

Serious Digital Game-Based Learning in Nursing Education: Empowering Students for Clinical Competence

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The evolution of technology in the era of digital transformation has significantly impacted the landscape of healthcare education, ushering in a paradigm shift in the way knowledge is imparted. This shift, accelerated by the imperative for online learning due to disruptions in traditional, in-person education caused by the COVID-19 pandemic, has compelled nursing educators to revamp existing curricula. Amidst these changes, digital educational applications, notably serious games, have gained prominence. Serious games are interactive computer applications designed with the aim of imparting specific learning objectives to players. Featuring challenging goals, engaging design, and scoring systems, serious games are believed to motivate students and aid in goal achievement. While the popularity of serious games in healthcare education is on the rise, their usage in nursing education has generally shown positive outcomes. This review aims to evaluate mobile-based serious games on the clinical competency development of undergraduate nursing students.

Keywords: healthcare education, serious games, clinical competency, nursing, nursing education.

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Introduction

In recent years, digital technologies have been rapidly developing in a way that will revolutionize the field of education. Innovations such as the internet, mobile devices and artificial intelligence are transforming teaching methodologies, student participation, learning processes, evaluation of learning and feedback methods (Ulupinar & Toygar, 2020). The accessibility of many of these technologies has caused them to become widespread in society and an indispensable part of daily life. As in every field, the effective use of digital technology has become important in the education sector. Changes in science and technology have also affected the structure of societies and have led to a rapid change towards a human profile that is inclined to use technology directly in many areas of life and whose technological skills are

increasingly following technology. Especially the Z or Net Generation, born after 1997, are introduced to technological devices such as computers, tablets and smartphones when they are still babies and start using them from a very young age. The effects of using current technology instead of meeting the educational needs of this young generation with classical and traditional methods continues to be the subject of many scientific studies (Demirel, 2021).

While studies investigating the effects of technology and games on education were almost nonexistent before 1990, they have increased rapidly since the mid-2000s (Olejniczak et al., 2020). With the opportunities provided by today's technology, methods such as online courses, video education, active games, simulations and game-based learning are finding more place in education. Especially the widespread use of the Internet, developments in smartphones and mobile devices, and digital technologies have enabled the development of the concept of Digital Game-Based Learning (DGBL). DGBL leads to significant changes in the management and evaluation of education in the age of technological evolution and digital transformation (Şenyuva, 2019). The learning method expressed as serious games in Digital Based Learning (DGBL) is increasingly gaining attention in nursing education as in all fields of health sciences. Digital games are designed to improve course and subject knowledge or nursing skills, and the effectiveness of the games is evaluated.

Serious games, which can be briefly defined as 'interactive computer applications designed to achieve specific learning objectives,' have the potential to motivate students to achieve specific learning goals. In more detail, Stuckless et al. (2014, p. 146) defined a serious game as 'an interactive computer application that has a learning objective, has a high potential to entertain the practitioner and/or includes an interesting, objective and valid scoring concept and provides the user with a skill, knowledge or attitude that can be applied to the real world' (Stuckless et al., 2014). In health care professions such as nursing, where the acquisition of practical skills in addition to theoretical knowledge is mandatory; Accessing information, ensuring rapid and permanent learning and adequate practice are the most important elements in gaining professional competence/clinical competence.

In order to adapt to the changing human profile, reforms and scientific and technological enrichments in educational methods are becoming widespread in the field of nursing education. Especially the interruption of traditional face-to-face education during the COVID-19 pandemic has increased the need for online learning in nursing education, forcing educators to re-

consider existing curricula and use distance education and digital teaching applications (Ali, 2020). The increase in digital education effectiveness studies conducted with serious games in the COVID-19 and post-COVID period is remarkable. Although digital games have become widespread in nursing education, it should not be forgotten that these games require serious preparation and cost in terms of preparation, monitoring and objective evaluation. In this section, serious DGBL applications in nursing education and their effectiveness in providing competence to nursing students are examined.

