information using verbal language	2.4±1.5
Clarity of information using non-verbal language	3.2±1.0
Problem solving (5-25)	<b>17.9±2.7</b>
Problem identification	3.6±0.8
Focus on solution at the expense of the problem	3.8±0.7
Considering the different solutions	3.6±1.0
Choosing the most suitable option	3.4±0.7
Critical reflection on the option taken	3.4±0.8

Notes: M = mean; SD = Standard deviation

## 2.4 Data analysis

The players experience survey was analyzed considering the average and percentage of the different answers (% slight; % moderate; % strong), in terms of socioemotional players' experience and students' perceptions on the serious dimension of game-based experience. Correlations between these two dimensions were calculated using the Pearson test ( $p < 0.05$ ).

Two blinded evaluators were involved in the analysis and in the classification of the students' opinions about other serious applications of the Magic Maze. After performing a first classification, the evaluators arranged a remote consensus meeting. Data on the facilitators' perceptions were considered in terms of the percentage of time that the group demonstrated a certain behavior.

## 3 RESULTS

### 3.1 Socioemotional skills characterization

Health students of physical therapy studies presented higher scores, (Table 1), in problem-solving ( $17.9 \pm 2.7$ ), followed by empathy ( $17.4 \pm 3.3$ ), and critical thinking ( $16.8 \pm 2.8$ ).

By socioemotional domains, students indicated that physical therapy students found significant behaviors, as competitiveness and enthusiasm ( $4.4 \pm 0.7$ ; 38.1%) quite relevant and valued a lot the interpersonal relationships with others ( $3.9 \pm 0.6$ ; 57.6%), during the game experience. On the other hand, active listening was the least scored, according to student's perception ( $2.9 \pm 1.6$ ), although 28.6% of the participants have considered it, as a relevant domain.

Critical thinking outcomes showed that students really perceived the logic of performance of their game ( $3.8 \pm 0.9$ ; 47.6%), as the other players ( $3.9 \pm 0.8$ ; 42.9%), and they also felt a moderate (23.8%) to high (28.6%) freedom to ask and share doubts and uncertainty with others ( $3.5 \pm 1.0$ ). However, students indicated some difficulties in

perceiving clearly the transmission of information through verbal language, oscillating between slight (19%) to moderate (14.3%). Finally, problem solving results revealed that students felt that they were able to identify the problem during the game experience ( $3.6 \pm 0.8$ ; 33.3%), to focus on its resolution ( $3.8 \pm 0.7$ ; moderately 23.8% to high: 28.6%), consider different solutions ( $3.6 \pm 1.0$ ; 38.1%), choose critically ( $3.4 \pm 0.8$ ; 33.3%) the more suitable solution ( $3.4 \pm 0.7$ ; moderately 28.6% to high: 28.6%).

### 3.2 Correlations among socioemotional domains

A significant positive and strong correlation was observed between critical thinking and problem-solving skills ( $r = 0.84$ ;  $p \leq 0.001$ ), which means higher scores in critical thinking subdomains are related to higher scores in the ability of problem solving. No relationships were observed between empathy and critical thinking ( $p = 0.09$ ) or problem solving ( $p = 0.20$ ).

### 3.3 Facilitator's experience

The facilitator explained the game's objectives of the session and the students. Students learned the game fast. After the first play, all the players were ready to play the game competitively. The sequence of multiple play sessions of Magic Maze, with increasing complexity, allowed players to learn the game and define strategies to improve their performance. The process proved how important it is to define a progressive method to learn a new game [20, 24]. During the debriefing process, the facilitator asked students what the necessary conditions to foster collaboration were. As showed in Table 2, 90% of the students strongly expressed the importance of a clear communication, 85% mentioned the knowledge of each player task, 80% mentioned continuous attention, 80% referred the definition of a strategy everyone could follow and 75% mentioned

**Table 2: Conditions to foster collaboration perception**

	Slight (1-2)	Moderate (3-4)	Strong (5-7)
<b>Knowledge of each player task</b>	5	10	85
<b>Continuous attention</b>	0	20	80
<b>Trusting peers</b>	10	15	75
<b>Stablishing clear communication</b>	0	10	90
<b>Defining a strategy to everyone</b>	5	15	80

trusting peers. Players referred that the game was very stressful due to time and communication restraints. Although they liked the collaborative approach, players said they were undoubtedly more engaged when the championship began. The team goals were more meaningful for the player when they were competing against other teams.

#### 4 DISCUSSION

The results exhibited that the Magic Maze Game can be an engaging prime strategy to stimulate socioemotional skills. Physical therapy students presented higher scores in problem solving skill perception, followed by empathy and critical thinking. In fact, previous studies suggested that these skills are key indicators to foster cooperation and effectiveness in health care teams and contexts [1, 7–9].

