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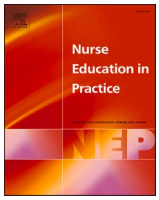

Innovative strategies in oncology education for undergraduate students: A rapid systematic review

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ABSTRACT

Aim: This rapid review was to inform the innovative strategies for teaching oncology to undergraduate nursing students.
Background: Oncology nursing education has become a priority owing to the increasing demand for specialized, person-centered care. Oncology care is recognized as a complex and challenging area in clinical practice and in education, requiring students to possess not only technical knowledge but also communication skills, empathy and decision-making abilities in delicate situations.
Design: A rapid systematic review was conducted in April 2025.
Methods: Four databases were searched: PubMed, Web of Science, the Cumulative Index to Nursing and Allied Health Literature and SCOPUS. The included studies focused on innovative teaching strategies, in undergraduate oncology nursing education, were primary research and were written in English or Portuguese. The review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Study quality assessed using JBI guidelines.
Results: Twenty-eight studies published between 1992 and 2025 were included in this review. The identified strategies comprised technological innovations (n = 15), such as clinical simulations, online educational programs and virtual reality; and non-technological approaches (n = 13), including case study analysis, concept mapping and multidisciplinary educational programs.
Conclusions: The integration of technological and non-technological strategies has shown itself is beneficial. A combined approach enables students to develop a broad and diverse set of competencies in oncology, promoting a more complete and effective educational experience.

1. Introduction

Cancer is recognized as one of the foremost global health priorities and remains a central focus in Europe, where current policy guidelines reflect a coordinated effort to enhance cancer control and optimize its treatment (OECD and European Union, 2020). As cancer increasingly shifts toward being a long-term condition requiring specialized and person-centered care, it has become essential to update pedagogical strategies, particularly in oncology education in undergraduate nursing programs (Domingo-Osle et al., 2021; Mitchell and Laing, 2019).

Nursing education has undergone significant transformation in response to new pedagogical paradigms, maintaining high standards to prepare professionals to address complex challenges in clinical practice (Domingo-Osle et al., 2021). Therefore, the complexity of care for cancer patients demands that future nursing professionals acquire the requisite skills, technical knowledge, critical thinking and the ability to make informed decisions (Bağçivan et al., 2025; Drury et al., 2023). These competencies can be fostered through targeted pedagogical approaches (İlaslan et al., 2023; Moreira et al., 2022; Solera-Gómez et al., 2022). In support of this, a meta-analysis by Wijnia et al. (Wijnia et al., 2024) highlights that, from the students' perspective, innovative educational methods, such as Problem-Based Learning, Project-Based Learning and

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Case-Based Learning, significantly enhance motivation and engagement in the learning process.

The evolving context and conceptual landscape of nursing have prompted changes in educational strategies, particularly because of the COVID-19 pandemic and rapid technological advancements (Leaver et al., 2022; Rincon-Flores et al., 2022). These abrupt and profound shifts in higher education have transformed teaching dynamics and content. The study by Lee et al. (2021) revealed context-driven changes among a sample of 2059 undergraduate and graduate students at a public university, using instruments to monitor symptoms of stress, anxiety and depression, as well as their use of psychological support services (J. Lee et al., 2021).

Indeed, the varied needs of stakeholders in the care process imply that combining technological and non-technological approaches can enhance the development of comprehensive competencies among nursing students (Gause et al., 2022; Nasrabadi et al., 2021). Technological innovation strategies are diverse and included virtual reality, high-fidelity manikin simulation, AI screen-based learning and other options (Liu et al., 2023; Sałacińska et al., 2025). Some of these have been applied in different pedagogical contexts and the outcomes regarding skill acquisition vary. For instance, virtual reality can be more time-efficient and motivating than manikin-based training, but it does not cover more complex clinical scenarios (Al Turki et al., 2025). In addition, when compared with high-fidelity simulation, virtual reality is less effective for some team-based or assessment-oriented competencies (Macnamara et al., 2021).

With the global rise in cancer incidence, all nurses will care for patients with cancer during their careers. Innovative educational approaches ensure that nurses are equipped to deliver safe, evidence-based and holistic care while adapting to new treatments and technologies in oncology (Davoodi et al., 2022; Silva et al., 2025).

Previous studies have not specifically examined undergraduate oncology education and innovative strategies emerging in health curricula, such as active learning approaches and broader curricular innovations, have not been systematically consolidated (De Lima Pontes et al., 2025; Hobenu et al., 2025; Kalu et al., 2023; Velarde-García et al., 2023). By addressing this gap, the present study contributes novel evidence and highlights the relevance of synthesizing these strategies to strengthen the pedagogical foundations of oncology education at the undergraduate level.

Given the methodological diversity and scarcity of studies in this area, it is essential to critically examine the educational strategies described in the literature that aim to strengthen oncology teaching in undergraduate nursing courses. We present the following research question to guide the review: What innovative educational strategies have been implemented to improve oncology teaching in undergraduate nursing education? Therefore, this literature review aimed to identify innovative strategies and describe their outcomes.

2. Materials and methods

A rapid systematic review (O'Leary et al., 2017) was performed in 2025 in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Page et al., 2021). The decision to adopt a rapid systematic review methodology was based on the recognized need to synthetize evidence within a limited timeframe while maintaining methodological rigor (Hamel et al., 2021). Rapid reviews are particularly suitable when timely evidence is required to inform policymakers, in our case educational practice and curricular development (O'Leary et al., 2017; Stevens et al., 2025; Tricco et al., 2017). These reviews play a crucial role in informing policies, clinical practices and educational strategies in nursing (O'Leary et al., 2017).

This approach allowed us to efficiently identify, appraise and synthesize studies (O'Leary et al., 2017) on innovative strategies in oncology nursing education while ensuring transparency in the search strategy, predefined eligibility criteria and quality appraisal. The choice of this design was further aligned with institutional priorities to integrate digital resources into teaching and with the practical constraints of workload and available evidence.

The purpose of this rapid review was to inform innovative strategies for teaching oncology. The review protocol was registered with the Open Science Framework (osf.io/c5662w).

2.1. Search strategy

A search strategy was developed using subject headings and keywords, structured according to the PCC framework: nursing students and professors as the population, innovative strategies as the concept and oncology teaching as the context (Table 1).