Advances in Digital Technologies

Digitalization and the internet environment, computer and game technologies, the proliferation of smartphones and tablets have also affected the education and training sector and have provided significant changes in the creation of a new and digital learning environment. In addition, tools such as online courses, digital classrooms, e-learning platforms have undergone a rapid transformation and are recommended for use by both public authorities (such as Ministries of National Education) and public and private educational institutions for student-teachers (Şenyuva, 2019). Various digital game applications have been developed and started to be used in formal education areas (Tschopp & Rach, 2019). All these efforts have made it possible for education to reach wider audiences.

Digital technologies play a critical role in increasing student engagement and making learning experiences interactive, both in improving and enriching communication skills. Game-based learning and virtual reality (VR) applications are innovative methods that encourage students' active learning (Güngör et al., 2024). These methods help students understand abstract concepts by providing experiential learning opportunities (Kirkley & Kirkley, 2005). The use of artificial intelligence (AI) technologies, which have started to have a significant impact within the scope of DGBL, also enables personalized learning experiences. AI-supported games can guide the structuring of educational processes and offer learning paths adapted to individual needs by analyzing student performance. Thus, it is possible to provide educational materials customized according to students' strengths and weaknesses (Şenyuva, 2019; Luckin et al., 2016).

International organizations, associations, local nursing organizations and nursing departments related to nursing education recommend the optimum use of technology in education to train nurses suitable for the ever-changing technology and human profile in the health field. The International Council of Nurses (ICN), the European Nurses Council, the American Nurses Creden-

tialing Center (ANCC) and national and local Nursing Associations emphasize that evidence-based patient care and adaptation of current technologies in nursing education are the most important factors in increasing nursing competence (Şenyuva, 2019).

Development of Serious Digital Games

Serious games are applications designed and operated in the digital field that are adapted to any level of education for any discipline or field of science, and that have specific educational goals and learning objectives. Although some digital games were developed for educational purposes with the widespread use of computer games towards the end of the last century, they began to be used in formal education much later. The concept of 'serious games', which was first comprehensively addressed and published in a book by C. C. Abt (1987), discussed the basis of learning through games in education, its conceptual framework, and the impact of games on education and other sectors. In his book, Abt emphasizes that 'games are considered serious games if their primary purpose is not entertainment and if they have a clearly stated and carefully planned educational purpose' and that the game activity must be prepared at a level appropriate to the age and educational capabilities of the students. In addition, for a game to be recognized as a serious game, it is necessary that it has measurable learning objectives and that there is a prior definition of how these objectives will be measured (Abt, 1987, pp. 7–11).

Serious games have continued to grow and spread in scientific and academic research and in the gaming industry for the last twenty years in parallel with the pace of development in digital technologies. Serious digital games have especially attracted the attention of health educators. Video games have begun to be used as an effective method for developing cognitive and practical skills of students in the health field (Gee, 2003). Today, it is expected that the use of mobile-based serious games to develop the clinical competencies of nursing students will become widespread and the concept of DGBL will become an important part of nursing curricula.

Serious games developed for educational purposes do not contain completely fictional and imaginary elements and have scenarios meticulously prepared by professionals in this field. These scenarios must be inspired by real environments. At the same time, the scenario must be created in a way that will carry the entertainment feature of the games. When compared to practical trainings with high-fidelity simulators frequently used in nursing education, the most important difference between serious digital games and serious games is that a serious game also includes the entertainment factor.

Thus, in trainings carried out with serious games, while simultaneously addressing the visual, auditory, sensory and psychomotor areas of the students, it is also aimed for the student to have fun using the decision-making mechanism in the game. Moreover, in a serious game, students find opportunities to improve their performance as measured by the scoring mechanism and can also self-assess their progress (Lu & Lien, 2020). This situation, unlike training with traditional simulators, offers the student the opportunity not only to reach the predetermined goal but also to benefit from the entertainment element (Blakely et al., 2009).

