The Effect of Gamification with Self-Regulated Approach to Promoting Nursing Students' Leopold's Maneuvers Performance

Intan SETIANI[a*], Ching-Yi CHANG[b] & Jie-Chi YANG[c]
[a]*Graduate Institute of Network Learning Technology, National Central University, Taiwan*
[b]*School of Nursing, College of Nursing, Taipei Medical University, Taiwan*
[c]*Graduate Institute of Network Learning Technology, National Central University, Taiwan*
*intansetiani@g.ncu.edu.tw

Abstract: Fetal appearance and proper position evaluation are crucial for determining the best labor treatments. Healthcare or midwifery nurses, require knowledge about the fetus's position and health to make decisions on whether to induce labor. In addition, attending to the patient's needs throughout labor is essential. The fetal positioning and monitoring process may be uncovered with the use of Leopold's techniques. Students find it challenging to apply what they learn in the classroom to real-world challenges since standard training lacks chances for clinical experience and application. This study aims to investigate the impact of integrating online game-based environments with gamification and a self-regulated learning (SRL) strategy on nursing students' Leopold's maneuvers skills. The use of games as a learning tool in education has gained popularity due to its ability to provide a playful and motivating experience for students, as well as fostering cooperation among them. However, the application of game-based learning and gamification in nursing skill instruction remains understudied. The researchers propose integrating an online game-based environment called Gather with gamification features and a self-regulated learning strategy for nursing students. The self-regulated learning approach in this study includes goal setting, performing tasks with gamification elements such as points, badge, leaderboards, and self-evaluation. An experiment will be conducted at a nursing school in a Taiwan university using a quasi-experimental design to investigate the learning performance, motivation, self-efficacy and perceptions.

Keywords: Gamification, online game-based environment, self-regulated learning, Leopold's maneuvers, nursing education.

1. Introduction

An accurate assessment of the fetus's presentation and position is crucial for determining the exact time of birth (McFarlin et al., 1985). The four Leopold's maneuvers identify fetal orientation (Mirghani et al., 2007). This technique gives expecting mothers a sense of their child's position in the womb, promoting awareness of the growing fetus (Nishikawa & Sakakibara, 2013). Nursing education emphasizes the importance of training in fundamental competencies such as knowledge, skills, and attitudes (Hwang & Chang, 2020). Nurses employ various interventions, such as Leopold's maneuvers, to strengthen maternal bonding and increase fetal awareness (Brandon et al., 2009). However, recognizing an occiput posterior fetus challenges traditional teaching and learning methods (Biancuzzo, 1993). Traditional training lacks clinical practice and application opportunities, making it difficult for students to apply classroom knowledge to real-world problems (Chang et al., 2020).

Furthermore, research has indicated that the implementation of successful pedagogical approaches is imperative for improving academic performance among students

(Chang et al., 2020). The researcher establishes a correlation between variances in students' learning abilities and insufficiency in self-regulatory skills. This viewpoint prioritized the identification of students' self-awareness to manage their boundaries and pursue their academic pursuits effectively. While educators need to know their students' learning abilities, their primary objective should be facilitating students' self-awareness of these differences. According to Zimmerman (2002), if students encounter difficulty comprehending a particular aspect of a course during class, it is incumbent upon them to exhibit self-awareness and strategic understanding to implement corrective measures. Hence, it is imperative to facilitate nursing students' learning through a self-regulated strategy.

The use of game-based learning and various forms of gamification is increasingly gaining traction within the realm of education. One of the rationales behind utilizing games as a learning tool is that it provides a playful experience that provides a source of motivation for students. Another factor pertains to the games' social dimension, which fosters student cooperation (Vidergor, 2021). However, this strategy has been investigated infrequently for nursing skill instruction (Chang et al., 2022). Previous research has demonstrated the effectiveness of online game-based learning (Yang et al., 2021). Using games as an educational tool has had positive results, as evidenced by documented improvements in academic performance, student motivation, and diligence across various fields of study (Barata et al., 2017). Gamification is a new method that tries to motivate and engage people (Bozkurt & Durak, 2018). To further understand the impact of certain gamification features or designs, academic research is increasingly looking to motivation, behaviour, and learning theories (Nacke & Deterding, 2017).

