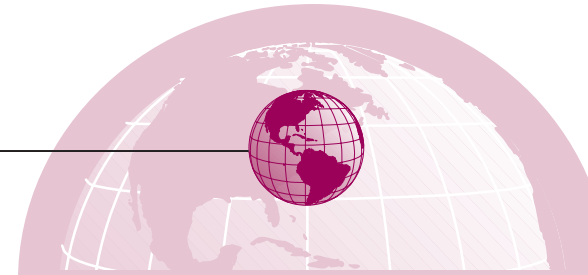
FEATURE ARTICLE



The Use of a Mobile Assistant Learning System for Health Education Based on Project-Based Learning

TING-TING WU, PhD

With the development of mobile devices and wireless technology, mobile technology has gradually infiltrated nursing practice courses to facilitate instruction. Mobile devices save manpower and reduce errors while enhancing nursing students' professional knowledge and skills. To achieve teaching objectives and address the drawbacks of traditional education, this study presents a mobile assistant learning system to help nursing students prepare health education materials. The proposed system is based on a project-based learning strategy to assist nursing students with internalizing professional knowledge and developing critical thinking skills. Experimental results show that the proposed mobile system and project-based learning strategy can promote learning effectiveness and efficiency. Most nursing students and nursing educators showed positive attitudes toward this mobile learning system and looked forward to using it again in related courses in the future.

KEY WORDS

Health education • Mobile devices • Project-based learning

Practical courses represent the most important part of nursing education. These courses help nursing students understand, internalize, and conceptualize nursing theory through real-life situations, familiarization, and the accurate application of nursing skills in practical experience. This type of learning effectively integrates theory with practicality and is an important method of cultivating nursing students into professional nurses.

The development of mobile devices for learning has led to new directions in education,[1] and their convenience and instantaneous features provide users with the chance to acquire and immediately access critical knowledge to solve pressing problems.[2] Various researchers have investigated the use of mobile devices to support nursing students in practical courses.[3–6] The introduction of mobile devices not only saves manpower and reduces errors but also enhances the professional knowledge and skills of nursing students.[7–9] However, most studies on this topic have focused on the design of data searching and indexing, and relatively few combined learning content and strategies with practical courses. Most studies referred to large-scale medical institutions and rarely explored public healthcare in regional health units. Therefore, this study used tablet PCs as a learning tool and introduced them in public health nursing practical courses. The instant support and services of the device can provide nursing students with a wide range of learning content, allowing teaching strategies that expand nursing practice in innovative learning environments.

Nursing practical courses have recently emphasized critical thinking, clinical judgment, and problem-solving abilities.[10] The teaching strategies adopted during learning activities affect the learner's message choice, acquisition, and structure, which in turn affect their behavior and thinking during the process.[11] Project-based learning (PBL) is potentially a perfect method of achieving the learning objectives of a practical course and integrating them with the traditional public health teaching method. Initially, PBL was designed for medical students, with the purpose of training learners how to think and seek solutions. However, the development of this approach is no longer limited to medical education, as PBL has been used in other professional areas.[12] An exploration-oriented learning method that chooses authentic, integrated, and challenging problems

Author Affiliation: Graduate School of Technological and Vocational Education, National Yunlin University of Science and Technology, Yunlin City, Taiwan.

This work was supported in part by the National Science Council (NSC), Taiwan, ROC, under grant NSC 102-2511-S-041-002 and NSC 102-2511-S-041-003.

The author has disclosed that she has no significant relationships with, or financial interest in, any commercial companies pertaining to this article.

Corresponding author: Ting-Ting Wu, PhD, Graduate School of Technological and Vocational Education, National Yunlin University of Science and Technology, No 123, Sec 3, University Rd, Douliou, Yunlin, 64002, Taiwan (danytingting@gmail.com).

DOI: 10.1097/CIN.0000000000000089

to draw conclusions and present results by asking questions, gathering information, analyzing, sorting, and using inductive reasoning is used in PBL.[13] This allows learners to structure their own knowledge system and provides actual experience in the pursuit of solving real problems. This learning pedagogy focuses on cultivating the ability of self-learning and solving problems.[14,15]

Therefore, this study used PBL as a basis for the strategic design and construction of a mobile assistant learning system for health education on tablet PCs for practical courses in public health nursing. The nursing students participating in this study were divided into groups to analyze and explore clients' data using tablet PCs. The learning activities were based on the construct theory for teaching strategies in the PBL process. Through teamwork, the nursing students planned exploration directions, collected the required information, established decision-making actions, and finally published their work. This process enabled them to not only learn by doing but also to learn from the research process.[12,16] The students also used technology-assisted tools to develop their information-searching skills and grasp the progress of work effectively.[17,18] The proposed system also helped students develop learning metacognition, critical thinking, and problem-solving abilities. Because public health nursing practical courses combine PBL with traditional teaching of professional knowledge, skills, and expertise, it focuses on allowing the nursing students to learn multidirection thinking and address the complexity of nursing practice process. This helps students take responsibility for their own behaviors and cultivate a humanitarian professional attitude.