Effects of COVID-19 Pandemic on Nursing Education

The COVID-19 pandemic has caused major changes in all areas of education. Almost all levels of schools and universities had to stop face-to-face education and then immediately switched to distance education methods. The interruption of formal education forced nursing schools to rapidly develop and effectively use distance education strategies (Min et al., 2022). Thus, in addition to the increase in distance education applications in nursing education, educator and student experiences regarding the use of this technology in education have also begun to develop. During the COVID-19 period, distance education, online live or video-trainings were used effectively in nursing education, and the internet and digital tools were used at this stage of education (Baker et al. 2020). Innovative technologies, especially mobile applications, virtual reality (VR) and augmented reality (AR), have begun to be used to improve students' clinical skills in nursing education and research has begun to be conducted in this field (Güngör et al., 2024).

The effectiveness of DGBL applications in developing nursing skills has recently become the subject of many nursing studies. For example, Chang et al. (2021) study showed that DGBL tools are an effective alternative in the skill training of nursing students, most students stated that serious game-based learning positively affected their learning during the pandemic process, and increased their communication skills and motivation (Chang et al., 2021). It is seen that serious games play an important role in terms of skill development and psychological strengthening, as well as cognitive and knowledge development. This situation has created an alternative way for the pandemic to physically limit nursing education, and has supported educators and students to make maximum use of technology in this process and contribute to the educational processes. However, although the benefits of distance education tools and digital technologies in nursing education are seen, it is also stated that evaluating the impact of these technologies, especially in terms

of clinical competence in nursing, may be premature and further studies are needed (Agu et al., 2021).

Clinical Competence and Learning Objectives in Nursing

Nursing is a care profession that provides health care using professional nursing knowledge and skills to protect, improve and regain the health of individuals. Nurses play a role in every step of the health system. Nurses have a critical role in protecting and improving the health of sick and healthy individuals. In this context, clinical competence in nursing refers to the ability of nurses to effectively care for patients with their professional skills and knowledge. There should be a curriculum and teaching method based on learning objectives to gain clinical competence in nursing. In order for nursing students to correctly and competently apply the nursing knowledge and skills they receive during their education after graduation, clinical competence should be compatible with learning objectives and measurable (Benner, 2001).

Learning objectives in nursing education are determined in a way that will enable students to gain these abilities (Perry et al., 2014). Learning objectives in nursing education aim to provide students with certain knowledge, skills, and attitudes. These objectives play a fundamental role in structuring educational programs and developing curricula. Learning objectives are generally determined in line with accreditation standards and professional standards (American Association of Colleges of Nursing, 2021). The determined learning objectives provide students with practical experience in nursing practice while also supporting them in providing high-quality service in patient care.

Competency-based education is essential for learners to gain basic competencies in their professional fields and thus to be entitled to take professional responsibilities as a member of a professional profession. In competency-based education, students are at the center of the learning environment and are tried to reach outcome-based goals. In health professions such as nursing, the curriculum, classroom and laboratory environment and practices should be continued by utilizing developing educational technologies in a way that encourages students to learn at a level appropriate for the responsibilities they need to acquire. Advances in learning environments and technologies, understanding developing student learning styles and preferences, and transitioning to outcome-oriented education and assessment are accepted as signs of the transition to competency-based education. Competency-based education designed in this way creates permanent learning and

professional attitudes because it establishes connections between knowledge and practices (American Association of Colleges of Nursing, 2021).

In addition to classical and traditional teaching methods, active learning methods such as in-class games, methods, laboratory applications, simulations, role-play are used to continue competency-based education in nursing. It is aimed that all health professions students receive education in a way that will enable them to develop their knowledge and skills optimally and to perform error-free applications before they come into contact with patients in real practice environments (Dieckmann et al., 2009).

Digital game-based learning methods, especially mobile-based serious games, have been increasingly used in clinical competence development in recent years. It is a fact that the COVID-19 pandemic has accelerated the transition to educational methods that require technology installation and knowledge, such as mobile applications, serious games, and distance learning. The technologies adapted in nursing education during this process can be considered an indicator of how the future impact of digital technologies in education may take shape (Baker et al., 2020).

