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EFFECTIVENESS OF PEAR DECK IN ENHANCING COGNITIVE, BEHAVIOURAL, AND EMOTIONAL ENGAGEMENT IN ONLINE PHARMACOLOGY EDUCATION FOR NURSING STUDENTS: A SYSTEMATIC REVIEW

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Abstract:

The transition to online learning during and following the COVID-19 pandemic has accelerated the adoption of interactive educational technologies in nursing education, particularly for content-intensive subjects such as pharmacology. Pear Deck, an interactive slide-based response system, has emerged as a promising tool for fostering student engagement in virtual learning environments. This systematic literature review synthesises empirical evidence on the effectiveness of Pear Deck in enhancing cognitive, behavioural, and emotional engagement among nursing students in online pharmacology education. Guided by the PRISMA 2020 framework, a comprehensive search was conducted across Scopus, Google Scholar, and Semantic Scholar. Nineteen studies published between 2020 and 2025 met the inclusion criteria and were analysed using a thematic synthesis approach informed by the Population–Exposure–Outcome (PEO) framework. Although the primary focus was on nursing and pharmacology education, relevant studies from closely related health sciences and higher education.

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Contexts were included to address the limited availability of domain-specific research. The findings indicate that Pear Deck supports cognitive engagement through interactive questioning and retrieval practice, behavioural engagement through increased participation and attentiveness, and emotional engagement through reflective prompts and emotional check-in features. Instructor pedagogical readiness, structured lesson design, and student digital literacy emerged as key facilitators, while technological constraints and cognitive overload were identified as barriers. This review highlights Pear Deck's pedagogical value in online nursing pharmacology education and provides evidence-based recommendations for educators and instructional designers.

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Keyword:

Nursing Education, Online Learning, Pear Deck, Pharmacology Education, Student Engagement

Introduction

In recent years, the integration of interactive technologies into teaching and learning has significantly transformed the landscape of digital education, particularly within online and blended learning environments (Anggoro, 2021; Wang & Chia, 2022). Interactive tools such as Pear Deck, Nearpod, and Flipgrid are increasingly adopted to enhance student engagement, particularly in online and hybrid learning environments (Anggoro, 2021; Miao et al., 2025). These tools support interactive instruction through real-time feedback, quizzes, multimedia presentations, and peer-to-peer collaboration, offering promising avenues for improving learning outcomes (Anggoro, 2021; Wang & Chia, 2022). Numerous empirical studies have investigated the impact of these technologies across various educational contexts. For instance, Maziidah and Qohar (2025) developed Pear Deck-assisted interactive modules to improve mathematical reasoning, while Grise (2025) explored online classroom engagement through active learning strategies. Similarly, Miao et al. (2025) investigated how academic self-efficacy affects motivation to learn on digital platforms.

Despite these contributions, findings across studies remain fragmented, frequently limited to specific disciplines, educational contexts, or individual technologies, with considerable variation in methodological approaches and theoretical grounding (Kramer, 2021; Idrissi et al., 2022). To date, there has been no comprehensive synthesis that critically evaluates the effectiveness of Pear Deck and related interactive learning tools across disciplines, educational contexts, and post-pandemic time frames (Kramer, 2021; Idrissi et al., 2022). Existing reviews tend to focus narrowly on individual tools or are outdated, omitting recent developments from 2021 onward (Kramer, 2021; Idrissi, 2022). Moreover, some studies focus primarily on

technical features rather than pedagogical impacts, and few explore learner perceptions or longitudinal effectiveness.

Given the accelerated adoption of interactive tools due to the COVID-19 pandemic and the subsequent digital transformation in education, a systematic literature review (SLR) is timely and necessary. Accordingly, this systematic literature review addresses the following research questions, guided by the Population–Exposure–Outcome (PEO) framework:

1. Population: What empirical evidence exists regarding the effectiveness of Pear Deck in enhancing cognitive, behavioural, and emotional engagement among nursing students in online pharmacology education?
2. Exposure: How is Pear Deck pedagogically implemented in online pharmacology classes for nursing students to support multidimensional student engagement?
3. Outcome: What facilitators and barriers are reported in the literature that influence the effectiveness of Pear Deck in promoting student engagement in online pharmacology education?