A thorough literature search was conducted in April 2025, using four databases: PubMed®, Web of Science®, the Cumulative Index to Nursing and Allied Health Literature (CINAHL® - though EBSCOhost) and SCOPUS®. Terms indexed in MEDLINE® and CINAHL® were used, as shown in Table 1, with the respective Boolean operators. Terms in natural language were also searched in the title, abstract, keywords according to the different database. Searching a limited number of databases is recommended when undertaking a rapid review (Garritty et al., 2021).

2.2. Eligibility criteria

Inclusion criteria: Papers were considered eligible if they met the following criteria:

1. The included studies addressed innovative teaching strategies;
2. Focused on undergraduate nursing education in oncology;
3. These were written in English or Portuguese;
4. These were original research articles. Publications in the form of literature reviews, protocols, book chapters, theses, editorials, or conference abstracts without full paper were excluded.

2.3. Study selection

The search results were downloaded from the databases and imported into Rayyan®. Duplicates were excluded. Eligibility criteria were applied through blind screening of titles and abstracts, conducted by two independent reviewers (SM, JM). The relevance of the articles was assessed based on the information provided in the title and abstract and any conflicts were carried forward to the next stage. Subsequently, full-text screening was performed independently by the same two reviewers (SM and JM).

2.4. Data extraction and analysis

Data extraction from the included studies was performed out by one reviewer (SM) and verified by a second reviewer (JM). In cases of disagreement, a third reviewer (HM) was consulted to resolve conflicts. A data extraction tool was developed by the researchers in accordance with the review objectives. It captured information on participants, countries, study design, innovative strategies in oncology teaching and reported outcomes. The extracted data were organized into thematic categories and the frequency was counted. Through this thematic analysis, we identified two primary themes and within each major theme we identified several subthemes. Furthermore, each subtheme was reviewed and refined to ensure consistency, clarity and depth analysis.

2.5. Methodological quality assessment

The quality of each study included was evaluated according to the JBI guidelines, with results presented both narratively and in table format. Following established recommendations, the studies were rated

Table 1
Search strategy.

Data bases	Search terms	Bolean operators	Search terms	Bolean operators	Search terms
CINAHL®	"students, nursing"[a] OR "Faculty, nursing"[a] OR "nurse educators"[a]	AND	"Educational Technology"[a] OR "Diffusion of Innovation"[a] OR "Competency-Based Education"[a] OR "E-learning"[a] OR"Online Education"[a] OR Learning[a] OR ""Education, Nursing, Research-Based"[a] OR "Education, Non-Traditional"[a] OR "teaching methods"[a] OR "nursing Educational"[a] OR "learning methods"[a] OR "Decision Making, Clinical"[a]	AND	"Oncology Nursing"[a] OR neoplasm[a] OR Tumor[a] OR cancer[a] OR oncol*[b]
PUBMED®	"Nursing Students"[a] OR "Nursing Faculty"[a] OR "University Professor"[a]		"Innovative Teaching Methods"[b] OR "Innovative Teaching Strategies"[b] OR "Educational Innovations"[b] OR "Blended Learning"[b] OR "Innovative Teaching"[b] OR "Learning Techniques"[b] OR "new learning strategies"[b] OR "alternative learning"[b] OR"advanced teaching methods"[b] OR Criativ*[b] OR Innovat*[b] OR "Educational Technology"[a] OR "Diffusion of Innovation"[a] OR "Active Learning"[a] OR"Online Learning"[a] OR "Online Education"[a] OR "Competency-Based Education"[a] OR "Experiential Learning"[a] OR Pedagogy[a] OR "Teaching Method"[a] OR "Educational Technics"[a] OR "Clinical Decision-Making"[a]		oncol*[b] OR "Oncology Nursing"[a] OR neoplasm[a] OR Tumor[a] OR cancer[a] OR "Cancer nurse"[a]
Web of Science®	"Nursing Students"[d] OR "Nursing Faculty"[d] OR "University Professor"[d]		"Innovative Teaching Methods"[d] OR "Innovative Teaching Strategies"[d] OR "Educational Innovations"[d] OR "Blended Learning"[d] OR "Innovative Teaching"[d] OR "Learning Techniques"[d] OR "new learning strategies"[d] OR "alternative learning"[d] OR "advanced teaching methods"[d] OR Criativ*[d] OR Innovat*[d] OR "Educational Technology"[d] OR "Diffusion of Innovation"[d] OR "Active Learning"[d] OR "Online Learning"[d] OR "Online Education"[d] OR "Competency-Based Education"[d] OR "Experiential Learning"[d] OR Pedagogy[d] OR "Teaching Method"[d] OR "Educational Technics"[d] OR "Clinical Decision-Making"[d]		oncol* OR "Oncology Nursing" OR neoplasm OR Tumor OR cancer OR "Cancer nurse"
Scopus®	"Nursing Students"[c] OR "Nursing Faculty"[c] OR "University Professor"[c]		"Innovative Teaching Methods"[c] OR "Innovative Teaching Strategies"[c] OR "Educational Innovations"[c] OR "Blended Learning"[c] OR "Innovative Teaching"[c] OR "Learning Techniques"[c] OR "new learning strategies"[c] OR"alternative learning"[c] OR"advanced teaching methods"[c] OR Criativ*[c] OR Innovat*[c] OR "Educational Technology"[c] OR "Diffusion of Innovation"[c] OR "Active Learning"[c] OR "Online Learning"[c] OR "Online Education"[c] OR "Competency-Based Education"[c] OR "Experiential Learning"[c] OR Pedagogy[c] OR "Teaching Method"[c] OR "Educational Technics"[c] OR "Clinical Decision-Making"[c]		oncol*[c] OR "Oncology Nursing"[c] OR neoplasm[c] OR Tumor[c] OR cancer[c] OR "Cancer nurse"[c]

[a] – Exact Subject Heading; *[b]* – Title/Abstract; *[c]* title/abstract and keywords; *[d]* title, abstract, keyword plus, and author keywords

based on the percentage of checklist items met. A score between 70–79 % was considered moderate quality, 80–90 % indicated high quality and scores above 90 % were classified as excellent (Barker et al., 2023; Munn et al., 2023).

3. Results

A total of 268 papers were retrieved for review. After duplicates were removed, titles and abstracts of 204 papers were screened and 47 full-text papers were assessed for eligibility. Twenty-eight studies met the inclusion criteria (Fig. 1).