Therefore, its important to guide nursing students in a self-regulated learning strategy with gamification inside. To this end, this study proposed an approach for integrating online game-based environments using Gather with gamification inside with a self-regulated learning strategy to investigate its impact on nursing students' Leopold's maneuvers skills. Gamification with self-regulated learning is integrated in this study. The self-regulated learning in this study included: goal setting, doing the task and having gamification inside; the students can get the points, rewards, and leaderboard after finishing the task, and the last step is self-evaluation. To investigate the potency of the proposed approach, an experiment will be conducted at a school of nursing in a Taiwan university. We will use a quasi-experimental design to answer the following research questions.

1.) How does gamification with a self-regulated approach improve the students' learning performance compared to gamification without an SRL approach to learning Leopold's maneuvers skill?
2.) How does gamification with a self-regulated approach improve the students' learning motivation compared to gamification without an SRL approach to learning Leopold's maneuvers skill?
3.) How does gamification with a self-regulated approach improve the students' self-efficacy compared to gamification without an SRL approach to learning Leopold's maneuvers skill?
4.) What is students' perception toward gamification with self-regulated learning?

2. Literature Review

2.1 *Gamification in Nursing Education*

The utilization of game-based learning and diverse forms of gamification is progressively garnering momentum in the domain of education (Vidergor, 2021). Gamification can enhance learning experiences by positively impacting various factors such as extrinsic motivation, enjoyment, feedback, collaborative work, and active learning (Ferriz-Valero et al., 2020). Several studies have explored the effectiveness of gamification in various health care domains, such as clinical skills training and teaching learning in medical education (Gentry, et al., 2019; Kim & Kim, 2022; Sardi et al., 2017). These studies have demonstrated positive effect, including increased knowledge, skills, professional attitudes, outcomes, and satisfaction attitude; was effective in helping students emphatize

with their patients and improve their problem-solving skills; gamification of e-Health frequently involves the utilization of rewards, feedback, and socialization elements. However, the use of gamification in the context of promoting nursing students' performance in Leopold's maneuvers remains limited.

For instance, a study by Koivisto, et al., (2016) implemented experiences of learning clinical reasoning processes by playing a 3D simulation game. The utilization of gamification has the potential to facilitate the development of clinical reasoning, problem identification, and the application of theoretical knowledge, as evidenced by the findings of this investigation. The utilization of 3D patient scenarios in clinical reasoning, which incorporate interactive patient and equipment features, can provide prompt feedback to healthcare professionals.

Another study by Brull et al., (2017) implemented a gamified learning platform to investigate the efficacy of three pedagogical approaches, namely didactic, online modules and gamification, in the context of wound management, pain management, and fall prevention during orientation. The platform integrates avatar-based gaming with educational content accompanied by knowledge-based challenges and the opportunity to earn badges. The results indicate that gamification is a viable instructional approach in contrast to conventional pedagogical techniques. The incorporation of gaming elements in the learning process was found to be positively received by staff and resulted in higher knowledge retention. The findings indicate that gamification effectively increases the users attention, elicits a sense of pleasure and foster the utilization of cognitive abilities. Therefore, to increases nursing students performance, motivation, self-efficacy and perceptions, researcher will conduct gamification elements during learning activity.