Care includes kindness and compassion for other's well-being. Therefore, establishing empathic relationships promotes high quality care and mutual help in clinical and stressful clinical settings [25]. Hence, health professionals can suffer from an enormous pressure, which can interfere in acute medical decision-making. Thus, critical thinking as sharing doubts, having a clear communication, avoiding oversimplifications, and considering other approaches is mandatory to problem solving and decision-making effectiveness [26]. Students achieve effective learning outcomes through repetition, memorization, and reflection, and thereby enhance their problem solving skill [27]. However, in current study programs students are passive learners, which can have a negative effect on learning, as they adopt the information without analyzing it, interpreting it and thinking critically [28]. Rodzalana e Saatb [28] carried out a study with undergraduate students, and their findings indicated that students perceived themselves as having highly critical thinking and problem solving skills. Nevertheless, when given a difficult task with limited time and with unfamiliar individuals, they stated that feelings have weakened their judgement. This suggests that the ability to make accurate decisions in problem solving may decrease, when they feel uncomfortable and under pressure, which then leads to stress in work. These findings suggest that a game-based experience, using magic maze game can be used as an innovative education tool in socioemotional skills training. Therefore, critical thinking, empathy and problem solving abilities, are fundamental in future health contexts as they are predictors of outcomes which include job satisfaction, effective communication, decision-making, therapeutic adherence, quality of life, team-work collaboration, and accurate diagnosis and treatment [9, 29]. The MBG designs can support engaging and effective learning activities when used in a systemic approach that allows progressive

learning, empowerment and reflecting through debriefing on the experiences.

#### 5 CONCLUSION

Physical therapy students self-perceived this experience with the Magic Maze game as significant to learn relevant socioemotional skills, especially real problem solving. The facilitator's perceptions confirmed that they were immersed and emotionally involved in this learning experience. Students also indicated the importance of the other significant behaviors, of positive reinforcement and of critical thinking to foster collaboration and teamwork, which is essential in health professional workplaces.

#### REFERENCES

- [1] Priscilla K Gazarian, Constance R C Morrison, Lisa Soleymani Lehmann, Orly Tamir, David W Bates and Ronen Rozenblum. 2021. Patients' and Care Partners' Perspectives on Dignity and Respect During Acute Care Hospitalization. *Journal of patient safety*, 17(5): 392-397. doi: 10.1097/PTS.0000000000000353.
- [2] Marko Urh, Goran Vukovic, Eva Jereb, and Rok Pintar. 2015. The Model for Introduction of Gamification into E-learning in Higher Education. *Procedia - Social and Behavioral Sciences* 197, 388–397. DOI:https://doi.org/https://doi.org/10.1016/j.sbspro.2015.07.154.
- [3] Maja Pivec and Olga Dziabenko. 2004. Game-Based Learning in Universities and Lifelong Learning: "UniGame: Social Skills and Knowledge Training." *Journal of Universal Computer Science* 10(1), 14–26.
- [4] Verónica Estrada-Plana, Roger Montanera, Ana Ibarz-Estruga, Jaume March-Llanes, Núria Vita-Barrull, Núria Guzmán, Agnès Ros-Morente, Rosa Ayesa, and Jorge Moya-Higuera. 2020. Cognitive Training with Modern Board and Card Games in Healthy Older Adults: Two Randomized Controlled Trials. *International Journal of Geriatric Psychiatry*.
- [5] Laura Ribeiro, Milton Severo, Maria A. Ferreira. 2016. Performance of a core of transversal skills: self-perceptions of undergraduate medical students. *BMC Medical Education*, 16(18). doi: 10.1186/s12909-016-0527-2.
- [6] Óscar Rodríguez-Nogueira, Antonio R. Moreno-Poyato, María José Álvarez-Álvarez, Arrate Pinto-Carral. 2020. Significant socio-emotional learning and improvement of empathy in physiotherapy students through service-learning methodology: A mixed methods research. *Nurse Education Today*, 90, 104437. doi: 10.1016/j.nedt.2020.104437.
- [7] Murat A. Çınar, Elif D. Dinler and Yavuz Yakut. (2019). The Effect of creative drama on empathic tendencies, communication skills and critical thinking of physiotherapy students. In *CBU International Conference Proceedings*, 7: 711-716.
- [8] Brandy Weidman and Helen Salisbury. 2020. Critical thinking in health sciences and how it pertains to sonography education: A review of the literature. *SAGE Journals*, 36 (3): 244-250. doi: 10.1177/8756479320908216.
- [9] Maria Moudatsou, Areti Stavropoulou, Anastas Philalithis, and Sofia Koukouli. 2020. The Role of Empathy in Health and Social Care Professionals. *Healthcare (Basel, Switzerland)* 8(1), 26. DOI:https://doi.org/10.3390/healthcare8010026.
- [10] Adolfo Peña. 2010. The Dreyfus model of clinical problem-solving skills acquisition: a critical perspective. *Medical education online*, 15(1). doi: 10.3402/meo.v15i0.4846.
- [11] Sara Shahbazi, Mohammad Heidari, Ehsan H. Sureshjani and Parvi Rezaei. 2018. Effects of problem-solving skill training on emotional intelligence of nursing students: An experimental study. *Journal of education and health promotion*, 7, 156. doi: 10.4103/jehp.jehp\_50\_18.
- [12] Eric Molleman, Manda Broekhuis, Renee Stoffels, and Frans Jaspers. 2008. How Health Care Complexity Leads to Cooperation and Affects the Autonomy of Health Care Professionals. *Health Care Analysis* 16, 4, 329–341.

