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Design of a Stepwise Learning Process for Understanding Information Systems in Nursing DX Education

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Abstract: This study reports a classroom practice designed to help nursing students understand the basic mechanisms of information systems. Although systems such as electronic medical records are widely used in clinical settings, opportunities to learn how they work are limited. To address this issue, we designed and implemented a three-phase stepwise learning process. The process guides students from understanding data flow, to learning data sharing and related risks, and finally to connecting this knowledge to nursing practice through a simulated system. The program was conducted over 12 classes. A post-class questionnaire indicated that students recognized both the convenience of data sharing and concerns about data protection and information leakage. These findings suggest that stepwise learning is effective in promoting understanding of both the value of data and its associated risks.

Keywords: Nursing DX Education, Medical Information System

1. Introduction

In clinical settings, information systems such as electronic medical records are widely used, and nurses are expected to provide care using these systems. However, nursing DX education has often focused on operating ICT devices and following procedures, with limited attention to understanding how information systems function and influence practice. To address this issue, this study proposes a framework that organizes information system understanding into three phases based on learners' engagement levels, enabling gradual and structured learning.

The aim of this study is to reorganize nursing DX education from the perspective of information system understanding and to present an educational structure based on a three-phase learning process.

2. Related Work

Previous studies have reported the increasing use of ICT and DX in nursing education, including e-learning, digital materials, and simulation-based learning, which can improve learning efficiency and motivation (Richardson, McKenna, Gilmour, Marshall & Nolan, 2014) (Raghunathan, & Morrison ,2021). However, these studies also indicate that educational effects depend on appropriate instructional design and that students often experience anxiety or insufficient understanding when using ICT (Nwozichi, Marcial, Farotimi & et al, 2019). In Japan, ICT use in nursing education has rapidly expanded, and many practices related to medical information systems focus on system operation and usage scenarios(Editorial Board for the Special Issue on DX in Nursing Education ,2025). Nevertheless, educational approaches that help students understand the underlying mechanisms of information systems—such as data flow, databases, and networks—and associated risks remain limited. This study addresses this gap by proposing a stepwise learning process that supports gradual understanding and connects it to nursing practice.

3. Design Concept of the Learning Process

In this study, a stepwise learning process was designed to help nursing students understand information systems not merely as tools, but as systems based on underlying mechanisms. To reduce the abstractness and perceived difficulty of information systems, the learning process was structured in three phases that build progressively from experience to

application in nursing practice. As shown in Figure 1 and Table 1, each phase is designed as a foundation for the next, enabling students to gradually deepen their understanding.

In Phase 1, students develop an overall understanding of information systems and data flow through hands-on activities, enabling them to grasp how data are generated, transmitted, and shared. In Phase 2, students learn how data are stored and shared through databases and networks, while also recognizing the associated risks such as information leakage and unauthorized access. In Phase 3, students connect their understanding to nursing practice by engaging with a simulated medical information system and working with shared and visualized vital data.

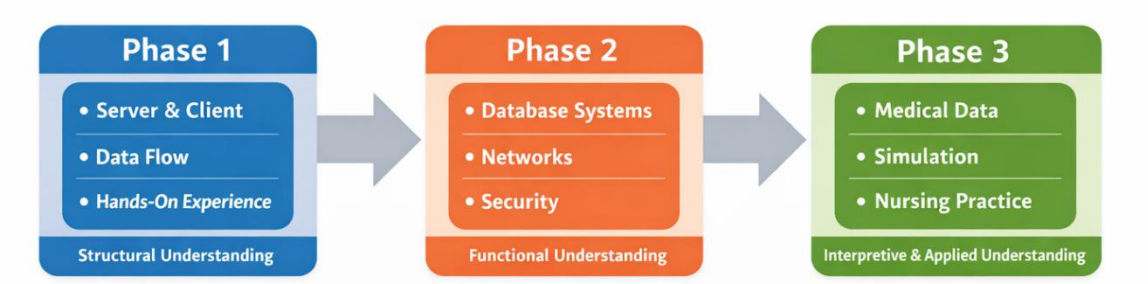

Figure 1. Progressive Learning in Information Systems

Table 1. *Structure of the Stepwise Learning Process*

Phase	Learning goal	Class activities	Key concepts
1	To understand the structure of information systems and the flow of data between servers and clients.	Gain hands-on experience with client-side technologies using the chat system of our proprietary information system.	Server–client model, data flow, network communication, client-side technologies
2	To understand how data are stored, shared, and protected, and to recognize the risks associated with data sharing.	Database operations and design, understanding the basic mechanisms of networks, discussion of cyberattacks targeting healthcare information systems.	Database, data sharing, network structure, information security, risk management
3	Understanding Information Systems Using Simulated Medical Data and Integrating Them with Nursing Practice	Hands-On Experience with a Simulated Healthcare Information System and the Sharing and Visualization of Medical data.	Vital data, simulated medical information system, data visualization, nursing practice

4. Implementation of the Stepwise Learning Process

The proposed three-phase learning process was implemented over 12 class sessions in undergraduate nursing education. Each phase was conducted sequentially to support students' gradual understanding of information systems.

In Phase 1, students engaged in activities such as simple programming, web page creation, and the use of a chat system to experience how data are generated, transmitted, and shared within information systems. In Phase 2, students learned basic database operations and network mechanisms and discussed real cases of cyberattacks to understand both data sharing and its associated risks. In Phase 3, students used a simulated medical information system to share and visualize vital data, enabling them to connect their understanding of information systems to nursing practice.

5. Results

A post-class questionnaire was conducted to examine students' perceptions of data sharing and information systems, as well as their perceived relevance to nursing practice. Responses were obtained from eight students.

5.1 Students' Perceptions of Data Sharing and Information Systems

Students recognized not only the convenience of data sharing but also concerns about data protection and information security. Representative comments included:

- “It is important to understand how the system works before handling data.”
- “I felt anxiety about the possibility of data leakage or data loss.”
- “Sharing data is similar to sharing personal information and requires careful handling.”

These responses indicate that students perceived information systems not merely as convenient tools, but as systems involving responsibility and risk.

5.2 Perceived Relevance to Nursing Practice

Students also connected their learning to practical situations in clinical settings, particularly in relation to electronic medical records and teamwork. Representative comments included:

- “The content can be applied to sharing and organizing patient information in electronic medical records.”
- “Information systems support teamwork and collaboration among healthcare professionals.”
- “Understanding the structure of medical records deepened my understanding of nursing practice.”

Overall, these findings suggest that students were able to relate their understanding of information systems to nursing practice and recognize the role of data sharing in clinical care.

6. Discussion

This study suggests that a stepwise learning process is effective in helping nursing students understand information systems. The results indicate that the sequence from experiential learning to understanding data sharing and risks, and finally to application in nursing practice, supported students’ learning. In particular, Phase 2 helped students recognize information security issues as realistic through database operations and real incident cases, while Phase 3 enabled them to connect information systems to nursing judgment and team-based care through simulated data sharing activities. However, this study is based on qualitative data, and future work should include quantitative evaluation to further validate the effectiveness of the proposed approach.

7. Conclusion

This study designed and implemented a stepwise learning process to support nursing students’ understanding of information systems in nursing DX education. The results indicated that students developed an understanding of both the benefits and risks of data sharing and were able to connect information systems to nursing practice. These findings suggest that learning designs focusing on understanding system mechanisms, rather than mere system operation, are effective in nursing DX education.

Future work will involve quantitatively evaluating learning outcomes and applying the proposed process in diverse educational contexts.

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