2.2 *Self-Regulated Learning in Nursing Education*

Self-regulated learning (SRL) is a construct that emphasizes learners active engagement in planning, monitoring and evaluating their learning process (Zimmerman, 2002). The ability to engage in self-regulated learning (SRL) is an essential skill that physicians must possess in order to pursue lifelong learning and provide superior healthcare services (Bransen et al., 2022). According to (Yang et al., 2018), students may lose sight of their learning objectives and performance if they don't use proper learning tactics when playing games. Several studies have explored the effectiveness of self-regulated learning in various health care domains, including SRL in a competency-based, e-learning on patient safety (Zheng et al., 2020; Gaupp et al., 2018). These studies examined the employment of self-regulated learning (SRL) by students across their self-reported levels of academic achievement. The findings revealed that students at all levels utilized planning and reflection strategies.

Furthermore, the study by (Yoo & Jung, 2022) pointed out that self-regulated learning was observed to manifest when individuals were provided with chances to engage in self-regulated study and leadership activities, as well as when they established interpersonal connections with their professors and peers. These methods have been acknowledged to enhance the level of satisfaction in the process of learning. Based on the findings of this investigation, it is imperative to devise pedagogical approaches that augment the degree of contentment experienced by learners enrolled in remote nursing education curricula. However the use of self-regulated learning in the context of Leopold's maneuvers skills or other clinical skills remains limited. Therefore, to enhance students self-regulated learning by their own learning, this study will conducted its impact on nursing students clinical skills, especially for Leopold's maneuvers skills.

3. Methodology

3.1 *Study design and participants*

We will adopt a quasi-experimental design and use online game-based learning environments using Gather and gamification inside with a self-regulated learning strategy to know its impact on nursing students Leopold's maneuvers skills. First-year nursing students

will be recruited as experiment participants, and the same teacher will teach all participants. We will randomly assign 25 participants to the experimental group to conduct gamification with a self-regulated learning strategy and 25 participants to the control group using traditional course learning. The experimental group use Gather as an online game-based learning environment.

3.2 *Development gamification with self-regulated learning strategy through an online game-based environment using Gather*

The adoption of digital technology in teaching and learning has garnered significant attention from educators, particularly those in higher education. The process of digitalized learning entails incorporating technological tools to transform educational materials into digital formats, which may include video recordings, audio files, and video conferencing (Yow, 2022). We used Gather to develop an online game-based environment as an interactive role-playing game to teach Leopold's maneuvers skills. The tool facilitates the creation of virtual spaces that accurately represent physical locations, with the added capability of integrating game settings such as tables, offices, and classrooms into virtual rooms. According to (Najjar et al., 2022), the tool facilitates the creation of virtual parts where users can position their avatars and communicate with other participants who are also present. They can also use video, audio, and chat to communicate.

By integrating gamification inside the Gather, we used a self-regulated learning strategy to regulate their limit throughout their learning interests. Figure 1. illustrates self-regulated learning with a gamification process through an online game-based environment using Gather. There are three phases the students must follow after they enter the learning game environment: forethought phase; goal setting, performance phase; doing the task, and self-reflection phase; self-evaluation. During the "forethought phase" the system prompts students to set learning objectives, including anticipated classification, anticipated correct-answer rate, and anticipated learning duration. During the "performance phase" students are instructed to observe and track their learning progress and rate of goal attainment while participating in the game. Also, upon completion of each phase of the game, the system provides feedback to students based on their game results. In the "self-reflection phase", students are guided to assess and reflect on their learning outcomes. They are then encouraged to modify their goal-setting approach for the next stage of the game. Before starting the game or learning activities, the teacher will introduce the system and learning material. To start the game, the students need to go in the direction in the first phase; they set their learning goals by embedding Google Forms into Gather. Then, before the students do the task, they can learn by watching a video about Leopold's maneuvers in Gather. After that, in the second phase, students do the task by following the directions in the game; while students do the task, they can see their points, badge, and leaderboard and other students' leaderboards. To end this game, in the third phase, students need to follow the direction to fill self-evaluation form in Gather to evaluate their learning according to their doing the task and goal-setting status.