By synthesizing empirical evidence published between 2020 and 2025, this SLR aims to identify trends, reveal gaps, and offer insights for future pedagogical practice and research.

Literature Review

Technology-Enhanced Learning in Online Nursing Education

The rapid expansion of online learning in higher education has significantly reshaped pedagogical practices, particularly in nursing education. Courses such as pharmacology, which require high levels of conceptual understanding and clinical reasoning, pose distinct challenges when delivered online. Previous studies have reported that nursing students often experience reduced engagement, cognitive overload, and motivational decline in virtual learning environments (Ghasemi et al., 2020; Jalaluddin & Othman, 2021). Consequently, educators have increasingly turned to technology-enhanced learning approaches to address these challenges and to promote more interactive and learner-centred instructional designs.

Interactive digital technologies have been identified as effective tools for supporting engagement in online learning contexts. Systematic evidence indicates that integrating digital platforms can enhance instructional quality by encouraging active participation, improving communication, and facilitating real-time feedback (Idrissi et al., 2022). Within nursing education, such approaches are particularly relevant as they align with professional expectations of accountability, critical thinking, and continuous engagement throughout the learning process.

Conceptualising Student Engagement in Online Learning

Student engagement is widely recognised as a multidimensional construct comprising cognitive, behavioural, and emotional components. Cognitive engagement refers to learners' mental investment in understanding content, applying learning strategies, and engaging in higher-order thinking. Behavioural engagement encompasses observable actions such as participation, persistence, and task completion, while emotional engagement relates to learners' interest, motivation, and affective responses to learning activities. These dimensions are interrelated and collectively contribute to meaningful learning outcomes in online education.

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In the context of nursing education, sustaining engagement across all three dimensions is critical due to the complexity and applied nature of the curriculum. Research has shown that disengagement in online nursing courses may negatively affect academic performance, satisfaction with learning, and professional preparedness (Cavite & Marcial, 2022; Farid et al., 2024). As such, instructional strategies that simultaneously address cognitive, behavioural, and emotional engagement are essential for effective online pharmacology education.

Cognitive Engagement and Interactive Digital Tools

Interactive learning technologies have been shown to support cognitive engagement by promoting active processing, comprehension, and self-regulated learning. Student response systems, in particular, enable learners to interact with instructional content through questioning, polling, and immediate feedback, thereby facilitating deeper cognitive involvement. Empirical studies demonstrate that such systems enhance learners' understanding and attention, especially in content-heavy courses that require sustained focus (Huang et al., 2022).

Although much of the existing research is situated within language education, the cognitive mechanisms underpinning engagement, such as elaboration, metacognitive regulation, and knowledge construction, are transferable to pharmacology education. In nursing programmes, strategies that enhance cognitive engagement have been associated with improved academic persistence and learning outcomes (Ghasemi et al., 2020). These findings suggest that interactive tools have substantial potential to support cognitive engagement in online pharmacology instruction.

Behavioural Engagement and Active Participation in Online Classes

Behavioural engagement is a critical indicator of student involvement in online learning environments. Interactive platforms facilitate behavioural engagement by encouraging learners to participate actively through real-time responses, collaborative tasks, and structured learning activities. Evidence from higher education research indicates that active learning strategies significantly increase participation rates and reduce learner passivity in online classrooms (Grise, 2025; Putri & Suyatno, 2022).

Within nursing education, behavioural engagement is closely linked to professional discipline and learning responsibility. Studies conducted during and following the COVID-19 pandemic highlight that interactive online learning environments help sustain participation and attendance among nursing students, even under challenging learning conditions (Mardhiyah et al., 2024; Farid et al., 2024). These findings reinforce the importance of incorporating interactive elements to promote consistent behavioural engagement in online pharmacology courses.

