Design and Preliminary Evaluation of Information Management Platform for Clinical Nursing Education: A Case Study in Shanghai M Hospital

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Abstract

This study evaluates the development and preliminary assessment of a dynamic clinical teaching information management platform implemented at Shanghai M Hospital to enhance nursing education. By adopting a hospital-school-student integrated approach, the platform enables real-time tracking of intern distribution and attendance, quantitative evaluation of internship performance, and comprehensive teaching quality analysis. A mixed-methods research design was employed, including qualitative interviews with key stakeholders and a quantitative study involving 200 nursing interns, 80 clinical educators, and 19 school administrators. Results indicate that the platform significantly improves teaching efficiency, enhances the supervision of nursing internships, and fosters collaborative teaching practices. Key challenges include technological adoption, data security, and scalability across diverse institutional settings. The findings suggest that this scalable and adaptable platform can serve as a model for integrating informatics into clinical nursing education, addressing long-standing inefficiencies in training management and improving educational outcomes. Future research should explore AI-driven enhancements and cross-disciplinary applications to further optimize clinical training environments.

1. Introduction

Clinical practice plays a pivotal role in nursing education, significantly influencing the overall quality of educational outcomes. Traditional clinical teaching management methods, which rely heavily on communication tools such as phone calls, messaging apps, or emails, often result in fragmented or inconsistent information exchange among schools, hospitals, and students. This lack of coordination poses challenges to effective clinical teaching.

Existing clinical teaching management platforms are often siloed, focusing on either hospital- or school-centric approaches. This fragmentation results in inefficiencies such as inconsistent student tracking, limited real-time feedback, and difficulties in performance assessment. Our study aims to bridge these gaps by answering the following research questions:

1) How does an integrated platform improve the efficiency of clinical teaching management?
2) What are the effects of real-time tracking and feedback on nursing students' learning outcomes?"

2. Objectives

1) Develop a user-friendly teaching management information platform tailored to nursing interns.
2) Provide comprehensive learning resources and management tools to support clinical education.
3) Enable dynamic monitoring and analysis of interns' activities and performance.

3. Literature Review and Theoretical Framework

A systematic review following PRISMA guidelines was conducted to analyze recent advancements in clinical nursing education platforms. Keywords included 'nursing informatics', 'clinical education platform', and 'hospital-school integration' in databases such as PubMed and Scopus (2018–2024).

In the past five years, clinical teaching has undergone significant transformations due to advancements in technology and a growing emphasis on personalized learning. International studies highlight the importance of integrating digital tools to enhance the quality and efficiency of clinical education. Ward and Sales [1] explored the role of multimedia platforms in adult nursing education, emphasizing their potential to improve knowledge retention and practical skills. Similarly, Fawaz and Samaha [2] investigated e-learning strategies during the COVID-19 pandemic, demonstrating their effectiveness in maintaining educational continuity despite challenging circumstances.

In China, research has focused on aligning teaching methodologies with local healthcare demands. Wu [3] analyzed the application of mobile-based learning tools in Chinese hospitals, finding that such platforms significantly improved student engagement and reduced administrative burdens. Furthermore, Hou and Deng [4] introduced a "hospital-school-student" integrated model, providing a framework for collaborative teaching and real-time feedback.

Dynamic management platforms have gained traction as effective solutions for addressing the complexities of modern education systems. Internationally, Keefe and Saunders [5] examined the implementation of dynamic platforms in pain management training, highlighting improved learner autonomy and resource accessibility. Domestically, Zhang et al. [6] emphasized the need for scalable platforms capable of supporting large cohorts of nursing students while maintaining data security and operational efficiency. Their findings underscore the importance of modular design and adaptability to diverse educational settings.

3.1. Gaps and Limitations in Existing Research

Despite these advancements, several gaps remain unaddressed. Most existing studies focus on single-institution settings or specific technological tools, lacking a comprehensive framework that integrates hospitals, schools, and students into a unified system. Additionally, research often overlooks the dynamic needs of students, such as real-time feedback mechanisms and personalized learning pathways. Few studies have systematically evaluated the long-term impact of such platforms on clinical teaching outcomes or explored scalability across diverse educational settings.

Previous studies, Keefe and Saunders [5] and Zhang et al. [6], have highlighted the benefits of dynamic e-learning in nursing education, but few have explored an integrated real-time teaching management system. Our study builds on this foundation by introducing an AI-driven, interactive hospital-school-student platform.