The educational scenarios that were formulated within the game were derived from a nursing textbook and a formal nursing protocol of fundamental nursing proficiencies (Superville et al., 2023), especially in Leopold's maneuvers skills (such as indications, contraindications, preparations, technique, complications and clinical significance) which were reviewed for content validity by two experts in the field of nursing education. The storyline in this game is based on the development of Leopold's maneuvers skills. Students need to learn the process of four Leopold's maneuvers by completing the five-step learning task (i.e., indications, contraindications, preparation, procedure and complication). In the first step, students need to understand what the indications are and the reasons or criteria that make Leopold's maneuvers of action appropriate or necessary for a patient. In the second step, students need to understand what are the specific circumstances, conditions, or factors that make a particular medical treatment, procedure, or intervention inadvisable or potentially harmful for a patient, especially for Leopold's maneuvers intervention. In the third step, nursing students need to be familiar with the specific equipment, instruments, and supplies

required for a particular procedure. They must know how to operate the equipment, ensure its proper functioning, and be aware of any specific considerations or precautions. In the fourth step, that important step, students need to understand well about Leopold's maneuvers skills procedure and how to implement the intervention. In the last step, students need to understand who can take risks, complications unexpected or undesirable outcomes that may occur during or after a medical procedure. Complications can range from mild and temporary side effects to severe and potentially life-threatening events.