Emotional Engagement, Motivation, and Learning Satisfaction

Emotional engagement plays a vital role in shaping learners' motivation, interest, and persistence in online learning. Traditional online instructional formats often fail to address learners' affective needs, resulting in reduced satisfaction and disengagement. However, research suggests that interactive digital tools can foster positive emotional responses by creating supportive, inclusive, and enjoyable learning environments.

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Meta-analytic findings indicate that gamified and interactive features enhance learners' motivation and emotional engagement (Sailer & Homner, 2020). In nursing education, emotional engagement has been found to mediate the relationship between instructional design and learning outcomes, influencing students' persistence and satisfaction with online learning experiences (Cavite & Marcial, 2022; Mardhiyah et al., 2024). These outcomes underscore the significance of emotional engagement as a key component of effective online pharmacology education.

Pear Deck as an Interactive Response System for Engagement

Pear Deck has emerged as a widely used interactive response system designed to enhance student engagement in online and blended learning environments. Empirical studies examining the use of Pear Deck report positive student perceptions, increased participation, and improved engagement across multiple learning contexts (Anggoro & Pratiwi, 2021; Hashim & Aziz, 2022). The tool's features, such as anonymous responses, immediate feedback, and interactive questioning, support active learner involvement and reduce anxiety associated with participation.

Further evidence indicates that Pear Deck enhances engagement during online learning periods, including during the COVID-19 pandemic (Haryani & Ayuningtyas, 2021). Although existing studies predominantly focus on language education, the pedagogical affordances of Pear Deck align closely with the instructional requirements of pharmacology education, where continuous feedback, active participation, and conceptual reinforcement are essential.

Research Gaps and the Need for a Systematic Review

Despite growing interest in interactive learning tools, several gaps remain in the existing literature. First, many studies examine student engagement as a general construct without explicitly differentiating between cognitive, behavioural, and emotional dimensions. Second, empirical research specifically investigating the effectiveness of Pear Deck in nursing pharmacology education is limited. Third, variations in methodological approaches and contextual focus hinder the development of consolidated conclusions regarding effectiveness.

These gaps highlight the need for a systematic review that synthesises existing empirical evidence on the use of Pear Deck in enhancing multidimensional engagement in online pharmacology education for nursing students. Such a review will provide a comprehensive understanding of current research trends, identify areas for future investigation, and inform evidence-based instructional practices in nursing education.

Methodology

This study followed the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure transparency and reproducibility throughout the review process (Page et al., 2021). The methodology comprised five components: search strategy, study selection and screening, inclusion and exclusion criteria, data extraction and synthesis, and data analysis.

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Search Strategy

A systematic search strategy was employed to identify relevant empirical studies by consulting three major academic databases: Scopus, Google Scholar, and Semantic Scholar.–These databases were selected to ensure comprehensive coverage of peer-reviewed and scholarly literature related to technology-enhanced learning and student engagement in higher education. The search was conducted on 26 December 2025 across all databases to ensure consistency and comparability in the retrieved records.

The search process utilised carefully constructed keyword combinations focusing on interactive digital learning tools and student engagement. Core search terms included “Pear Deck”, “interactive slide-based tool”, “student engagement”, “online learning”, “e-learning”, and “nursing education”. Boolean operators (AND, OR) were applied to broaden or narrow the scope of literature retrieval, while quotation marks were used to ensure precision when searching for exact phrases.

Search strings were tailored to accommodate the syntactic and functional requirements of each database. For example, Scopus employed broader tool-related descriptors, whereas
Google Scholar and Semantic Scholar incorporated discipline-specific and engagement-focused terms to enhance relevance. This structured and database-specific approach was intended to maximise retrieval sensitivity while maintaining relevance to the objectives of the systematic literature review (Table 1).

Table 1: Search Terms Used

Database	Search String	Date of Search
Scopus	(“Pear Deck" OR "interactive slide-based tool")	Dec 26, 2025
Google Scholar	"Pear Deck" AND "student engagement" AND "online learning" AND nursing	Dec 26, 2025
Semantic Scholar	"Pear Deck" AND "student engagement" AND ("online learning" OR "e-learning")	Dec 26, 2025

Study Selection and Screening

The study selection process was conducted in four sequential stages, in accordance with PRISMA guidelines.