Twenty-eight studies were included, covering the period from 1992 to 2025. Of these, 54 % (n = 15) were published between 2020 and 2025. Most studies were conducted in the United States (n = 8) and Turkey (n = 6), followed by the United Kingdom (n = 3), Spain and South Korea (n = 2), (Table 2).

Regarding the study design, the included studies comprised quasi-experimental (n = 14), descriptive observational (n = 9), clinical trial (n = 3) and analytical observational (n = 2) designs.

For data analysis, we categorized the active teaching strategies in oncology into two categories: those using digital technology (n = 15) and those not using digital technology (n = 13), (Fig. 2). With technological support, the use of clinical simulation (n = 6) (Alkhalaf and Wazqar, 2022; Burrell, Ross, Byrne, et al., 2023; Burrell, Ross, D'Annunzio, et al., 2023; Demi Rel et al., 2024; A. Jang et al., 2021; Kim and Jung, 2016), online educational programs (n = 5) (Baron et al., 2019; Incesu et al., 2024; Siegel et al., 2021; Wingfield, 2007; Wittenberg et al., 2020) and virtual reality (n = 4)(H.-Y. Chan et al., 2021; Orr et al., 2021; Simsek-Cetinkaya and Cakir, 2023; Uslu-Sahan et al., 2025) stood out. Non-technological strategies encompass a variety of approaches, including case study analysis (n = 3) (Ham and O'Rourke, 2004; Mathibe, 2007; Slaninka, 1992); oncology programs involving various professionals (n = 2) (Dean et al., 2013; Edwards et al., 2016); internships (n = 2) (Arbuthnot et al., 2007; Davoodi et al., 2022); concept maps (Trevisani et al., 2016), the Six Thinking Hats method (Karadag et al., 2014), phenomenological reflection (Carvajal et al., 2021), digital storytelling (Fenton, 2014), escape room (Dönmez et al., 2025) and problem-based learning (Roca et al., 2016) (n = 1).

All included studies demonstrated high quality, with over half achieving scores above 88 % based on JBI assessment criteria. The main weaknesses identified in the included articles were that, in experimental studies, the outcome assessors were not blinded to the allocation of the intervention/pedagogical technique, while in observational longitudinal studies and cohort studies, researchers did not employ strategies to mitigate the potential impact of confounding factors.

4. Discussion

The findings of this review highlight the use of both technological and non-technological strategies, with a predominance of technological approaches.

At the methodological level, the predominance of quasi-

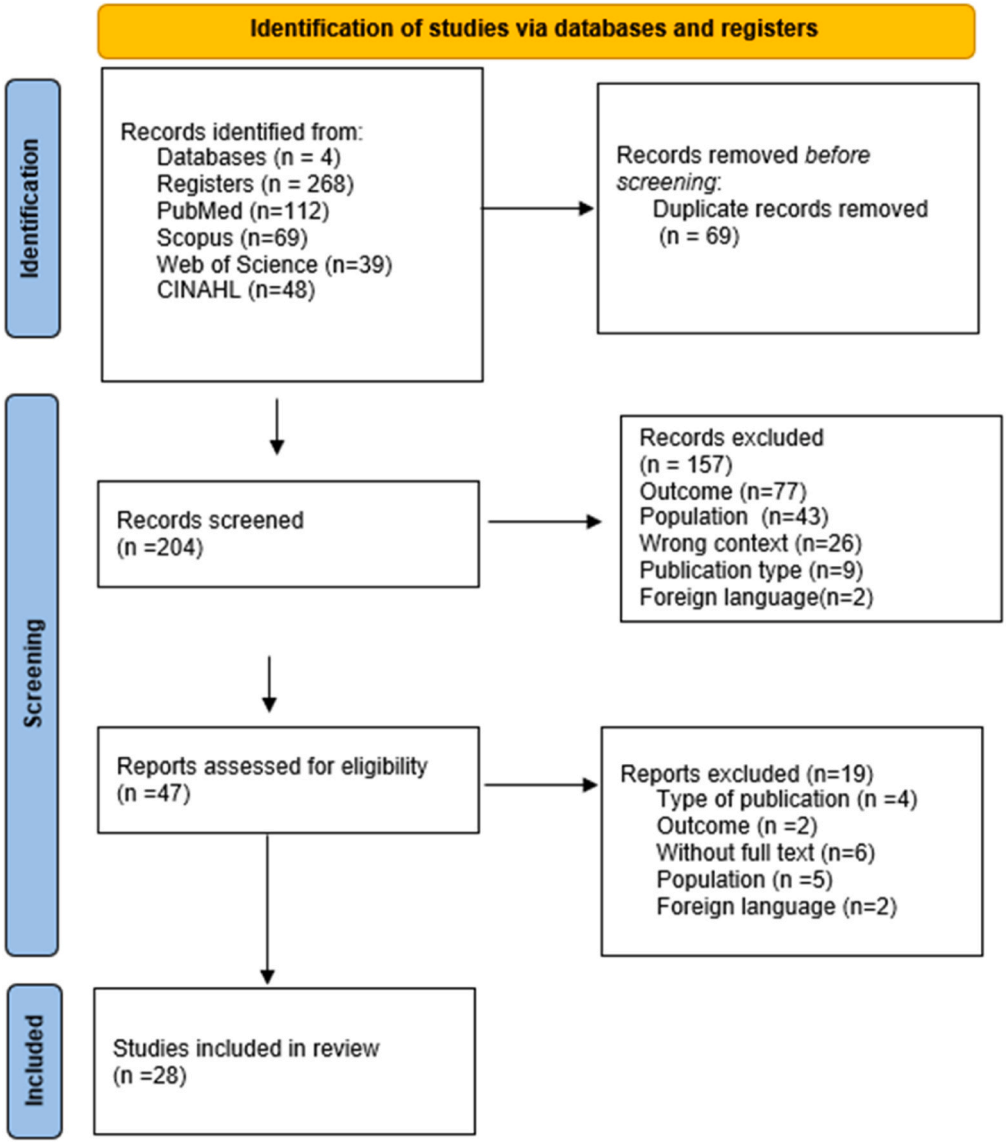

Fig. 1. Results from the application of PRISMA Statement (Page et al., 2021)).

experimental designs (n = 14) underscores a practical focus on evaluating educational interventions. In contrast, the relatively low number of clinical trials (n = 3) suggests that more rigorous experimental designs are still underused in oncology education research. This is largely due to the challenges associated with complex logistics, high costs and potential risks for the participants (Fogel, 2018).