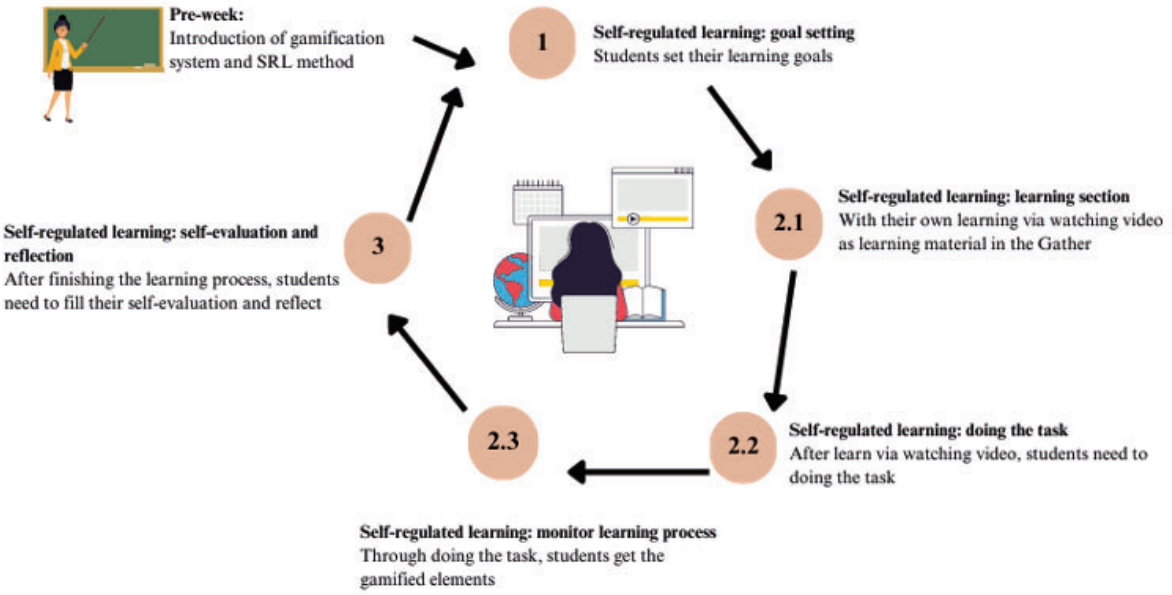

Figure 1. Self-regulated learning with gamification process

3.3 *Experimental procedure*

Figure 2. illustrates the experimental procedure of this study. Before the learning activities, the teacher introduces Leopold's maneuvers skills syllabus and learning goals. All students will take the learning performance pre-test and complete the learning motivation and self-efficacy pre-questionnaire. The students will be divided into the experimental group and control group to learn about Leopold's maneuvers skills. More specifically, the experimental group will complete gamification with a self-regulated learning strategy, while the control group will complete this course using traditional classroom. The experimental group utilized gamification with self-regulated learning strategy, which is gamification involves incorporating gamification elements such as points, badge and leaderboard into the learning process to enhance learning outcomes and motivation. And self-regulated learning involves the students taking an active role in their learning process. They set their learning goals, watch instructional video, complete task and then evaluate their learning performance. While the control group follows a traditional approach to learning. Students in this group watch instructional video, practice and complete learning sheets. Furthermore, the learning activity will carry out once a week for 100 mins each time, for a total of 200 mins over two weeks. The purpose of this study is to investigate whether the gamification and self-regulated learning approach in the experimental group leads to better learning performance, increase motivation and improved self-regulated learning compare to traditional classroom approach in the control group. After the learning activities, all students will complete the learning performance post-test and the post-questionnaire of learning motivation and self-efficacy.

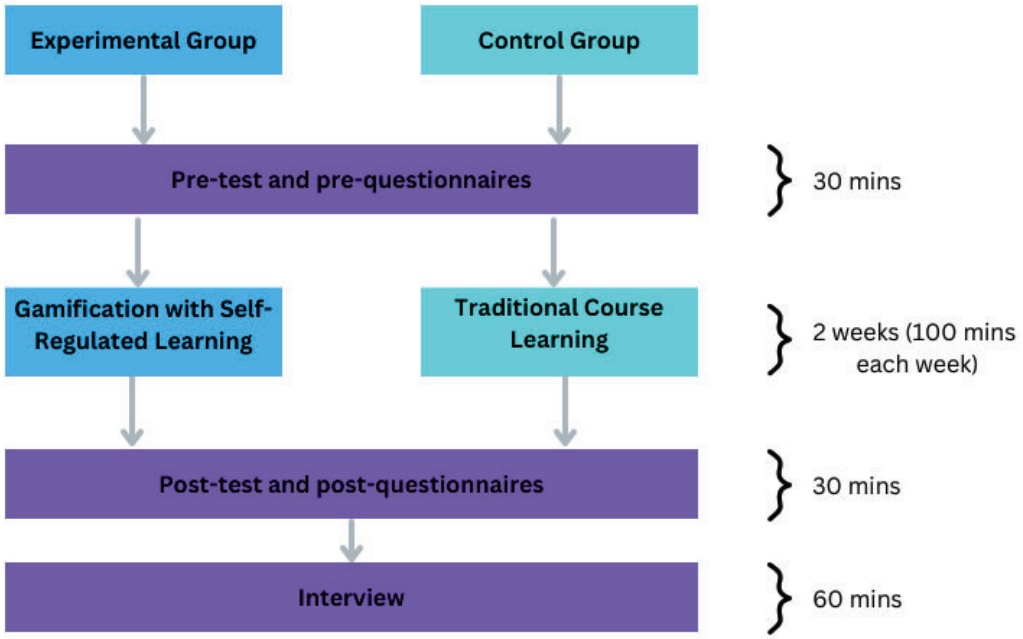

Figure 2. Experimental procedure

3.4 *Instruments*

The Leopold's maneuvers test was created by two experienced nursing educators to assess students' pre- and post-knowledge of Leopold's maneuvers. Each test had 20 multiple-choice questions about Leopold's maneuvers, with a total score of 100.

The learning motivation scale was adopted by Wang and Chen (2010). It consisted of three items for intrinsic motivation such as "In this course, I prefer course material that really challenges me so I can learn new things.", "In this course, I prefer course material that arouses my curiosity, even if it is difficult to learn." and "When I have the opportunity, I choose to do the quizzes in this course that I can learn from, even if they don't guarantee a good grade." and three items for extrinsic motivation such as "Getting a good grade and mastering Leopold's maneuvers skills in this course are the most satisfying things for me.", "If I can, I want to get better grades in this course than most of the other students." and "I want to do well in this course because it is important to show my skills to my family, friends, employer, and others.". A 5-point Likert scale will be adopted in this measure, ranging from 1 (strongly disagree) to 5 (strongly agree).