1. Identification: A total of 219 records were initially identified across the three databases.
2. Screening: All retrieved records were imported into a reference management system, and duplicate records were removed.
3. Eligibility: Titles, abstracts, and full-text articles were reviewed to determine alignment with the review objectives.
4. Inclusion: Based on the predefined inclusion and exclusion criteria, 19 studies were selected for final synthesis

A summary of the study selection process is presented using a PRISMA flow diagram **(**Table 2):

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Table 2: Search Terms Used

Step	Count
Records Identified	219
Records Screened	26
Records Excluded	7
Studies Included	19
Date of Search	26 Dec 2025

Appraisal: Inclusion and Exclusion Criteria

After the search results were retrieved, duplicates were removed. The remaining articles were screened by title and abstract, followed by full-text review using the following predefined criteria. Details of record exclusion at each stage of the screening process are illustrated in the PRISMA flow diagram (Table 3).

Table 3: Inclusion and Exclusion Criteria

Criteria	Decision
Published between 2020 and 2025	Included
Written in English	Included
Peer-reviewed journal or conference paper	Included
Focus on interactive tools (e.g., Pear Deck, Nearpod, Flipgrid) in learning	Included
Lacks full-text access or is a review/meta-review	Excluded
Duplicate or inaccessible full-text articles	Excluded

Data Extraction and Synthesis

For each included study, data were extracted covering:

- Author(s) and year
- Research setting and population
- Interactive tool studied
- Methodology used
- Key findings and outcomes

Data were synthesized using a narrative synthesis approach, categorizing studies by tool, educational level, and measured outcome (e.g., engagement, performance, motivation).

Analysis

A thematic analysis was used to identify recurring patterns and trends across studies. The findings were grouped into major themes:

1. Student engagement and interaction
2. Instructional effectiveness
3. Technological accessibility and usability

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The results section presents these findings in detail, supported by frequency tables and thematic summaries.

PRISMA Flow Diagram

In accordance with the PRISMA guidelines (Page et al., 2021), a comprehensive literature search was conducted to identify empirical studies. The selection process is summarized using a PRISMA flowchart (Figure 1), which reflects the number of studies:

a) Identified through database searching.
b) Screened after removing duplicates.
c) Excluded at the title/abstract or full text stages.