Notably 54 % (n = 15) of the included studies were published between 2020 and 2025, a period marked by the global COVID-19 pandemic. This time frame was transformative on a global scale and had a significant impact on health education. In response to social distancing and isolation measures implemented to mitigate the spread of the virus, it became necessary to adopt innovative teaching strategies, particularly those based on digital education technology (K. Lee et al., 2022).

These restrictions have limited nursing students' ability to engage directly with real-world clinical practice settings (Merino-Godoy et al., 2024). Consequently, there has been a surge in the development and implementation of methods such as virtual clinical simulations and online educational programs (Sim et al., 2022). Undoubtedly, the pandemic acted as a promoter of the digital transformation of oncology education, reinforcing digital pedagogical approaches as viable means for developing clinical competencies in a safe and controlled environment (Baldwin-Medsker and Srwira-Brown, 2022).

To understand innovative strategies in oncology education for undergraduate students, the classifying of active teaching strategies into technological and non-technological approaches not only provides a clearer understanding of these strategies but also highlights that the development of non-technological methods remains robust, even in the digital era.

Clinical simulation was the most commonly used technological strategy (Alkhalaf and Wazqar, 2022; Burrell, Ross, Byrne, et al., 2023; Burrell, Ross, D'Annunzio, et al., 2023; Demi Rel et al., 2024; Jang et al., 2021; Kim and Jung, 2016). For instance, the study by Alkhalaf and Wazqar (Alkhalaf and Wazqar, 2022) conducted a quasi-experimental study (n = 68) using a two-group pretest-posttest design with high-fidelity simulation technology to assess nursing students' competency in managing chemotherapy extravasation in cancer patients and the intervention group showed higher scores of competence concerning this issue. In addition, undergraduate nursing students have reported high levels of satisfaction with the use of simulation in education, as well as an improvement in oncology-related knowledge (Jang et al., 2019). Furthermore, it supports students' perceptions of evidence-based practice and facilitates the integration of scientific evidence into clinical practice (Leal-Costa et al., 2024).

Table 2
Data extraction.

Author/ Year/ Country	Aim	Study design	Participants	Educational strategy used in the teaching of oncology	Outcomes	JBI critical appraisal (total)
(Wittenberg et al., 2020) - EUA	Assess the impact of an online communication training module on nursing students' attitudes, knowledge, and behaviors regarding communication with cancer caregivers.	Quasi-experimental pre- and post-test without control group	Undergraduate nursing students n = 128 (all years)	Online Communication Training Module – COMFORT™ SM Curriculum The module was part of a cancer-focused communication curriculum, specifically addressing interactions with family caregivers of cancer patients.	• Significant improvement post-module across all years of study. • First and fourth-year students showed the greatest improvement in learning gains. • High satisfaction and perceived usefulness of the online module.	8/9 (88 %)
(Siegel et al., 2021) - EUA	Test an educational intervention intended to teach nursing students about skin cancer so they can reach competence and be certified by faculty to educate their patients.	Quasi-experimental	Undergraduate nursing students (n = 146)	Online skin cancer education to traditional educational methods: • Intervention group: 112 students received online educational treatment. • Control group: 34 students completed only the posttest.	The online module improved students' behavioral intent and understanding of their role in skin cancer prevention, though it didn't significantly increase factual knowledge	8/9 (88 %)
(Edwards et al., 2016) - Uk	Evaluation of an innovation in curriculum content and delivery within undergraduate nursing education in the UK. Its purpose was to investigate the effect on knowledge and attitudes and confidence in delivering cancer care.	Pre-test/post-test survey design with a comparison group	Undergraduate nursing students (n = 175) (3rd year)	• The intervention group (n = 84): receive 3.5-day programme of cancer education, coproduced with patients, carers, and health professionals, which focused on cancer as a life-changing long-term condition. • Comparison group (n = 91): received a traditional 2-day lecture-based program with limited patient interaction	• The new model, led to better knowledge, attitudes, and confidence in cancer care delivery. • It highlights the importance of experiential learning and patient-centered education in nursing curricula.	8/8 (100 %)
(Dönmez et al., 2025) - Turkey	Develop, implement, and evaluate an escape room game for oncologic emergencies.	Quasi-experimental pilot study	Undergraduated nursing students (n = 76)	Escape Room Game on Oncologic Emergencies Designed and implemented by course instructors After completing the game, students were given access to the data collection tools including: • Introductory Information Form; • Instructional Materials Motivation Survey; • Student Satisfaction and Self-Confidence in Learning Scale; • Simulation Design Scale by clicking on a link at the end of the game.	The escape room strategy proved to be an effective and engaging tool in oncology nursing education. It enhanced motivation, satisfaction, and confidence, suggesting that gamified learning can complement traditional theoretical and practical approaches.	9/9 (100 %)
(Kim and Jung, 2016) South Korea	Evaluate the efficacy of mobile-based virtual women's breast cancer nursing simulation training content on nursing students' confidence, satisfaction, and learning flow. It also examines the nursing students' virtual patient care experiences.	Quasi- experimental	Undergraduate nursing students (n = 40) (4th year)	Mobile-based virtual women's breast cancer nursing simulation training: • Experimental group: 20 students used the mobile-based virtual simulation module • Control group: 20 students with previous simulation practice but no module exposure	The mobile virtual simulation significantly improved satisfaction, confidence, and learning engagement.	9/9 (100 %)
(Orr et al., 2021) - Australia	Development and evaluation of a learning innovation that has relevance for nursing education given the increasing demand for remote and online learning.	Descriptive	Undergraduate nursing students	Virtual Patient Case Study (VPCS) + Online Modules: development and evaluation of a learning innovation, an integrated virtual patient case study and complementary online resources for person-centred nursing practice.	This integrated and culturally sensitive learning innovation helped nursing students strengthen person-centered practice, improve confidence, and gain insight into Indigenous health disparities.	8/10 (80 %)

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Table 2 (*continued*)

