*engineering proceedings*

MDPI

*Proceeding Paper*

# Teaching Knowledge in the Logic and Engineering Method through Board Games †

**Kuan-Yin Lee [1] and Prasana Kumar Samanta [2,*]**

[1] Department of Marketing and Logistics Management, Chaoyang University of Technology, Taichung 413310, Taiwan; kylee@cyut.edu.tw
[2] Department of Business Administration, Chaoyang University of Technology, Taichung 413310, Taiwan
* Correspondence: prasanna.samanta.777@gmail.com
† Presented at the 3rd IEEE International Conference on Electronic Communications, Internet of Things and Big Data Conference 2023, Taichung, Taiwan, 14–16 April 2023.

**Abstract:** Today, students are accustomed to visual information and need engaging, stimulating, and fun teaching in logic and engineering methods for learning purposes. Traditional presentations and the transfer of memory information cannot arouse students' interest. By implementing logic and engineering methods in their teaching, teachers strive to promote active learning and deepen the learning effect by motivating students and engendering interest in learning. Problem-based learning (PBL) allows students to clarify or solve problems by identifying gaps in their knowledge, constructing clear educational topics, and integrating relevant information (PBL). This study aims to motivate students to learn through problem-oriented game-based approaches which help to solve chain board game development problems that increase learning efficiency. Third-year students have already mastered the basics of theoretical knowledge and have gained relevant work experience in industry–academy internships, class cadre work, and community service. Learning effectiveness and methods of learning, social interaction, and subject engagement are significantly different, according to an analytical study of SPSS data. The use of methods and the organization of notes are significantly more likely to be observed in students with high learning outcomes than in students with low learning outcomes. Learning outcomes do not differ significantly between students with high and poor peer ratings of board games. Students with high peer ratings of board games perform better than their poor peers in terms of learning methods. Students with poor peer scores in board games have significantly more body input than students with good scores. The results of this study can be helpful to teachers in subsequent curriculum design to improve students' learning effectiveness.

**Keywords:** game learning method; logic; engineering method; learning effectiveness



**Citation:** Lee, K.-Y.; Samanta, P.K. Teaching Knowledge in the Logic and Engineering Method through Board Games. *Eng. Proc.* **2023**, *38*, 46. https://doi.org/10.3390/engproc2023038046

Academic Editors: Teen-Hang Meen, Hsin-Hung Lin and Cheng-Fu Yang

Published: 27 June 2023



## 1. Introduction

Learning outcomes need to be improved by effective teaching strategies in response to educational changes [1]. Razon defined play as a voluntary and freely performed activity that provides happiness [2]. Games can stimulate growth, improve skills, and improve mood. By enhancing experience and fun, board games stimulate students' enthusiasm for learning [3]. Additionally, teachers are incorporating learner-centered principles into their courses and modifying traditional teaching methods [4]. Playing games allows the present generation to learn about complex interconnected knowledge bases while having fun. Games are a good way for educators to convey knowledge to learners and engage them in the course material.

The learner-centered teaching method is becoming increasingly popular among teachers. They try to arouse students' motivation and interest in learning through teaching activities design, thereby promoting active learning and deepening the learning effect. Learning topics that provide students with insight into their knowledge gaps can help them to identify and correct the knowledge gaps using problem-based learning (PBL).

Games play a role in our everyday lives when they become part of our lives, bringing us entertainment and learning, as well as uniting people's feelings and sometimes serving as educational tools. The board game industry has grown in popularity over the past few years. By playing board games over the internet, people can interact in "face-to-face" contact and with 3C products in order to enjoy games in "face-to-face" contact.

In reviewing the teaching site, several problems were found.

- People are always carrying their mobile phones in the 3C era.
- Concentration time is shortened year by year.
- Despite cross-domain learning, multiculturalism, and youth influence, there are small groups in the classroom that are even more difficult to cross.
- The learners seem to have unfulfilled ambitions and talents, and always have the feeling that the teacher does not understand what students want.

Therefore, the following is possible.

- Through board games, the interaction is brought back to the human world, and at the same time, it assists teachers in teaching.
- Sharing and learning from the results with peers to enhance human-to-human interaction.
- Developing related board games using chain knowledge and enhancing students' learning abilities through the board game development program.

Therefore, this study developed a complete and exclusive board game for students studying chain enterprise management. Students can learn the benefits of board games by using their brains, activating their brains, and increasing interest in life through board game activities.

Teachers teach students the basic knowledge and guide students to design a "chain enterprise theme board game" through problem-based learning (PBL) and learn the content of chain enterprise management and build team soft power. Furthermore, lecturers from the board game industry will teach students how to develop board games based on theoretical foundations.