The self-efficacy scale was adopted by Pintrich et al. (1991). It consisted of eight items, such as "I believe I will receive an excellent grade in this class.", "I'm certain I can understand the most difficult learning material presented in this game.", "I'm confident I can understand the basic concepts taught in this course.", "I'm confident I can understand the most complex material presented in this game.", "I'm confident I can do an excellent job on the tasks in this game.", "I expect to do well in this course.", "I'm certain I can master Leopold's maneuvers skills being taught in this course." and "Considering the difficulty of this course, the teacher, and the Leopold's maneuvers skills, I think I will do well in this course.". A 5-point Likert scale will be adopted in this measure, ranging from 1 (strongly disagree) to 5 (strongly agree).

The online game-based environment using Gather.town was developed in this study. This is capable of running on individual personal computers. The students can choose their avatar and sign in to the game map and enable to open the video, audio and chat with other students. By embedding learning strategies into Gather and gamification inside the task.

Furthermore, a set of questions was adopted by Chang et al. (2020) to interview to know the students' perceptions after using this system: 1.) What was the difference between this kind of instruction and the way you expected? 2.) As a whole, what were the advantages of this learning approach from your perspectives? 3.) In which part did you gain the most by using this approach? In which part did you learn the most? 4.) What should be improved with regard to the function or interface design of the system? 5.) Do you look forward to learning with this learning approach again? What kind of subject? Why? Why are these subjects suitable for this type of learning? 6.) Would you recommend that your classmates learn by using this system or this kind of method? Do you think they need to learn using this kind of approach? Or, do you think they would like to learn using this method? 7.) Would you recommend that your teachers teach using this system or this kind of method? Do you think they need to teach in this way? Or, do you think they would like to teach using this method?

4. Expected Results

The study aims to examine the impact of a gamified learning intervention with a self-regulated approach on nursing students' performance in conducting Leopold's maneuvers. It is anticipated that gamification and self-regulated learning strategies will lead to several positive outcomes. To begin, nursing students engaging in the intervention are required to exhibit enhanced skill in completing Leopold's maneuvers. Gamified learning and self-regulation approaches are expected to improve students' performance, motivation, and self-efficacy due to their interactive and engaging character. Second, the intervention is intended to improve information retention among nursing students since gamification and self-regulated learning promote deeper comprehension and memory consolidation. Third, implementing self-regulatory skills inside the gamified learning is expected to boost students' development of self-regulatory abilities such as goal-setting and self-evaluation. This may result in enhanced self-awareness, self-efficacy, and the capacity to recognize and address areas for improvement in performing Leopold's maneuvers. Finally, the intervention is projected to elicit positive student feedback and satisfaction since the engaging and immersive character of gamification, combined with the autonomy and control offered by self-regulated learning, is likely to promote a good learning experience.

5. Conclusions

While gamification and self-regulated learning have each shown favorable impacts in nursing education, their combined influence on enhancing nursing students' performance in Leopold's maneuvers is unknown. As a result, future research should focus on designing gamified learning procedures that combine self-regulated learning principles in order to increase nursing students' knowledge of Leopold's maneuvers.

Nursing educators may improve the efficacy of teaching and learning approaches, thereby boosting the quality of care offered by future nurses, by exploiting the potential of gamification and self-regulated learning. Interactive simulations, virtual reality settings, or instructional games that involve students in practicing and implementing Leopold's maneuvers in a controlled and immersive environment are examples of gamified learning interventions.

Integrating self-regulated learning into these gamified interventions might help nursing students take responsibility of their learning experience even more. Students may improve their metacognitive abilities and gain a better comprehension of Leopold's skills by encouraging goal-setting and self-evaluation. The purpose of this study is to improve nursing students' motivation, self-efficacy, and perceptions of competence.