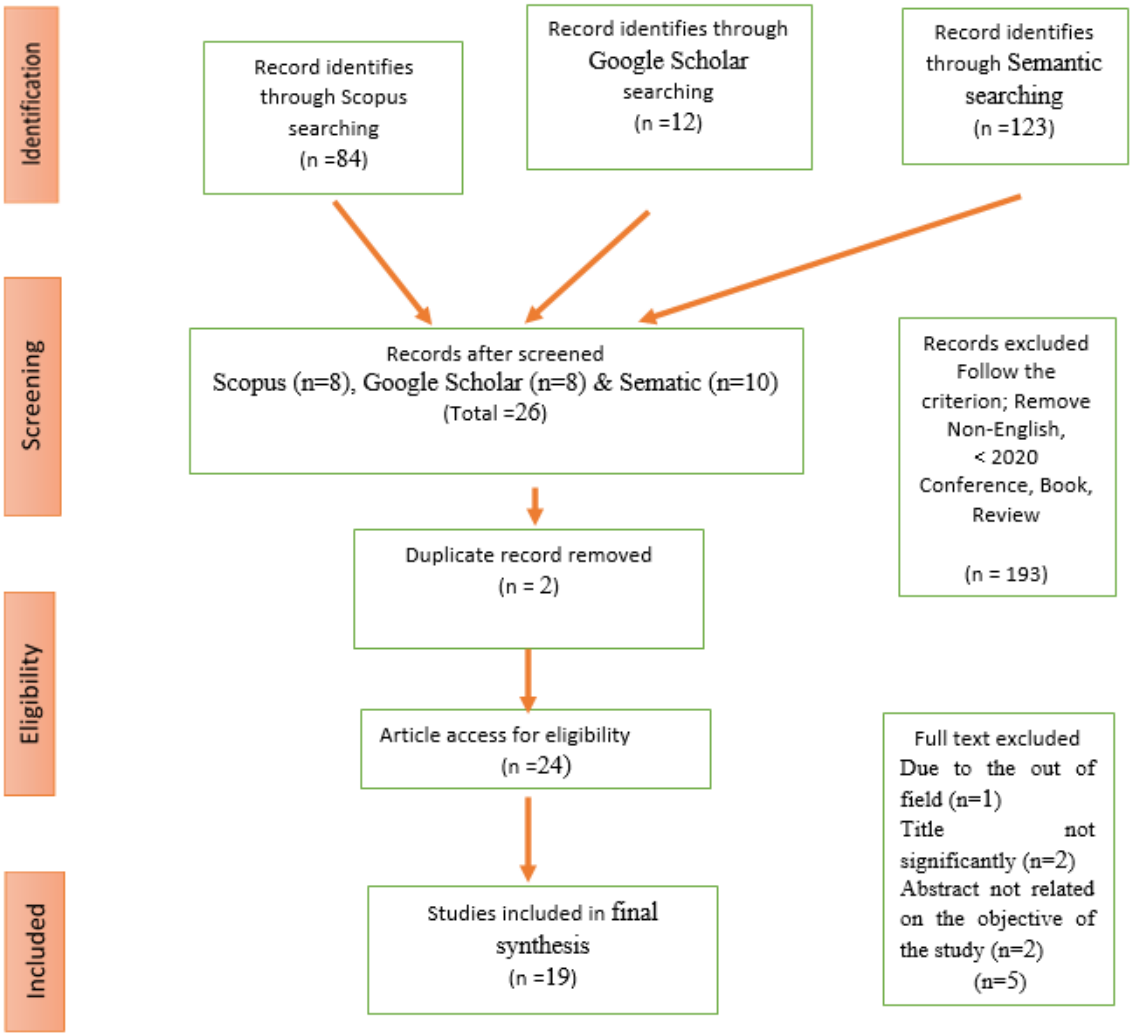

Figure 1. PRISMA Flow Diagram

Results

This review included 19 studies published between 2020 and 2025, identified from Scopus (n = 6), Semantic Scholar (n = 7), and Google Scholar (n = 6) (Figure 2).

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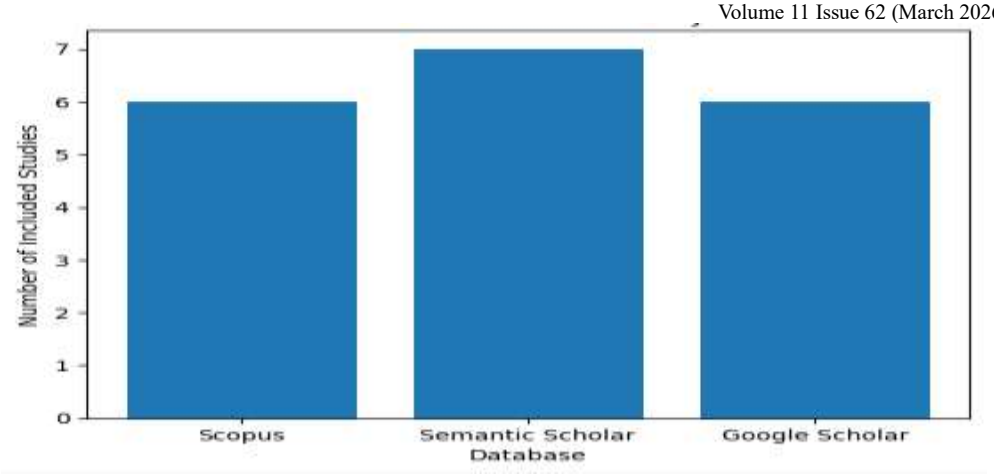

Figure 2: Number of Studies by Database.