Students should learn relevant knowledge and set goals in order to develop chain board games based on the dominance of learning. In addition to integrating knowledge, students must also ensure that play and learning are enjoyable for peers by focusing on factors such as entertainment, ease of play, and comprehension.

PBL is a teaching method that can improve students' ability to solve problems and manage related decisions. Furthermore, it facilitates active learning, strengthens memory, promotes teamwork, and fosters active learning attitudes [5]. The research results use problem-oriented and game-based learning strategies which are used to help students learn through action, which enhances their interest in learning and results in better learning outcomes.

## 2. Literature Review

### *2.1. Gamification Design*

Gamification means that through the design of systems, services, organizations, and activities, learners have the same experience and motivation as games to influence user behavior [6]. Games are entertaining, enhance interpersonal relationships, and integrate elements of education and learning, allowing gamers to cultivate creativity, and emotional management, and improve learning stability [7].

Since games are an effective learning method, many theories become the basis for arguments. ARCS motivation theory mentions that games are a process of enhancing learning motivation, including attention, relevance, confidence, and satisfaction [8]. Learning environments and contexts play a key role in the authenticity of learning activities and knowledge [9]. As a result, using games to motivate students to learn and allowing them to play within a game context will transform the current educational scene and attract learners.

### *2.2. Learning Input*

Reeve and Tseng pointed out that student input was important, and students were not only passive recipients of information but also active learners [10]. Increasing students' engagement helps achieve better learning outcomes, and teachers' teaching practices have a positive outcome [11].

Most studies examined students' learning engagement through multiple facets which were distinguished from behavioral and emotional engagement. Emotional engagement can refer to school identification, school belonging, liking for school, or being bored at school [12], while behavioral engagement includes participating in activities in and out of the classroom [13]. Game development is the focus of this research, specifically game development for learning, as opposed to game development for commercial value. This study intends to apply the knowledge gained. Therefore, when developing games, the behavioral side needs to be able to understand the knowledge taught, and the emotional side can interact well with teachers and peers to achieve the purpose of the game learning curriculum. Therefore, we use study skills, emotional engagement, and interaction engagement as aspects of studying students' learning engagement.

### *2.3. Learning Effectiveness*

Student academic performance is the most basic definition of learning effectiveness (midterm and final grades) [14]. Learning outcomes include cognitive learning and perceptual learning. Cognitive learning includes changes in personal psychology [15] and perceptual learning is defined as the changes in learners' perceptions of skills and knowledge levels before and after learning experience. In this study, we define learning outcomes as the subjective outcomes obtained from one's learning gains after participating in the learning process of board games.

## 3. Research Method

The junior students already have a basic understanding of theory and accumulated relevant learning achievements. Competitor awards, industry–academy experience, class cadre experience, and community involvement are among these achievements. The research involved 125 students from two classes.

### *3.1. Curriculum Design*

The weekly content and teaching activities are shown in Table 1.

**Table 1.** Weekly content and teaching activities.

| Weekly | Content | Teaching Activities |
|---|---|---|
| Week 01 | Course Introduction | 1. The teacher explains the course objectives, teaching methods, and assessment methods<br>2. Introduction to PBL<br>3. Small group (group of 5–6 people) |
| Week 02 | 1. History and Introduction of Chain Enterprise Development—Chain Store | 1. The theoretical knowledge of chain enterprises is taught by teachers<br>2. The case is read and discussed within the groups<br>3. The results of the discussion are shared<br>4. Board game experience |
| Week 03 | 2. Chain Enterprise Market Opportunities | |
| Week 04 | 3. Chain Headquarters Management, Organization, and Development Conditions | |
| Week 05 | 4. Chain Headquarters Management—Franchisor | |
| Week 06 | 5. Affiliate Entrepreneurial Opportunity Assessment | |
| Week 07 | 6. Franchisee Store Operation Strategy—Franchisee | |
| Week 08 | 7. The Relationship between Franchisees of the Chain Headquarters | |

**Table 1.** *Cont.*

| Weekly | Content | Teaching Activities |
|---|---|---|
| Week 09 | Board Game Development and Design Speech | 1. The development process of board games is shared<br>2. Board game setting mechanism |
| Week 10 | Semi-Structured Interview and Board Game Questionnaire | |
| Week 11 | Interim Report: Publication of PBL Works | The results of board games are shown |
| Week 11 | Interim Report: Publication of PBL Works | Other group members are encouraged to play board games designed and developed by themselves |

### *3.2. Board Game Experience Process Program*

Board game experience and development flow chart is shown in Figure 1.