The Effect of Digital Serious Games on the Development of Nursing Competencies

- Engagement and Learning Outcomes: Digital game-based learning can facilitate students' learning motivation and achievement of course learning objectives.
- Simulation and Skill Development: It has been determined that serious games, especially those using technologies such as virtual reality (VR) and augmented reality (AR), have a significant effect on the skill development of nursing students. Güngör et al. (2024) reported that VR-based serious games play an important role in the development of specific nursing skills such as surgical gloving practices.
- Critical Thinking Skill Improvement: Perhaps the most important effect of digital serious games is the development of students' critical thinking skills. The development of critical thinking skills plays an important role in using quality and scientific evidence-based practices in nursing practices. A meta-analysis study published on this subject has shown that digital games are effective in developing critical thinking skills of nursing students (Chen et al., 2021). This result can be considered as an indication that serious games can encourage critical and analytical thinking skills.

- Collaborative Learning Experience: Serious games can be developed in a design that encourages group work and team collaboration according to learning objectives. This offers students the opportunity to work as a group, develop teamwork, leadership and communication skills (Chen et al., 2021).
- Assessment and Feedback: Serious games that are suitable for a sufficient infrastructure and well-designed have the ability to provide real-time feedback to students and teachers to monitor and evaluate learning processes.
- Collaboration with Health Care Professionals: Serious games that involve other professionals in the health care team allow nurses to develop their skills in working with other health professionals. Chang et al. (2021) found that serious games encouraged nursing students to interact with other health disciplines.

Advantages of Serious Game-Based Learning

Serious digital game-based learning method creates an e-learning resource that provides nursing students with the opportunity to practice clinical reasoning and decision-making skills in a realistic environment without harming patients, by having fun, and with its participatory and feedback-based structure (Thangavelu et al., 2022).

Increasing Motivation

The interaction provided by games also leads to significant development in students' cognitive development. Game-based learning increases students' motivation and makes learning processes more interactive (Özdemir & Dinç, 2022). The feedback and interaction provided increase students' participation in the learning process. Thanks to the interactive feedback they receive instantly during games, it becomes easier for them to make quick decisions, which increases their motivation and self-confidence. Serious games allow students to gain hands-on experience by simulating clinical scenarios. Thus, they can help students reinforce their nursing knowledge (Ordu & Çalışkan, 2021). and support the development of clinical decision-making skills. Chang et al. (2021) stated that serious games also contribute to students' achievement of learning goals.

Participation in Education and the Development of Problem Solving Skills

Studies examining the effects of serious games have examined the effects of games on not only the achievement of learning objectives but also on the

cognitive development of students and other dynamics of the educational process. These games provide students with the opportunity to put their theoretical knowledge into practice, develop their problem-solving skills, and simulate clinical situations, thus increasing their cognitive abilities such as systematic and quick thinking and making correct decisions in different clinical situations/problems (Stuckless et al., 2014). In particular, it is known that in education through serious games, student participation in the lesson increases significantly and the retention of information obtained at the end of the games is significantly higher compared to other teaching methods. The features of the games require students to analyze complex situations in scenarios quickly and accurately, make the right decisions and think about the outcomes when they encounter them; these are important competencies required in nursing practice (Lee et al., 2024).

Increase in Clinical Competence with Realistic Clinical Scenarios

The scenarios developed in DGBL applications can simulate real situations/cases that nurses may encounter in the hospital. It is stated that nursing students who participate in this training method increase their clinical reasoning and decision-making skills compared to traditional methods. In addition, such an experience can also provide deep and permanent learning and the development of nursing competencies.

Flexible Learning Environment and Team Collaboration

Many serious games are designed to encourage cooperation and the team concept among players. The training process carried out with serious games also allows students to increase their communication skills, get to know the team, and cooperation. In addition, the fact that the players are peers and that a learning environment and opportunities are provided at the same speed allows students to benefit from the learning environment to the maximum (Chang et al. 2021).