The findings were thematically organised in accordance with the study's research questions and grouped into three overarching themes.

Theme 1: What empirical evidence exists regarding the effectiveness of Pear Deck in enhancing cognitive, behavioural, and emotional engagement among nursing students in online pharmacology education? RQ1

Several studies highlighted Pear Deck's capacity to promote multiple dimensions of student engagement in online learning environments. Cognitive engagement was commonly supported through interactive questioning, low-stakes quizzes, and visual scaffolds that prompted critical thinking (Maziidah & Qohar, 2025). Behavioural engagement was evident in increased participation rates, reduced dropout, and higher completion of in-class tasks when Pear Deck was used compared to passive instruction (Grise, 2025).

Emotional engagement was less frequently examined using quantitative measures, but qualitative data from student surveys indicated feelings of enjoyment, reduced anxiety, and increased sense of connection to instructors and peers (Miao et al., 2025). While most studies were not specific to nursing or pharmacology, the engagement outcomes in health-related and STEM subjects suggest strong transferability to pharmacology education settings.

Theme2: How is Pear Deck pedagogically implemented in online pharmacology classes for nursing students to support cognitive, behavioural, and emotional engagement? RQ2

Pear Deck was typically implemented using several instructional approaches within:

- Educators used Pear Deck to present pharmacological concepts alongside embedded comprehension checks, such as polls, multiple-choice questions, and draggable elements (Wang & Chia, 2022).
- Active Retrieval Practice: Tools within Pear Deck facilitated low-stakes quizzes and open-ended prompts that reinforced knowledge retention (Maziidah & Qohar, 2025).
- Real-Time Feedback: Instructors provided instant feedback during virtual lectures, reinforcing participation and correcting misconceptions in real time.
- Reflective Prompts: Some studies used Pear Deck's exit ticket and emotional check-in features to promote metacognition and emotional regulation, supporting deeper engagement.

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These strategies were reported to be most effective when integrated consistently throughout the course, rather than as standalone interventions.

Theme 3: What facilitators and barriers are reported in the literature that influence the effectiveness of Pear Deck in promoting learning engagement in online pharmacology education for nursing students? RQ3

Facilitators:

- Instructor Familiarity and Training: The literature consistently indicated that instructors with prior training and pedagogical familiarity with Pear Deck achieved more favourable engagement outcomes.
- Structured Lesson Design: Pre-planned interactive sessions using Pear Deck yielded more sustained student attention and performance improvements.
- Student Digital Readiness: Higher engagement levels were associated with students who were already comfortable using online platforms and tools.

Barriers:

- Technology Limitations: Poor internet connectivity and incompatible devices hindered the user experience, particularly for students in low-resource settings (Farid et al., 2024).
- Cognitive Overload: Some students reported feelings of cognitive overload when multiple Pear Deck features were densely integrated within a single instructional session.
- Lack of Interactivity Variety: Repetition of the same activity types reduced novelty and emotional engagement over time.

These findings underscore the importance of balanced instructional design and the need for professional development to optimize the use of Pear Deck in complex, content-heavy subjects such as pharmacology. Overall, the findings demonstrate that Pear Deck supports multidimensional student engagement in online learning environments through structured interactivity, real-time feedback, and reflective learning activities. The effectiveness of its implementation is influenced by pedagogical design, instructor preparedness, and contextual technological factors. These findings provide a foundation for further interpretation in relation to existing literature and theoretical perspectives, as discussed in the following section.

Distribution by Year

As illustrated in Figure 3, the number of publications examining Pear Deck and interactive engagement increased steadily from 2020 to 2025.