Innovation of the Study

This study bridges these gaps by developing and evaluating a "hospital-school-student" integrated platform tailored to address the specific needs of nursing education. Unlike prior research, the platform provides a dynamic and modular solution, enabling real-time monitoring, seamless communication, and data-driven decision-making. It leverages systems theory and educational informatics to offer a scalable model that aligns with both local and global trends in clinical teaching innovation.

3.2. Theoretical Basis

This study is grounded in systems theory and the theory of educational informatics. Systems theory emphasizes the interdependence of components within an educational ecosystem, advocating for integrated solutions that promote seamless communication and resource sharing. Educational informatics provides the foundation for designing user-centric platforms that facilitate data-driven decision-making and enhance learning outcomes.

4. Research Method

This study employed a mixed-methods approach that combined qualitative and quantitative research techniques to ensure comprehensive data collection and analysis. The methodology was designed to align with the study's objectives and theoretical framework, ensuring robustness and replicability.

4.1. Study Design

A sequential exploratory design was adopted, starting with qualitative methods to identify key requirements, followed by quantitative methods to validate findings and measure the platform's impact. The study spanned from January 2024 to November 2024.

4.2. Study Setting and Population

The study was conducted at a top-class hospital in Shanghai, with participants including nursing interns, clinical teachers, and school practice managers. Inclusion criteria ensured that participants were directly involved in clinical teaching or internship management and consented to participate. A stratified random sampling method was used to select 200 nursing interns, 80 clinical teachers, and 19 school practice managers, ensuring demographic and role diversity.

5. Data Collection Methods

5.1. Qualitative Phase

Semi-structured interviews were conducted with a purposive sample of 20 participants (10 interns, 5 clinical teachers, and 5 school managers). The interviews explored challenges in current clinical teaching practices and desired platform features. Interview transcripts were analyzed using thematic analysis to identify recurring themes and inform platform design.

5.2. Quantitative Phase

A structured questionnaire was developed based on insights from the qualitative phase. The questionnaire included sections on user needs, platform usability, and satisfaction. A power analysis was conducted using G*Power 3.1 to determine the appropriate sample size. Based on an expected effect size of 0.5 and $\alpha = 0.05$, a total sample of 200 interns and 80 educators ensured a power of 0.85.

5.3. Reliability and validity:

Pilot Testing: The questionnaire was pretested with 30 participants, and necessary revisions were made based on their feedback.

Reliability Assessment: Cronbach's alpha coefficient ($\alpha=0.91$) confirmed high internal consistency.

Validity Testing: Content validity index (CVI = 0.89) was calculated based on expert ratings of item relevance.

5.4. Intervention

The "hospital-school-student" integrated clinical teaching platform was deployed in the experimental group, while the control group continued with traditional teaching methods. All participants in the experimental group received training on platform usage prior to implementation.

5.5. Outcome Measures

- Comprehensive Student Scores: Monthly assessments of theoretical and practical knowledge.
- Platform Effectiveness: Evaluated using the Effect Evaluation Scale, covering educational, scientific, and practical dimensions.
- Satisfaction: Measured using a Likert-scale-based questionnaire assessing user satisfaction with platform modules.

5.6. Data Analysis

Data were analyzed using SPSS 22.0. Descriptive statistics summarized demographic information, while independent t-tests were used to compare outcomes between groups. A p-value of <0.05 was considered statistically significant.

6. Research Process

6.1 Design and Development of the Platform

A multidisciplinary team of nursing educators, clinical practitioners, and software engineers was formed to design the "hospital-school-student" integrated platform. Key responsibilities included module construction, questionnaire design, and iterative software improvements based on user feedback. The platform's structure and functions were informed by theoretical models such as teaching cybernetics and energy-level correspondence theory.

6.2. Needs Analysis

A dual-phase needs assessment was conducted in March 2024.

Functional Requirements: Surveys and interviews with 200 nursing interns, 80 clinical teachers, and 19 school managers identified desired platform features, including real-time feedback and assessment tools. Four core modules student, hospital teaching, school management, and back-office management were defined based on this input.

Non-Functional Requirements: Focus areas included system security, operational stability, user-friendly design, and scalability for future enhancements.

6.3. Expert Consultation

Eight senior nursing educators and two software engineers reviewed and refined the platform's design, ensuring it met academic and operational standards. Adjustments were made based on their recommendations to optimize usability and functionality, as shown in Table 1.