Author/ Year/ Country	Aim	Study design	Participants	Educational strategy used in the teaching of oncology	Outcomes	JBI critical appraisal (total)
(Chan et al., 2021) - Taiwan	Examined the effect of virtual reality-based documents on knowledge and attitude towards chemotherapy administration in nursing students.	Randomised Controlled Trial	Undergraduate nursing students (n = 77): experimental (n = 38) and control group (n = 39)	• Control group received the education documents • Experimental group used Reality-Based Learning -based documents (VRdocs) soft-ware consisting of an application about chemotherapy administration.	• The use of VRdocs significantly enhanced nursing students' learning outcomes in chemotherapy administration. • Participants who engaged with the immersive VR simulation showed notable improvements in both knowledge and attitudes compared to those who used traditional printed materials. • Students evaluated the VRdocs as more engaging, realistic, and effective for clinical training, expressing greater satisfaction, a willingness to reuse the material, and a strong inclination to recommend it to peers. • A combination of two teaching methods has been recommended for better results. • After receiving the classroom teaching, if the student does not understand the chemotherapy guide, the VRdocs can be used for self-learning.	12/13 (92 %)
(Simsek-Cetinkaya and Cakir, 2023) - Turkey	Evaluate the effectiveness of artificial intelligence-assisted screen-based simulations practice and standard patient simulation in teaching breast self-examination skills in nursing undergraduate students	Randomized clinical trial	Undergraduate nursing students (n = 103) experimental (n = 52) and control group (n = 51)) (1st year)	AI-AISBS (Artificial Intelligence-Assisted Interactive Screen-Based Simulation: • Students interacted with a virtual female avatar powered by AI, which provided personalized feedback and performance scores based on the (breast self-examination) BSE checklist. SPS (Standard Patient Simulation): • Students engaged in face-to-face simulation with a trained standard patient, practicing BSE in a realistic outpatient setting.	• SPS group achieved significantly higher performance scores in BSE techniques. • AI-AISBS group reported greater satisfaction with the simulation experience AI-AISBS group experienced higher anxiety than the SPS group.	13/13 (100 %)
(Wingfield, 2007) - UK	The aim of this tool is for the student nurses to have a better understanding of the surgical rationale for breast cancer, thereby providing improved care for patients	Descriptive	Undergraduate nursing students	Computer-Based Distance Learning - Learning tool uses a PowerPoint slide show. It comprises 73 slides with action buttons and hyperlinks to navigate around the slide show. Hyperlinks were used on all pages enabling the user to navigate between pages and return to pages as required.	• Self-directed learning. As e-learning develops within the NHS this type of learning tool will become more commonplace. • Improved understanding of surgical rationale and patient options • Enhanced confidence and clinical awareness among students. Better communication and care quality with breast cancer patients.	6/8 (75 %)
(Ham and O'Rourke, 2004) - EUA	Describe the development and implementation of experiential learning activity designed specifically for beginning nursing students	Cohort	Undergraduate nursing students (n = 82) (2nd year)	• A client scenario was developed by faculty and distributed to students one week prior to the planned activity. • Small groups containing 3–4 nursing students were formed, and instructions were given to plan care for the client in the scenario. • All members of the group must participate in the activity, from planning to actually carrying out the simulation (simulation of real clinical task, critical thinking practice, debriefing sessions)	• Many students indicated they would use the time-management systems developed in their groups to plan client care in the clinical setting. • Reduced anxiety before first clinical experience and improved confidence in clinical communication and organization • Increase students' comfort with patient interaction.	6/8 (75 %)

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Table 2 (*continued*)

Author/ Year/ Country	Aim	Study design	Participants	Educational strategy used in the teaching of oncology	Outcomes	JBI critical appraisal (total)
(A. Jang et al., 2021) - South Korea	Developed and subsequently applied a simulation program based on clinical reasoning for acute myelocytic leukemia to improve the learning outcomes and describe the learning experience for nursing students.	Quasi-experimental	Undergraduate nursing students (n = 91) 4th year (45 in the experimental group (simulation-based training) (46 in the control group) (lecture and skill practice)	Experimental group: • High-Fidelity Simulation (HFS) Based on Clinical Reasoning, developed scenarios focused on acute myelocytic leukemia (AML), Integrated clinical reasoning framework: signs/symptoms, etiological factors, nursing diagnoses, reflection journaling used to qualitatively assess learning outcomes. Control group: • Conventional instruction: theory class and self-practice of basic skills.	• Transformation into a self-directed learner for understanding the clinical situation. • Increased awareness of clinical reasoning ability. • Embodiment of the clinical reasoning process. • Theoretical Knowledge- Statistically significant increase in post-test scores for experimental group. • Clinical Performance - Experimental group significantly outperformed control group.	9/9 (100 %)
(Davoodi et al., 2022) - Iran	Determine the impact of an oncology internship training on learning outcomes of nursing students using an integrated teaching-learning method.	Quasi-experimental pre- and post-test study	Undergraduate nursing students (n = 107), 4th year, 51 students in the intervention group and 55 in the control group	Intervention group • Participated in a structured 6-day oncology internship (patient case scenario development, targeted questions related to clinical situations); critical analysis and nursing diagnoses; group presentations and collaborative discussion; instructor-guided learning and feedback. Conventional group: • Received standard patient care assignments under supervision, without the structured scenario-driven protocol	• Nursing students' cognitive learning and clinical decision-making scores were improved as a result of the integrated teaching-learning method • Cognitive learning: Post-test scores were significantly higher in the intervention group (mean = 15.17 vs. 13.27; $p < 0.001$) • Clinical Decision-Making (CDMNS): Total scores and all four subscales improved, especially in areas of consequence evaluation and assimilation of new information • Strengthening the connection between theory and clinical practice	9/9 (100 %)
(Baron et al., 2019) - EUA	Prepare nurses who typically do not encounter patients undergoing cancer treatments to provide safe, high-quality nursing care to these patients.	Descriptive educational report	Baccalaureate nursing students	• Authentic Learning through Illness Narratives and Storytelling. • Developed a series of six videos documenting the cancer journey of Ann, a nursing faculty member and cancer patient. • Ann shared her experience from diagnosis to survivorship, blending her roles as both nurse and patient. • Based on Smith & Liehr's "Attentively Embracing Story" theory, emphasizing intentional dialogue and reflective awareness.	• Enhanced understanding of patient experiences with cancer. • Encouraged reflective practice and emotional engagement. • Reinforced the value of storytelling in nursing education to bridge theory and practice.	6/8 (75 %)
(Alkhalaf and Wazqar, 2022) - Saudi Arabia	To investigate the effects of high-fidelity simulation technology on the competency of nursing students in the management of chemotherapy extravasation and the transfer of this skill from traditional learning labs to clinical settings.	Quasi-experimental (n = 68)	Undergraduate nursing students (n = 68), 3rd year	Intervention group: • Scenario-based simulation using computerized manikins. • Simulation designed around real extravasation cases from a chemotherapy day care unit. • Students experienced role-play, patient case management, and debriefing sessions. Control group: • Received standard instruction: textbook, lecture, videos, case studies, supervised lab practice.	• Nursing faculty can use either HFS or traditional learning methods to effectively teach students how to manage chemotherapy extravasation and transfer this skill to clinical settings (Both HFS and traditional methods are effective for teaching chemotherapy extravasation) • Students who underwent simulation scored slightly higher in competency than those in the control group (differences were not statistically significant).	7/9 (77 %)