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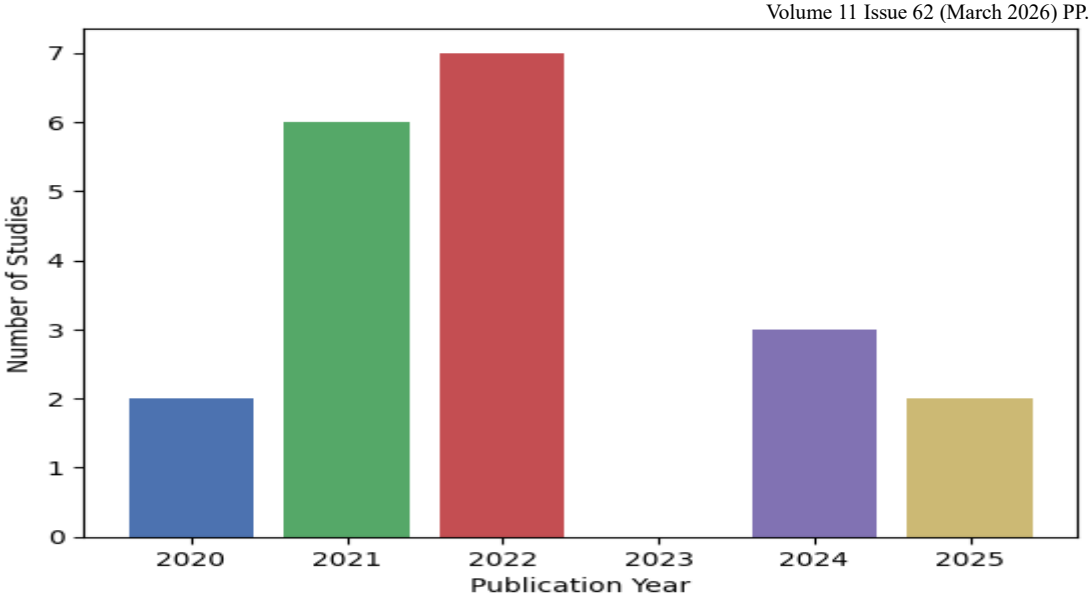

Figure 3: Distribution of Articles by Year (2020–2025).

Discussion

This systematic literature review synthesised empirical studies published between 2020 and 2025, highlighting how Pear Deck influences student engagement within online learning contexts. The findings support the view that Pear Deck functions as an effective pedagogical tool for enhancing cognitive, behavioural, and emotional dimensions of student engagement.

Interpretation of Findings

The reviewed studies consistently demonstrated that Pear Deck facilitates real-time interaction, immediate formative feedback, and student accountability in online instructional settings, leading to increased behavioural engagement such as participation and attentiveness (Grise, 2025; Wang & Chia, 2022). Cognitive engagement was supported through structured question prompts, low-stakes quizzes, and visual scaffolds that encouraged active processing of pharmacological content that scaffolded complex learning topics (Maziidah & Qohar, 2025). Though emotional engagement was less frequently studied directly, student reflections indicated a heightened sense of presence and satisfaction during Pear Deck-enhanced sessions (Miao et al., 2025). Importantly, the reviewed studies validate the theoretical assumption that active learning technologies can mitigate disengagement in online settings by enhancing both interaction and motivation (Farid et al., 2024). This aligns with broader research trends suggesting that learner agency and real-time communication are key determinants of engagement in digital learning environments.

Comparison with Prior Reviews

Previous literature reviews and meta-analyses on interactive technologies have focused largely on general engagement strategies or broad categories of tools (e.g., LMS platforms, video conferencing). However, this review is among the first to focus specifically on Pear Deck, particularly in the context of health and nursing education. Whereas earlier reviews may have highlighted passive learning outcomes (e.g., test scores), this study emphasises engagement as a multidimensional construct and shows how tools like Pear Deck affect how students think, feel, and behave in learning environments. Unlike past studies that considered technology

implementation at a surface level, this SLR delves into the pedagogical depth of integration a key contribution to both practice and theory.

Practical Implications

For Educators:

- Lesson planning with Pear Deck requires intentional design to avoid cognitive overload.
- Instructors benefit from training in interactive pedagogy, not just technical usage.
- Use of Pear Deck's reflection and emotional check-in features can boost emotional engagement and metacognition.

For Instructional Designers:

- Develop modular Pear Deck templates aligned with pharmacology content that support scaffolded learning.