Measurement and Evaluation

Serious games allow for the evaluation of pre-structured goals and rapid feedback can be given. Various models can be used in the evaluation of learning. For example, Bloom's taxonomy can be used to assess learning objectives and learning outcomes (Krathwohl, 2002).

- 1.0: To Remember:
- 1.1. To Recognize, 1.2. To Recall

- 2.0: To Understand:
 - 2.1. To Interpret, 2.2. Sample, 2.3. Classify, 2.4. Summarize, 2.5. To Infer, 2.6. To Compare, 2.7. To Explain
- 3.0: Apply:
 - 3.1. Implement, 3.2. Use
- 4.0: Analyze:
 - 4.1. Segregate, 4.2 Organize, 4.3 Attribute
- 5.0 Evaluate:
 - 5.1 To Check, 5.2 To Criticize
- 6.0 Create:
 - 6.1 Create, 6.2 Plan, 6.3 Produce

Using a taxonomy like the one above, feedback can be given to students with an objective and universal evaluation method. This allows educators to see the development and weaknesses of the students and can also highlight areas that need development (Yurdabakan, 2012).

Serious Digital Game Preparation Steps and Evaluation Methods

Studies show that serious digital games have the potential to be used in nursing education to improve knowledge, skills, and core clinical competencies. By simulating real-life scenarios, developing critical thinking and collaboration skills, effective evaluation methods, and flexible learning environments, serious games can be used as an effective method to improve the quality of healthcare for future nurses. Incorporating serious digital games into nursing education involves serious preparation processes, planning in line with learning objectives, and developing objective evaluation tools and feedback mechanisms. The following summarizes the steps involved in designing a serious digital game for use in nursing education (Fleming, 2008; Kalelioğlu & Gülbahar, 2014):

- *Defining Learning Objectives*: Clearly articulate the specific skills, knowledge, and competencies that the game will address. This could include clinical skills, critical thinking, teamwork, and decision-making.
- *Identify Target Audience*: Understand the demographic of your nursing students, including their level of education (undergraduate vs. graduate), prior gaming experience, and learning preferences.
- *Select Appropriate Games*: Choose or design games that align with the

learning objectives. Look for evidence-based games that have been validated in nursing education or similar fields.

- *Integrate Curriculum:* Ensure that the game fits seamlessly into the existing curriculum. Consider how it complements other learning activities, such as lectures, simulations, or clinical practice.
- *Develop a Teaching Plan:* Create a detailed plan for how the game will be introduced, played, and debriefed. Include time for instruction on the game mechanics and objectives.
- *Facilitate Technical Preparation:* Ensure that all necessary technology and resources are available, including devices, internet access, and any software or applications required.
- *Train Educators:* Provide training for educators on how to facilitate the game, manage student engagement, and guide discussions post-gameplay.
- *Plan for Feedback:* Design a structured debriefing session to reinforce learning, allow students to reflect on their experiences, and discuss how the game relates to real-world nursing practice.

Suggested Assessment Methods for Serious Digital Games in Nursing Education

- *Formative Assessment:* Informal assessments can be used during the game, such as observing student participation, teamwork, and decision making. Provide quizzes or analysis questions immediately after the game to gauge understanding.
- *Peer Assessment:* Encourage students to provide feedback on each other's performance, especially in team-based scenarios. This can encourage collaboration and critical evaluation.
- *Self-Assessment:* Use surveys to allow students to assess their own learning and performance in the game. Provide feedback focused on skills developed and areas for improvement.
- *Performance Measures:* Use in-game metrics such as completion rates, scores, or time spent completing tasks to measure student performance.
- *Pre- and Post-Tests:* Conduct assessments before and after the game to measure knowledge gains, changes in attitudes, or skill acquisition related to nursing competencies.
- *Critical Incident Reports:* Encourage students to describe a significant moment or challenge they encountered in the game and how they

overcame it. This helps assess critical thinking and the transfer of knowledge into practice (Kalelioğlu & Gülbahar, 2014).