Table 1.
Module settings and main functions of the Trinity Clinical Teaching Management Platform of "hospital-school-student".

module	Sub-module	function
Student module	Intern's personal files	Check the intern's personal name, gender, school, age, contact information, and check the internship agreement, rotation plan, internship starting and end time, etc. Set the personal account password, improve and modify more personal information.
	Learning garden	It includes two forms of live teaching and video teaching, covering theoretical explanations and operational explanations. In terms of content, the theory and operation not only fit clinical practice but also provide an interpretation of the progress in nursing frontiers. At the same time, a corresponding exercise bank is equipped, with each department and the nursing department uploading exam questions, allowing students to conduct simulation exams to consolidate their knowledge.
	Theory and operation assessment system	The theoretical assessment system shall set the assessment content and assessment time in advance by the background management. Students who are selected by the system can answer the questions by entering the page at the specified time, and automatically hand in the papers after the deadline. The operation assessment system is managed by the background management to release the assessment content, time and place in advance. The assessment students determined by the system receive a message to participate in the assessment. After the assessment, the teachers will upload the assessment results and examination comments.
	Personal internship	Interns can check the personal department scheduling, teachers, previous theory and operation assessment results, learn pre-job training materials, understand the intern management system, upload the internship materials, check the internship assessment results, attendance records, relevant notices and announcements, etc.
	Internship feedback system	Interns can upload the opinions and suggestions of the department and the teachers to the background through the feedback system. They can also register for participation in various learning and training, leave, department, stay in the hospital and other application matters.
Hospital teaching management module	information services	Check the basic personal information of interns, rotation plan, internship start and end time, intern scheduling, theory and operation assessment results, attendance records, department exit evaluation and section exit files.
	Assessment and evaluation system	Release the theoretical and operational assessment content, and set up the opening time of the assessment system and the assessment list. Upload the operation assessment standards, the intern assessment results and the evaluation. Upload and update the intern learning video courses and theoretical assessment questions.
	Internship management system	Upload the weekly schedule of interns, make attendance records, review the department materials, and upload the department results and the department summary.
	Survey and feedback	Release various questionnaires such as psychological tests and career tendency tests for the interns, and provide feedback on the difficulties encountered that need to be addressed by the higher authorities during the internship.
	information services	Query the intern rotation plan, department scheduling, theory and operation assessment results, attendance records, department records,

School management module		teachers' evaluation of students, intern teaching plan, hospital teaching quality evaluation results, and have a comprehensive understanding of what students have learned and mastered the situation.
	Interactive function	Through this function, the school can give feedback on the interns' internship in the school, so as to realize the communication and docking with the teachers, and the teachers can understand the general situation of the students in the school, so as to adjust the teaching plan appropriately.
	Information upload	Upload the school training plan, improve the relevant information of interns, and release the relevant school notice requirements.
Background Management Module		Upload the intern rotation plan arrangement, approve the intern leave, send students' feedback on the internship to relevant departments and teachers, and conduct a sampling inspection on the teaching quality. Account registration and approval, permission setting, etc.

6.4. Initial Deployment

The platform was trialed with an experimental group of nursing interns and their supervisors. Training sessions were provided to familiarize users with the platform, followed by a six-month implementation phase.

7. Results
7.1. Student Comprehensive Scores

The experimental group outperformed the control group in both theoretical and practical assessments (Table 2).

Table 2.
Comprehensive scores of the two groups of nursing students (points) $\overline{X} \pm S$

Group	No.	Student's comprehensive results
Experimental	50	93.86±6.45
Control	50	86.72±5.44
t-value		9.28
p-value		<0.01

The results in Table 2 indicate a statistically significant improvement in comprehensive scores for the experimental group compared to the control group. This suggests that the implementation of the "hospital-school-student" integrated platform positively impacts both theoretical and practical knowledge acquisition. The high t-value and low p-value (p < 0.01) confirm the reliability of these findings.

7.2. Platform Use Effectiveness

The experimental group demonstrated significantly higher platform effectiveness scores compared to the control group (Table 3).

Table 3.
Evaluation of the platform of two groups (points) $\overline{X} \pm S$.

Group	No.	Platform use effect evaluation
Experimental	119	74.79±8.22
Control	119	60.90±10.65
t		14.23
P		<0.01

Table 3 demonstrates that the platform significantly enhances perceived effectiveness among users in the experimental group compared to the control group. The notable difference in mean scores, coupled with a high t-value and statistically significant p-value (p < 0.01), highlights the platform's ability to address key educational and operational needs effectively.

7.3. Satisfaction with Platform Use

Satisfaction rates were significantly higher in the experimental group across all modules (Table 4).

Table 4.
Satisfaction of the two groups [n /(%)].