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Table 2 (*continued*)

Author/ Year/ Country	Aim	Study design	Participants	Educational strategy used in the teaching of oncology	Outcomes	JBI critical appraisal (total)
(Carvajal et al., 2021) - Spain	To determine what thoughts, experiences and feelings nursing students have when reading a phenomenological text about the experience of a person living with advanced cancer.	Descriptive qualitative study	Undergraduate nursing students (n = 14) 3rd and 4th years	• Phenomenological text reading and reflective writing. • Students read a text narrating the lived experience of a person with advanced-stage cancer. • Encouraged self-reflection, emotional engagement, and deeper understanding of patient-centered care.	• Learnings identified empathy toward pain and suffering; recognition of body-soul unity; challenged students to explore personal vulnerability, identity, and existential questions and awareness of how attitudes and actions influence patient experience, especially at end-of-life. • The students also showed a greater capacity for empathy, as well as a more holistic view, which helps them to focus more on the person than on the disease.	8/8 (100 %)
(Burrell, Ross, Byrne, et al., 2023) - EUA	Determine the effect of simulation-based experiences (SBEs) with standardized participants (SPs) involving a patient and family member on baccalaureate nursing students' confidence and competence, anxiety and self-confidence with clinical decision-making, and satisfaction	Quasi-experimental	Baccalaureate nursing students (n = 25)	• Simulation-Based Experiences (SBEs) using Standardized Participants (SPs): • Two scenarios on oncologic emergencies: hypercalcemia (lung cancer patient) and hypersensitivity reaction (ovarian cancer patient) • Including a family member for realism and complexity • Implemented after 5 weeks of didactic content	• Confidence: Improved significantly from pre-seminar (27.6) → post-SBE (45.6) • Competence (self-perceived): Improved from 29.5 → 46.6 Objective Competence: • 7/7 student groups competent in hypercalcemia scenario • 5/7 groups competent in hypersensitivity reaction scenario • Self-confidence: Increased from 104.3 → 132.7 Anxiety: Decreased from 85.2 → 61.2	8/9 (88 %)
(Burrell, Ross, D'Annunzio, et al., 2023)- EUA	Evaluate the effect of standardized patient simulation on nursing students' knowledge, confidence, and competence (objective and self-perceived) related to oncology evidence-based symptom management principles, and to determine nursing students' perceptions, satisfaction, and self-confidence with learning using standardized patient simulation in a seminar-style course.	Quasi-experimental	Baccalaureate nursing students (n =63)	Standardized Patient (SP) Simulation integrated into a seminar-style course: • Two SP scenarios: Breast cancer and colorectal cancer patients • Focused on evidence-based symptom management (EBSM) • Included debriefing sessions and evaluations of communication, assessment, education, and clinical judgement	• Knowledge: Increased significantly across time points • Self-Confidence & Competence: Large effect size with improvements at each time point • High levels of satisfaction and positive perceptions of SP simulations	8/9 (88 %)
(Karadag et al., 2014) - Turkey	Determine nursing student knowledge, behavior and beliefs for breast cancer and breast self-examination receiving courses with a traditional lecturing method (TLM) and the Six Thinking Hats method (STHM)	Quasi-experimental	Undergraduate nursing students (n = 69) (2nd year)	• Traditional Lecturing Method (TLM) (n = 34) • Training via the Six Thinking Hats Method (STHM) (n = 35) -A student-centered active learning strategy using colored hats to represent different modes of thinking: • White Hat = Facts & data • Yellow Hat = Positivity & benefits • Black Hat = Risks & caution • Red Hat = Emotions & intuition • Green Hat = Creativity & alternatives • Blue Hat = Process control & reflection	• Significant increase in knowledge about breast cancer and BSE in both groups. • Both groups showed a statistically significant increase in self-efficacy/ confidence regarding breast self-examination (BSE). • Students trained with STHM showed earlier improvement in frequency of practicing BSE (significant after 15 days and 3 months). • TLM group showed significant change only after 3 months.	9/9 (100 %)
(Slaninka, 1992) - USA	Description of the journey of teaching – learning process that allowed students to experience the adventure of cancer nursing	Descritive	Baccalaureate	Drawing exercises, communication dyads and role play, gaming strategies, and case study analysis are among the teaching strategies	• Students reported: • Enhanced communication skills and empathy • Greater comfort discussing topics like grief, pain, and hope • Increased interest in oncology nursing • A shift in attitudes toward cancer care—from fear to understanding • Appreciation for experiential learning methods ("I didn't take many notes, but I sure learned a lot")	6/8 (75 %)

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Table 2 (*continued*)