Furthermore, the use of gamified learning interventions can help to bridge the gap between theoretical knowledge and practical application. Students can obtain vital experience and confidence in completing Leopold's maneuvers by imitating real-world conditions and offering instant feedback. This method not only increases students' learning performance but also prepares them for the difficulties they may face in clinical settings.

Finally, the combination of gamification and self-regulated learning has significant promise for increasing nursing education and nursing students' competency in completing Leopold's maneuvers. More study in this area might give useful insights into creating and implementing successful gamified learning interventions that increase skill development, motivation, and self-efficacy among nursing students. Finally, these improvements have the potential to improve the overall quality of care offered by future nurses.

References

Anguas-Gracia, A., Subiron-Valera, A. B., Antón-Solanas, I., Rodriguez-Roca, B., Satustegui-Dorda, P. J., & Urcola-Pardo, F. (2021). An evaluation of undergraduate student nurses' gameful experience while playing an escape room game as part of a community health nursing course. *Nurse Education Today*, *103*, 104948.

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2017). Studying student differentiation in gamified education: A long-term study. *Computers in Human Behavior*, *71*, 550-585. https://doi.org/10.1016/j.chb.2016.08.049

Biancuzzo, M. (1993). How to recognize and rotate an occiput posterior fetus. *The American Journal of Nursing*, *93*(3), 38-41.

Bozkurt, A., & Durak, G. (2018). A systematic review of gamification research: In pursuit of homo ludens. *International Journal of Game-Based Learning (IJGBL)*, *8*(3), 15-33. https://doi.org/10.4018/IJGBL.2018070102

Brandon, A. R., Pitts, S., Denton, W. H., & Stringer, E. H. M. (2009). A hıstory of the theory of prenatal attachment. *Journal of Prenatal and Perinatal Psychology & Health,* 23(4), 201–222.

Bransen, D., Driessen, E. W., Sluijsmans, D. M., & Govaerts, M. J. (2022). How medical students co-regulate their learning in clinical clerkships: a social network study. *BMC Medical Education*, *22*(1), 193.

Brull, S., Finlayson, S., Kostelec, T., MacDonald, R., & Krenzischeck, D. (2017). Using gamification to improve productivity and increase knowledge retention during orientation. *The Journal of Nursing Administration*, 47(9), 448–453.

Chang, C. Y., Chung, M. H., & Yang, J. C. (2022). Facilitating nursing students' skill training in distance education via online game-based learning with the watch-summarize-question approach during the COVID-19 pandemic: A quasi-experimental study. *Nurse Education Today*, *109*, 105256. https://doi.org/10.1016/j.nedt.2021.105256

Chang, C.-Y., Kao, C.-H., Hwang, G.-J., & Lin, F.-H. (2020). From experiencing to critical thinking: A contextual game-based learning approach to improving nursing students' performance in electrocardiogram training. *Educational Technology Research and Development*, *68*(3), 1225-1245.

Chang, C.-Y., Panjaburee, P., Lin, H.-C., Lai, C.-L., & Hwang, G.-H. (2022). Effects of online strategies on students' learning performance, self-efficacy, self-regulation and critical thinking in university online courses. *Educational Technology Research and Development*, *70*(1), 185-204

Dastjerdi, N. B. (2016). Factors Affecting ICT Adoption among Distance Education Students Based on the Technology Acceptance Model - A Case Study at a Distance Education University in Iran. *International Education Studies*, *9*(2), 73-80. https://doi.org/10.5539/ies.v9n2p73

Gaupp, R., Fabry, G., & Körner, M. (2018). Self-regulated learning and critical reflection in an e-learning on patient safety for third-year medical students. *International Journal of Medical Education*, *9*, 189.

Gentry, S. V., Gauthier, A., L'Estrade Ehrstrom, B., Wortley, D., Lilienthal, A., Tudor Car, L., ... & Car, J. (2019). Serious gaming and gamification education in health professions: systematic review. *Journal of medical Internet research*, *21*(3), e12994. https://doi.org/10.2196/12994.