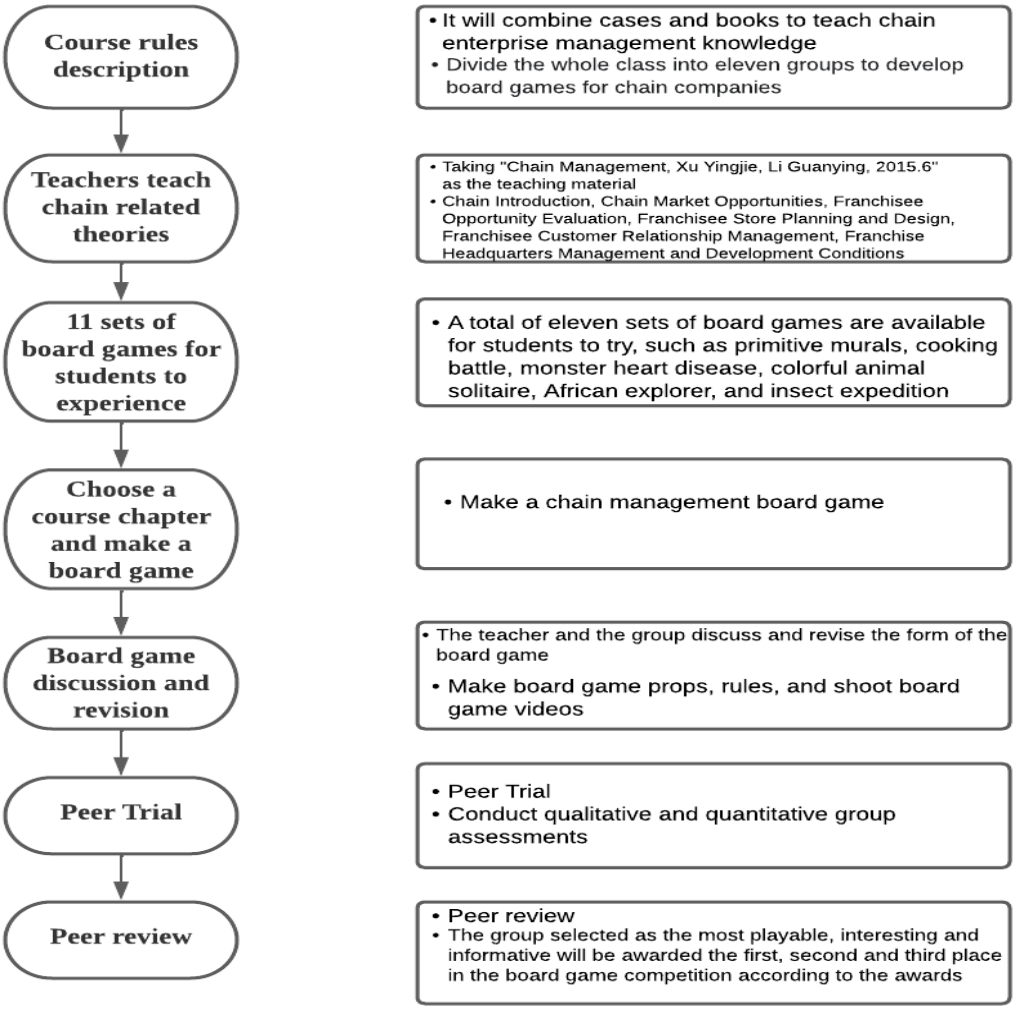


**Figure 1.** Board game experience and development flow chart.

### *3.3. Board Game Content Design*

This research plan review process is conducted by teachers with more than ten years of experience in teaching chain courses and in practicing chain courses to ensure that the content is valid. Table 2 shows the basic content that the group should develop for developing board games based on at least one key concept from the chain chapter.

**Table 2.** Chain chapters and foci.

| Chain Chapters | Focus | Chain Chapters | Focus |
|---|---|---|---|
| 1. Development History and Introduction of Chain Enterprises | 1-1 Chain definition<br>1-2 Types of chain operations<br>1-3 Chain fee (three gold)<br>1-4 Chain enterprise value chain | 5. Affiliate Entrepreneurial Opportunity Assessment | 5-1 Startup funding rule of thirds<br>5-2 Affiliate survey |
| 2. Chain Enterprise Market Opportunities | 2-1 Advantages and disadvantages of chain headquarters<br>2-2 Advantages and disadvantages of franchisee<br>2-3 Chain development trend | 6. Franchise Store Operation Strategy | 6-1 Window classification<br>6-2 Magnet theory<br>6-3 Display method<br>6-4 VP PP IP |
| 3. Chain Headquarters Management, Organization and Development Conditions | 3-1 Chain organization chart<br>3-2 Affiliate type<br>3-3 Chain headquarters and their conditions<br>3-4 Member's conditions | 7. The Relationship Between Franchisees of the Chain Headquarters | 7-1 Forms of communication<br>7-2 Chain headquarters training content<br>7-3 The basic content of the franchise company |