Author/ Year/ Country	Aim	Study design	Participants	Educational strategy used in the teaching of oncology	Outcomes	JBI critical appraisal (total)
(Demi Rel et al., 2024) - Turkey	Evaluate the effect of enhanced reality simulation on nursing students' learning satisfaction and self-confidence and patient care management knowledge and skills regarding postmastectomy care.	A quasi-experimental study using a pretest-posttest design with a non-equivalent control group	Undergraduate nursing students (n = 78) (4th year)	Both groups received theoretical training and scenario-based practice focused on postmastectomy care: • Study group (n = 39): Trained with enhanced reality simulation (trained in a simulated clinical environment using high-fidelity moulage, a lifelike manikin, voice simulation, and realistic hospital-like conditions). • Control group (n = 39): Trained using routine adult standard patient care methods (followed standard practice scenarios using traditional teaching with adult patient mannequins).	• Students who trained with Enhanced Reality Simulation (ERS) showed a significant increase in their knowledge scores. • Both ERS and control groups improved in satisfaction and confidence after training. • ERS group had slightly stronger improvements, especially in self-confidence	9/9 (100 %)
(Incesu et al., 2024) -Turkey	To examine the effect of web based self-breast examination education on nursing students' knowledge, skills, and self-directed learning skills in self-breast examination.	Randomized controlled trial	Undergraduate nursing students (90 students): the intervention group (n = 43) and the control group (n = 47)	Both groups received education covering the same topics: breast anatomy, prevalence and risks of breast cancer: • Intervention group (n = 43): Received web-based education (featured interactive modules, multimedia videos, quizzes, and gamified activities in a self-paced format accessed through a custom website) • Control group (n = 47): Received traditional classroom-based education (involved lectures, slides, discussion, video demonstrations, and hands-on practice using simulators)	The control group had higher scores in the knowledge test both after education and at 15-day follow-up. Both groups improved their SBE skills, but the web-based group performed better in skill retention at the 15-day follow-up.	13/13 (100 %)
(Uslu-Sahan et al., 2025) - Turkey	Compare the effectiveness of the Virtual Reality Simulation Program and the Standardized Patient Simulation Program in chemotherapy education for breast cancer patients among undergraduate nursing students, focusing on knowledge, cognitive load, satisfaction and self-confidence levels.	Quasi-experimental two-group comparative study	Undergraduate nursing students (1st year) (107 students) Virtual Reality (VR) Simulation Program (n = 54) Standardized Patient (SP) Simulation Program (n = 53)	• The VR Simulation Program was delivered entirely online, combining an e-learning module with a computer-based simulation. It did not involve VR headsets—students used standard computers and headphones to complete the scenarios. • The SP Simulation Program was entirely face-to-face, involving lectures followed by interactive sessions with actors trained to play patients.	• Both groups showed improvement in knowledge scores after the intervention, but the SP Simulation group consistently outperformed the VR group across all outcomes. • The SP approach fostered deeper learning, even though it also imposed a higher cognitive load. Students in this group felt more confident and satisfied, likely due to the immersive, human-centered nature of the training.	9/9 (100 %)
(Mathibe, 2007) - South Africa	Assess the feasibility and students' perceptions regarding the use of Lance Armstrong's autobiography of surviving against cancer as a teaching tool.	Cross-sectional study (mixed methods)	Bachelor of Nursing (3rd year) (25 students)	Use of Lance Armstrong's autobiography *"It's Not About the Bike: My Journey Back to Life"* as a teaching tool. Selected chapters were read aloud by students while the lecturer elaborated on pharmacological concepts, especially cytotoxic drugs. The class was split into two sessions: Interactive reading and discussion and traditional didactic lecture (chalk-and-talk style).	• 80 % of students said the autobiography increased their interest in cancer drugs. • 84 % agreed it enhanced their pharmacology knowledge	7/8 (87 %)

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Table 2 (*continued*)

Author/ Year/ Country	Aim	Study design	Participants	Educational strategy used in the teaching of oncology	Outcomes	JBI critical appraisal (total)
(Arbuthnot et al., 2007) - Canada	Described is how the engagement of students and subsequent application of a population health template contributed to a community-based bowel cancer education and screening campaign.	Descriptive	Undergraduate nursing students (2nd year)	Community-based bowel cancer education and screening campaign. Students used the Population Health Promotion Model and Community as Partner Model to design interventions.	• Positive impact on students: Gained competencies in public health nursing, epidemiology, adult education, communication, and critical thinking. • Strengthened understanding of population health frameworks and determinants of health.	8/10 (80 %)
(Dean et al., 2013) - USA	Describes the collaborative Dedicated Education Unit initiative developed between a university school of nursing and a tertiary cancer center to provide senior nursing students with an innovative method to develop their competencies in oncology nursing practice and care.	Descriptive	Undergraduate nursing students	Dedicated Education Unit: a structured model where experienced hospital staff nurses serve as clinical instructors for nursing students. Paired learning: Each instructor mentored two students with patient assignments, emphasizing progressive skill-building.	Students: Improved clinical skills, increased satisfaction, enhanced job readiness.	6/8 (75 %)
(Fenton, 2014) - UK	Develop and embed a digital learning object within taught modules in order to expose students to the lived experience of a young person with a life threatening condition and evaluate students' perceptions of this as a teaching and learning tool.	Qualitative, descriptive study	Undergraduate nursing education	Digital Storytelling: A young person's experience with leukemia was captured in audio and visual formats and embedded into a Digital Learning Object (audio, text, images).	Over 80 % of students rated the resource as interesting and motivating	7/8 (87 %)
(Trevisani et al., 2016) - Brazil	Identify whether the use of concept mapping strategy assists a student to extend and revise their expertise in oncology and analyze the abilities developed in a student in order to go through theoretical to practical knowledge	Descriptive qualitative	Undergraduate student's 3rd year (20 students)	Concept Mapping (CM) —used as a teaching and learning strategy to help students integrate and apply oncology knowledge through clinical case resolution.	CM facilitated the development of clinical reasoning, autonomy, and the integration of theoretical knowledge into practice. Students reported improved understanding of oncology concepts and greater multilinear thinking. Some difficulties were noted by students unfamiliar with active methodologies or CM.	7/8 (87 %)
(Roca et al., 2016) - Spain	Compare three teaching methodologies (problem-based learning, case-based teaching and traditional methods) in terms of the learning outcomes achieved by nursing students.	Quasi-experimental, with three randomized groups and a single post-test design.	Nursing Degree program (74 students)	Three teaching methodologies were compared: 1. Problem-Based Learning (PBL) 2. Case-Based Teaching 3. Traditional Methodology (lecture-based)	• PBL showed the best learning outcomes (14.84 %), both in theoretical and theoretical-practical dimensions. • Case-based teaching had intermediate results (12.96 %). • Traditional methodology had the lowest performance (9.13 %).	9/9 (100 %)