Hwang, G.-J., & Chang, C.-Y. (2020). Facilitating decision-making performances in nursing treatments: a contextual digital game-based flipped learning approach. *Interactive Learning Environments*, 1-16. https://doi.org/10.1080/10494820.2020.1765391

Kim, H., & Kim, B. (2022). Effects of Situation-Based Flipped Learning and Gamification as Combined Methodologies in Psychiatric Nursing Education: A Quasi-Experimental Study. In *Healthcare* (Vol. 10, No. 4, p. 644). MDPI. https://doi.org/10.3390/healthcare10040644

Koivisto, J. M., Multisilta, J., Niemi, H., Katajisto, J., & Eriksson, E. (2016). Learning by playing: A cross-sectional descriptive study of nursing students' experiences of learning clinical reasoning. *Nurse Education Today,* 45, 22–28. https://doi.org/10.1016/j.nedt.2016.06.009 PMID:27429399

McFarlin, B. L., Engstrom, J. L., Sampson, M. B., & Cattledge, F. (1985). Concurrent validity of Leopold's maneuvers in determining fetal presentation and position. *Journal of Nurse-Midwifery*, *30*(5), 280-284.

Mirghani, H. M., Khair, H., & Ahmed, B. (2007). LEOPOLD'S MANEUVERS: HOW COMMON IS IT IN OUR DAILY PRACTICE? *Gynaecologia et Perinatologia: Journal for Gynaecology, Perinatology, Reproductive Medicine and Ultrasonic Diagnostics*, *16*(2), 79-82.

Nacke, L. E., & Deterding, S. (2017). The maturing of gamification research. *Computers in Human Behavior*, *71*, 450-454. https://doi.org/10.1016/j.chb.2016.11.062

Najjar, N., Stubler, A., Ramaprasad, H., Lipford, H., & Wilson, D. (2022). Evaluating Students' Perceptions of Online Learning with 2-D Virtual Spaces. Proceedings of the 53rd ACM Technical Symposium on Computer Science Education V. 1,

Nishikawa, M., & Sakakibara, H. (2013). Effect of nursing intervention program using abdominal palpation of Leopold's maneuvers on maternal-fetal attachment. *Reproductive Health*, *10*(1), 1-7.

Sardi, L., Idri, A., & Fernández-Alemán, J. L. (2017). A systematic review of gamification in e-Health. *Journal of biomedical informatics*, *71*, 31-48. https://doi.org/10.1016/j.jbi.2017.05.011

Superville SS, Siccardi MA. Leopold Maneuvers. [Updated 2023 Feb 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560814/

Vidergor, H. E. (2021). Effects of digital escape room on gameful experience, collaboration, and motivation of elementary school students. *Computers & Education*, *166*, 104156. https://doi.org/10.1016/j.compedu.2021.104156

Yang, J. C., Chung, C. J., & Chen, M. S. (2021). Effects of performance goal orientations on learning performance and in-game performance in digital game based-learning. *Journal of Computer Assisted Learning*, *38*(2), 422-439. https://doi.org/10.1111/jcal.12622

Yang, J. C., Lin, M. Y. D., & Chen, S. Y. (2018). Effects of anxiety levels on learning performance and gaming performance in digital game-based learning. *Journal of Computer Assisted Learning,* 34(3), 324–334. https://doi.org/10.1111/jcal.12245

Yoo, L., & Jung, D. (2022). Teaching presence, self-regulated learning and learning satisfaction on distance learning for students in a nursing education program. *International Journal of Environmental Research and Public Health*, *19*(7), 4160.

Yow, H.-Y. (2022). A Case Study of Virtual Anatomy Museum: Facilitating Student Engagement and Self-paced Learning through an Interactive Platform. *International Journal of Information and Education Technology*, *12*(12).

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, *41*(2), 64-70.