- *Give Qualitative Feedback:* Collect qualitative data through post-game interviews or focus groups to gain insight into students' experiences and perceptions of the learning process (Scherer et al., 2016).
- *Portfolio Assessments:* Encourage students to create portfolios documenting their learning experiences, including their thoughts about the game, the skills they developed, and how they put what they learned into practice.

Barriers and Limitations for Creating and Implementing DGBL in Nursing Education

It is seen that creating a learning environment with serious game method has the potential to contribute to the field of nursing education. There are also some limitations in the adoption of game-based learning. Lack of technological infrastructure, digital literacy levels of instructors and social factors affecting student motivation may be among these obstacles. Some students may not find the content presentation and educational benefits of the game effective enough, and students' access to technology should be considered as a factor that increases these difficulties. In addition, most of the studies have design deficiencies, most require a high budget, and learning in small groups limits their generalizability and application to large masses.

Developing serious games with well-defined learning objectives, well-defined skill contents, a solid theoretical basis and conceptual framework requires serious time, work and technological competence. Another important issue is that the development of these games requires long-term work with experts in scientific fields other than nursing disciplines, such as computer and software engineering, and a technical infrastructure and the ability to use this technology. These aspects include challenging features for nursing educators.

Implications for Nursing Education

The development of serious games allows nursing education curricula to be updated according to current conditions and to enrich students' clinical experiences. The inclusion of these games in the educational process allows students to practice as much as necessary to develop their knowledge and skills without harming the patient before applying them in real-life settings, and helps students develop active learning skills while gaining important compe-

tencies such as communication and teamwork (Chang et al., 2021). When integrating serious games into their curricula, nursing educators should pay attention to how the game connects to its educational objectives. The selection of games should be considered in accordance with educational objectives and the appropriateness of the content of the games should be evaluated.

Conclusion

Serious digital game-based learning stands out as an important tool in improving students' clinical competence in nursing education. The COVID-19 process has accelerated the integration of these methods and emphasized their importance in education. Although nursing education is built on a strong scientific foundation, the effective use of digital technologies provides students with more effective learning experiences. In the future, more research and innovation are needed to cope with the challenges encountered and to fully utilize the potential of game-based learning.

By carefully preparing and assessing the use of serious digital games in nursing education, educators can create an engaging and effective learning environment that enhances the educational experience and better prepares students for their future roles as healthcare professionals. Continuous evaluation and iteration of these methods will ensure that they remain relevant and effective.

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Resno digitalno učenje na podlagi iger v izobraževanju zdravstvenih delavcev: opolnomočenje študentov za klinično kompetenco

Razvoj tehnologije v obdobju digitalne transformacije je pomembno vplival na izobraževanje na področju zdravstvene nege, saj je povzročil premik v načinih posredovanja znanja. Ta premik, ki ga je dodatno pospešila potreba po spletnem učenju zaradi motenj v tradicionalnem, neposrednem izobraževanju med pandemijo covid-19, je izobraževalce v zdravstveni negi prisilil k preoblikovanju obstoječih učnih načrtov. V sklopu teh sprememb so digitalne izobraževalne aplikacije, zlasti resne igre, pridobile na pomembnosti. Resne igre so interaktivne računalniške igre, zasnovane z namenom posredovanja specifičnih učnih ciljev. Z vključevanjem zahtevnih ciljev, privlačne zasnove in

sistemov točkovanja naj bi resne igre motivirale študente ter jim pomagale pri doseganju ciljev. Priljubljenost resnih izobraževalnih iger v izobraževanju na področju zdravstvene nege narašča, njihova uporaba na tem področju pa že izkazuje pozitivne rezultate. V pričujočem preglednem članku bomo predstavili vpliv mobilnih resnih izobraževalnih iger na razvoj kliničnih kompetenc pri dodiplomskih študentih zdravstvene nege.

Ključne besede: izobraževanje v zdravstvu, resne igre, profesionalne kompetence, zdravstvena nega, izobraževanje v zdravstveni negi