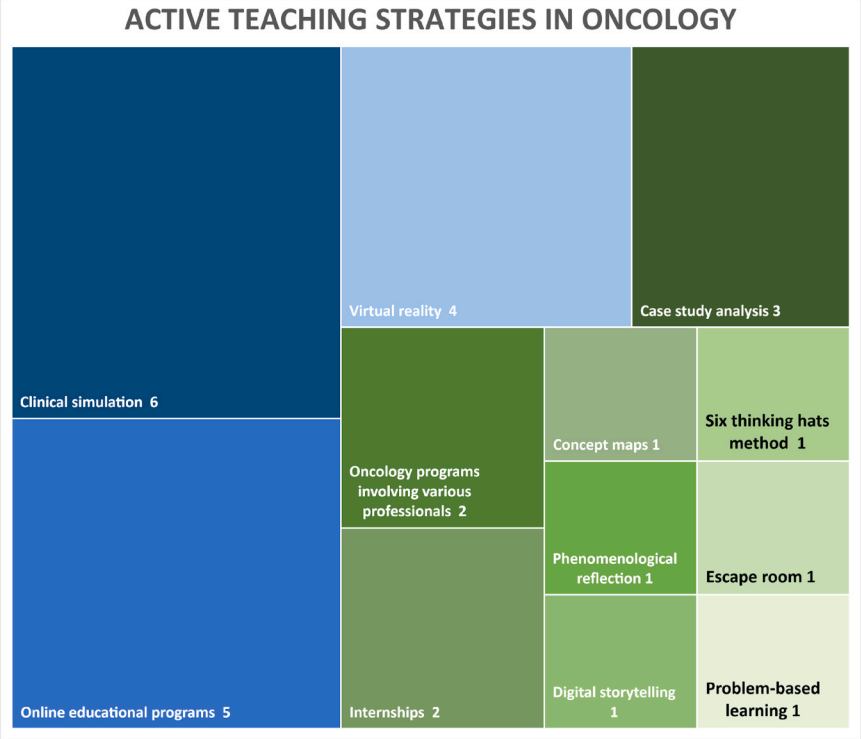

Fig. 2. Active teaching strategies in oncology, (in blue digital technology and green not using digital technology). Source – authors.

Regarding these educational strategies, recent studies have highlighted that technological approaches are continuously gaining ground in education. The most impactful strategies today, according to recent systematic reviews, are virtual reality (VR), high-fidelity simulation and virtual/computer-based simulation (Alharbi et al., 2024; Tong et al., 2024). These technologies are shaping future practice because they help nursing students prepare better for clinical practice by exposing them to realistic scenarios and complex decision-making. As a result, students develop greater competence and confidence, which ultimately enhances patient outcomes and helps close the gap between theory and actual clinical practice.

In addition, the integration of artificial intelligence (AI) systems into clinical simulation devices has significantly transformed the learning process for nursing students. AI enables the creation of dynamic and adaptive scenarios, where the simulator's responses vary according to the student's interventions, further bridging the gap between simulation and the complexity of real practice. Moreover, it allows for automatic collection and analysis of performance data, generating immediate, objective and personalized feedback that guides students in correcting errors and reinforcing good practices. These features foster the development of critical thinking, evidence-based clinical decision-making and the ability to prioritize care, contributing to safer, more efficient training that aligns with the demands of contemporary healthcare contexts (M. M. K. Chan et al., 2025).

Regarding non-technological strategies, although less frequently identified in this review, the most commonly used were case study analysis and oncology programs involving different professionals. One such example is the study of Edwards et al. (Edwards et al., 2016) a cohort study that implemented a 3.5-day cancer education program. The intervention cohort demonstrated greater overall knowledge of the impact of cancer, more positive attitudes and increased confidence in their ability to deliver cancer care (Edwards et al., 2016). Another non-technological strategy is the use of concept maps. Although it is used less frequently, this does not mean that it is less important. Trevisani et al. (Trevisani et al., 2016) conducted a qualitative study involving 20 undergraduate nursing students to analyze their abilities in using concept maps and the findings revealed that concept maps promote autonomy and clinical reasoning in nursing practice. A more recent systematic review by Faraji et al. (Faraji et al., 2025) further supports these findings, indicating that concept maps enhance conceptual understanding, improve critical thinking, enrich learning experiences and promote active learning.

Overall, the findings suggest that integrating both technological and non-technological strategies is beneficial, as these methodologies complement each other and enable undergraduate nursing students to acquire a diverse and comprehensive set of competencies in oncology setting. This combined approach enhances skill development an oncology education for undergraduate nursing student. However, this process is neither easy nor straightforward. The transformation of nursing education to integrate both technological and non-technological approaches into the curriculum faces several challenges. In particular, the adoption of technological strategies is hindered by limited faculty expertise, resource inequalities and high implementation costs, all of which can impede the successful implementation of this hybrid approach (Qutishat et al., 2025).

Insights into future directions in oncology nursing education present a wide range of opportunities and significant effort is needed to shape the future of oncology nursing education. We emphasize the potential for more personalized, AI-driven adaptive learning for students and, the development of interprofessional education scenarios and models to strengthen collaborative and interdisciplinary competencies among nursing students.

Despite providing valuable insights, this review has several limitations. First, a rapid systematic review is an abbreviated version of a full systematic review, which could lead to potential bias in the findings of the study. However, this approach allows for the timely provision of evidence-based results that can support decision-making. Additionally, there is a lack of heterogeneity in the contexts where the studies were conducted, as most were carried out in only four countries, primarily the USA and Turkey.

Future research should focus on conducting studies with a higher level of evidence, particularly given that this review identified only

three clinical trials (H.-Y. Chan et al., 2021; Incesu et al., 2024; Simsek-Cetinkaya and Cakir, 2023).

5. Conclusions

This rapid systematic review highlights the evolving scenario of innovative strategies employed in oncology education for undergraduate nursing students worldwide. A turning point was the COVID-19 pandemic, which accelerated the adoption of digital methods in response to restrictions on in-person contact, revealing the potential of technology in clinical education and training. Nonetheless, the evidence suggests that a dual approach, integrating both technological and non-technological active teaching strategies, is the most effective, as each contributes uniquely to the development of essential competencies in oncology nursing.

To strengthen future educational practices, the nursing curriculum should be redesigned to integrate these complementary strategies more effectively. Furthermore, the teaching process should incorporate ongoing evaluation and continual updating strategies to ensure alignment with evolving clinical standards and evidence-based practices in oncology.

Overall, such insights can contribute to a better understanding of these approaches and support the enhancement of oncology curricula in nursing education.

CRediT authorship contribution statement

Abreu Miguel Susana Sofia: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Helga Martins:** Writing – review & editing, Writing – original draft, Supervision. **Moreira Jose:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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