Module	Experimental Group (%)	Control Group (%)	χ^2	p-value
Student Module	48 (44.0)	40 (6.0)	6.06	<0.01
Teaching Management	45 (40.0)	35 (10.0)	6.25	<0.01
School Management	18 (14.0)	10 (5.0)	8.68	<0.01

Table 4 underscores the superior satisfaction rates for the experimental group across all platform modules. Higher satisfaction percentages in the student, teaching management, and school management modules demonstrate the platform's user-centered design and effectiveness in meeting diverse stakeholder needs. The statistically significant χ^2 and p-values (p < 0.01) validate the impact of the platform on user satisfaction.

8. Discussion

8.1. Scientific Design of the Platform

Under the guidance of Kenneth C. Laudon's information management system framework, the platform was designed as a modular system comprising four key components: the student module, hospital teaching management module, school management module, and background management module. To enhance accessibility and usability, the student and teacher interfaces were developed as mobile applications compatible with both iOS and Android, while the school and background management systems were implemented as web-based platforms. This cross-platform integration ensures flexibility in different educational and clinical environments, allowing for real-time data synchronization and communication.

8.2. Requirement Investigation and Functional Analysis

Survey results indicated a strong demand for interactive and transparent communication between hospitals, schools, and students. Specifically, 98.33% (294/299) of respondents emphasized the necessity of three-way interactive communication, while 94.98% (284/299) highlighted the importance of real-time feedback mechanisms. Compared to traditional platforms that focus primarily on administrative management, this system provides enhanced transparency, allowing students to track their progress and receive immediate evaluation feedback.

A key finding was the need for personalized learning pathways, where 94.31% (282/299) of respondents suggested incorporating adaptive learning resources such as updated guidelines, case simulations, and competency-based assessments. Furthermore, 96.32% (288/299) of respondents stressed the importance of ensuring that nursing students have access to detailed performance evaluations and assessment criteria, improving fairness and motivation in the learning process.

8.3. Challenges in Implementation

Despite the promising outcomes, several challenges emerged during the implementation phase:

Technological Barriers: Some faculty members and hospital staff faced difficulties adapting to the new digital tools due to a lack of familiarity with information systems. This highlights the need for structured training programs to facilitate digital literacy and ensure smooth platform adoption.

Data Privacy and Security: Given the sensitivity of student performance data and hospital operations, concerns about compliance with data protection regulations (e.g., China's Cybersecurity Law, GDPR for international scalability) must be addressed. Future iterations of the platform should incorporate stronger encryption protocols and role-based access controls to enhance security.

Scalability and Interoperability: While the platform was successfully deployed in Shanghai M Hospital, its adaptation to other hospitals with differing IT infrastructures remains a challenge. Future developments should focus on interoperability with existing hospital information systems (HIS) and electronic medical records (EMR) to ensure seamless data exchange across institutions.

8.4. International Comparisons and Best Practices

Comparing this study with similar international initiatives provides valuable insights into the platform's impact and areas for improvement. In Australia, the Clinical Learning Hub [7] has successfully integrated digital learning tools with hospital-based training programs, demonstrating a 25% increase in student engagement. Similarly, the Nursing Informatics Platform in the UK [8] has shown improvements in real-time performance monitoring, reducing administrative workload by 30%. These findings underscore the importance of user-centered design and AI-driven analytics to enhance nursing education globally.

Additionally, studies in the United States and Canada emphasize the role of virtual reality (VR) simulations in clinical training. Incorporating immersive VR case scenarios could further enhance the practical application of theoretical knowledge, an area that could be explored in future iterations of this platform.

8.5. Future Research Directions

Building on these findings, several areas warrant further investigation:

Artificial Intelligence Integration: Future studies should explore how AI-driven predictive analytics can provide personalized learning recommendations and real-time performance assessments.

Expansion Beyond Nursing Education: While this platform focuses on nursing students, its modular design could be adapted for other medical disciplines, such as pharmacy, physiotherapy, and medical residency programs.

Longitudinal Studies on Educational Outcomes: A longer-term evaluation (e.g., tracking students for 2–3 years post-graduation) could assess the real-world impact of digital teaching platforms on professional competency and patient care quality.

Global Adaptation and Cross-Cultural Usability: Investigating how the platform performs in different healthcare systems will be essential for optimizing its functionality for international adoption.

8.6. Conclusion

This study provides a novel, data-driven approach to optimizing clinical nursing education through a hospital-school-student integrated platform. While initial findings demonstrate improvements in teaching efficiency, student performance, and satisfaction, future work must address technological, security, and scalability challenges. By incorporating AI-driven analytics, adaptive learning pathways, and cross-institutional interoperability, this platform has the potential to serve as a global model for digital transformation in healthcare education.

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