For Policy Makers:

- Institutions should ensure equitable access to digital tools and technical support, particularly in low-resource settings (Farid et al., 2024).

Theoretical Contributions

This review contributes to the student engagement literature by reinforcing the conceptualisation of engagement as a multidimensional construct encompassing cognitive, behavioural, and emotional components. Specifically, the review contributes to understanding how tools like Pear Deck support constructivist and socio-emotional learning theories through interactivity, feedback, and learner-centred design. It also supports the framework that engagement is multidimensional, comprising cognitive, behavioural, and emotional layers, and that these can be independently and jointly influenced by technology-enhanced instruction.

Unexpected Insights

While Pear Deck is generally perceived positively, some students reported feeling overwhelmed when multiple features of the tool were overused in a single session (Wang & Chia, 2022). Another surprising finding was the importance of pacing: instructors who guided students slowly through Pear Deck slides saw more sustained engagement than those who paced more quickly. Additionally, emotional engagement is often under-researched and has emerged as a critical yet underutilised dimension that warrants deeper investigation, especially in emotionally taxing fields such as nursing and pharmacology.

Revisiting Research Gaps

This review addressed several key research gaps previously identified:

- A lack of systematic synthesis of Pear Deck's role in online learning.
- Limited focus on post-2020 studies was expanded here to include recent work up to 2025.
- Few studies examined the engagement triad (cognitive, behavioural, emotional). This review categorised findings accordingly.
- Specific application in nursing and pharmacology remains sparse, highlighting the need for domain-specific trials, but this SLR provides a foundational landscape for future targeted studies**.**

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Conclusion

This systematic literature review examined the role of Pear Deck as an interactive learning tool in fostering cognitive, behavioural, and emotional engagement among nursing students in online pharmacology education. Findings were organised thematically in alignment with three research questions and synthesised from 19 studies published between 2020 and 2025.

Key Findings

Effectiveness of Pear Deck: Empirical evidence suggests that Pear Deck positively impacts all three dimensions of engagement. Pear Deck supports cognitive engagement through structured questioning, low-stakes quizzes, and interactive content that promotes active processing of pharmacological knowledge. It supports cognitive engagement through scaffolded learning tasks and real-time quizzes (Maziidah & Qohar, 2025), enhances behavioural engagement by encouraging participation and accountability (Grise, 2025), and promotes emotional engagement through reflective prompts and emotional check-in features that foster a sense of presence and connection in online learning environments (Miao et al., 2025).

Pedagogical Implementation: The reviewed literature highlights that Pear Deck is most effective when integrated into structured lesson design. Features such as live slide interactions, open-ended questions, and emotional check-ins contribute to a richer learning experience (Wang & Chia, 2022).

Facilitators and Barriers: Key facilitators include instructor readiness, student digital literacy, and consistent integration throughout the course. However, barriers such as poor internet access, cognitive overload, and limited variation in interactivity design can hinder effectiveness (Farid et al., 2024).

Contribution to the Field

This review provides a consolidated, updated view of Pear Deck's instructional role in health education contexts, particularly in nursing and pharmacology. While many previous studies focused narrowly on tool features or single outcomes, this SLR provides a multidimensional analysis of engagement across diverse educational settings. Moreover, by framing the synthesis through the PEO framework, the review offers a structured approach that can guide further evaluations of emerging educational technologies.

Directions for Future Research

Based on identified gaps and limitations, the following areas merit further exploration:

- Domain-specific studies on Pear Deck's application in pharmacology education for nursing students, using larger and more diverse populations.
- Longitudinal studies that track engagement over time, not just within a single course or session.
- Mixed-methods research that combines quantitative outcome measures with qualitative insights into emotional engagement and learner experience.
- Investigations into the cost-effectiveness and scalability of Pear Deck across institutions with varying resource capacities.

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In conclusion, Pear Deck shows significant promise as an engagement enhancing tool in online nursing education. However, its impact depends not just on technological availability but on thoughtful pedagogical integration, instructional design, and learner support. These factors must be addressed holistically to maximise their potential to improve pharmacology education outcomes.

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