## 4. Conclusions

Since "Management of Chain Enterprises" is a compulsory course of the department, we asked the students on the course to develop a board game of chain chapter knowledge and let the group monitor the developed board game and rate the learning gains of chain knowledge. After the game was over, a questionnaire on learning engagement and learning effectiveness was issued and tested, and suggestions for future course design and arrangement were put forward as a reference for future related issues and follow-up research.

**Author Contributions:** Conceptualization, K.-Y.L.; methodology, K.-Y.L.; validation, K.-Y.L.; investigation, P.K.S.; writing—original draft, P.K.S.; writing—review and editing, P.K.S. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** The study did not require ethical approval.

**Informed Consent Statement:** All participants in the study were students and informed consent was given prior to the questionnaires being administered.

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The authors declare that research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## References

1. Richardson, C.; Percy, M.; Hughes, J. Nursing therapeutics: Teaching student nurses care, compassion and empathy. *Nurse Educ. Today* **2015**, *35*, e1–e5. [CrossRef] [PubMed]
2. Razon, N. *Okul Öncesi Eğitimde Oyunun, Oyunda Yetişkinin Işlevi*; Ya-Pa Okulöncesi Eğitimi ve Yaygınlaştırılması Semineri: İstanbul, Turkey, 1985.
3. Garris, R.; Ahlers, R.; Driskell, J.E. Games, motivation, and learning: A research and practice model. In *Simulation in Aviation Training*; Routledge: England, UK, 2017; pp. 475–501.
4. Schmidt, C.K.; Davis, J.M.; Sanders, J.L.; Chapman, L.A.; Cisco, M.C.; Hady, A.R. Exploring nursing students' level of preparedness for disaster response. *Nurs. Educ. Perspect* **2011**, *32*, 380–383. [CrossRef] [PubMed]
5. Saarinen-Rahiika, H.; Binkley, J.M. Problem-based learning in physical therapy: A review of the literature and overview of the McMaster University experience. *Phys. Ther.* **1998**, *78*, 195–207. [CrossRef] [PubMed]
6. Hamari, J.; Koivisto, J.; Sarsa, H. Does gamification work?—A literature review of empirical studies on gamification. In Proceedings of the 2014 47th Hawaii International Conference on System Sciences, Waikoloa, HI, USA, 6–9 January 2014; pp. 3025–3034.
7. Ozorio, B.; Fong, D.K. Chinese casino gambling behaviors: Risk taking in casinos vs. abstract investments. *UNLV Gaming Res. Rev. J.* **2004**, *8*, 3.

8. Keller, J.M.; Kopp, T. Application of the ARCS model of motivational design. In *Instructional Theories in Action: Lessons Illustrating Selected Theories and models*; Reigeluth, C.M., Ed.; Lawrence Erlbaum: Hillsdale, NJ, USA, 1987.
9. Brown, J.S.; Collins, A.; Duguid, P. Situated cognition and the culture of learning. *Educ. Res.* **1989**, *18*, 32–42. [CrossRef]
10. Reeve, J.; Tseng, C.M. Agency as a fourth aspect of students' engagement during learning activities. *Contemp. Educ. Psychol.* **2011**, *36*, 257–267. [CrossRef]
11. Ogunmokun, O.A.; Unverdi-Creig, G.I.; Said, H.; Avci, T.; Eluwole, K.K. Consumer well-being through engagement and innovation in higher education: A conceptual model and research propositions. *J. Public Aff.* **2021**, *21*, e2100. [CrossRef]
12. Leithwood, K.; Jantzi, D. Transformational school leadership effects: A replication. *Sch. Eff. Sch. Improv.* **1999**, *10*, 451–479. [CrossRef]
13. Lipps, G.; Norris, C.; Pignal, J. Measuring school engagement. *Educ. Q. Rev. Online* **2003**, *9*, 25–34.
14. Piccoli, G.; Ahmad, R.; Ives, B. Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Q.* **2001**, *25*, 401–426. [CrossRef]
15. Siegler, R.S.; Shipley, C. Variation, selection, and cognitive change. In *Developing Cognitive Competence: New Approaches to Process Modeling*; Lawrence Erlbaum Associates, Inc.: Mahwah, NJ, USA, 1995; pp. 31–76.