- [13] Alicia M Zavala, Gary E Day, David Plummer, and Anita Bamford-Wade. 2018. Decision-making under pressure: medical errors in uncertain and dynamic environments. *Australian health review: a publication of the Australian Hospital Association* 42 (4), 395–402.
- [14] Timothy A Judge, Daniel Heller, and Michael K Mount. 2002. Five-factor model of personality and job satisfaction: a meta-analysis. *The Journal of applied psychology* 87 (3), 530–541. DOI:<https://doi.org/10.1037/0021-9010.87.3.530>.
- [15] Geoffrey Engelstein and Isaac halev. 2019. Building Blocks of Tabletop Game Design: An Encyclopedia of Mechanisms. CRC Press LLC. doi: 10.1201/9780429430701.
- [16] Kasper Lapp. 2017. Magic Maze [Gameboard]. Sit Down !
- [17] Daisy Abbott. 2018. Modding tabletop games for education. In *International Conference on Games and Learning Alliance*, 318–329.
- [18] Edward Castronova and Isaac Knowles. 2015. Modding board games into serious games: The case of Climate Policy. *International Journal of Serious Games*, 2(3), 41–62. doi: 10.17083/ijsg.v2i3.77.
- [19] Micael Sousa. 2020. Modern Serious Board Games: modding games to teach and train civil engineering students. 2020 IEEE Global Engineering Education Conference (EDUCON), 197–201. doi: 10.1109/EDUCON45650.2020.912526.
- [20] Micael Sousa and Joana Dias. 2020. From learning mechanics to tabletop mechanisms: modding steam board game to be a serious game. 21st Annual European GAMEON@Conference, GAME-ON@'2020.
- [21] David Crookall. 2010. Serious Games, Debriefing, and Simulation/Gaming as a Discipline. *Simulation & Gaming* 41(6), 898-920.
- [22] Micael Sousa and Edgar Bernardo. 2019. Back in the Game. In *International Conference on Videogame Sciences and Arts* (pp. 72-85). Springer, Cham.
- [23] Igor Mayer, Geertje Bekebrede, Casper Hartevelde, Haral J. G. Warmelink, Qiqi Zhou, Theo van Ruijven, Julia Lo, Rens Kortmann and Ivo Wenzler. 2014. The research and evaluation of serious games: Toward a comprehensive methodology. *British Journal of Educational Technology*, 45(3), 502–527. doi: 10.1111/bjet.12067.
- [24] Albert Bandura. 2006. Guide for constructing self-efficacy scales. Self-efficacy beliefs of adolescents, 5(307-337). In: *Psychology*: 307–37.
- [25] Aiko Sato and Jonathan de Haan. 2016. Applying an Experiential Learning Model to the Teaching of Gateway Strategy Board Games. *International Journal of Instruction*, 9, 3–16. ISSN: 1694-609X.
- [26] Lena Gustin .2017. Compassion for self and others as key aspects of well-being in changing times. *Scandinavian Journal of Caring Sciences*, 31: 427–433. doi: 10.1111/scs.12536.
- [27] Louis S. Jeevanantham. 2005. Why Teach Critical Thinking? *Africa Education Review*, 2(1): 118-129.
- [28] Shazaitul A. Rodzala and Maisarah M. Saab. 2015. The Perception of Critical Thinking and Problem Solving Skill among Malaysian Undergraduate Students. *Procedia - Social and Behavioral Sciences* 172: 725 – 732. doi: 10.1080/18146620508566295.
- [29] Krsiten Purcell, Lee Rainie, Alan Heaps, Judy Buchanan, Linda Friedrich, Amanda Jacklin, Clara Chen and Kathryn Zickuhr. 2012. How Teens Do Research in the Digital World: Pew Research Center.