THE MOBILE ASSISTANT LEARNING SYSTEM FOR HEALTH EDUCATION

To effectively use technology, fulfill the requirements of public health nursing practical courses, and fit the traditional teaching activity's content, the researcher discussed with nurse educators the system design, user requirements, operating procedures, and accessibility features before establishing the proposed learning system. The proposed system was developed based on the results of this discussion. The nursing students used Acer TF-101 tablet PCs (Acer, New Taipei City, Taiwan), equipped with Android 4 operating systems (Google, Mountain View, CA). Figure 1 shows the system interface of the learning software developed for practice activities. The left side of the system interface is the health education content, and the right-hand side shows annotations to prepare for explaining materials of health education to clients. The top of the right side shows the other support functions that provide further help.

In traditional practice activities, nursing students use a paper-based method to record and collect information. This approach not only increases costs and is time-consuming but also endangers information privacy. Therefore, the proposed system records information in a digital format. Using digitized content can effectively improve information storage, transmission, management, and application and also increases information sharing, exchange, and interaction among peers, teachers, and students. Before engaging in home visits, nursing students should prepare materials and design annotated content for explanation. Nursing students can gather a variety of information on the Internet by using the learning system and transform this information into constructed knowledge. The proposed system can read document files as well as rearrange and organize pages. Nursing students can arrange the materials and annotate the crucial parts that they must explain to clients. The proposed system allows audio and video files as annotations in addition to general text and graphics annotations. The resources used for annotation can be accessed from the storage and SD cards of the tablet PCs, and a variety of related information can be collected from the Internet and used in the annotation

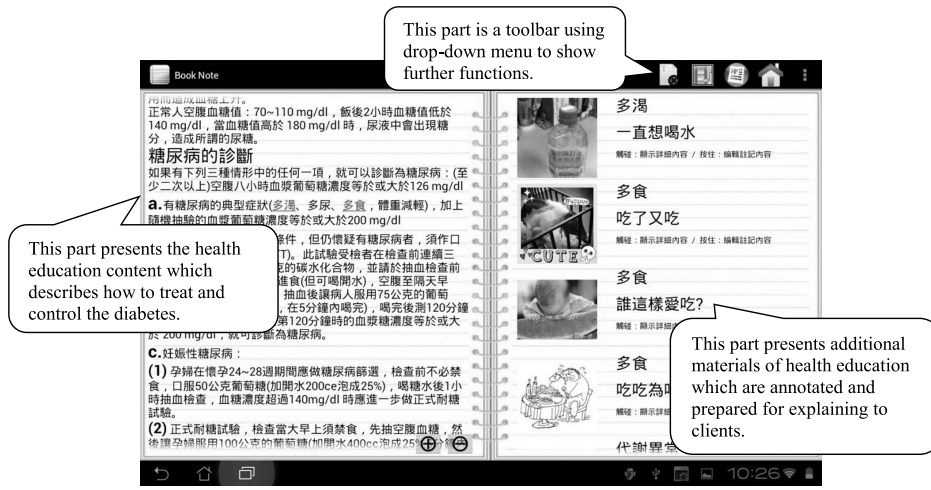


FIGURE 1. Interface of the learning system.

process. When practicing home visits, nursing students can use a rich variety of content on tablet PCs to explain and present health education materials. The annotated text, images, and audio/video files prepared before the home visit are great teaching tools in the health education process. Using a tablet PC, nursing students can present diverse and lively health education content that captures the attention of the clients, deepens the memories of taught content, and improves the healthcare services provided. The proposed system comes with audio and video recording functions, allowing nursing students to record the complete learning process before the home visits or during health education practice. Nursing students can use the recorded learning portfolio as guidance for self-reflection and self-regulated learning. Nurse educators can also use the learning portfolio to monitor each nursing student's learning progress and provide guidance and feedback at the appropriate times. Further analysis of the learning portfolio can provide nurse educators with a reference for adjusting or designing their teaching strategies.

RESEARCH DESIGN

Participants

The participants of this study were fourth-year nursing students at a 5-year nursing college, with 36 students in the class. All students attended public health nursing practical courses and volunteered to participate in this experiment. The group was divided into three practice echelons by the college. The first batch of nursing students served as the control group (12 people), the second was experimental group P (12 people), and the last one was experimental group M (12 people). The control group used the traditional teaching method. Experimental group P used the PBL strategy. Both groups used pen and paper to record and exchange information during the entire learning activity. Conversely, the nursing students in experimental group M used the tablet PC and conducted PBL teaching activities using the assisted learning system. The nurse educator for all three groups was the same person. To ensure that each nursing student achieved good execution ability and experienced a positive learning process during the whole experiment, the grades they got after the learning activities were listed as one of the practical achievements in this semester.

Learning Procedure

The total time of the public health nursing practical course in the regional health center was 4 weeks, with 7 hours a day. For the first 2 weeks, the nursing students stayed in the health center to learn the content and function of primary healthcare and organized and prepared health education materials for home visits. During the last 2 weeks, they started going out to intern home visits and participating in community health nurse jobs. This study focused on the exploration of data collection and preparation of health education in the first 2 weeks. Figure 2 shows the whole learning process.

On the first day of practice activities, the nurse educator introduced primary information and jobs to all the nursing students. This information included the work role and function of public health center nurses, activity programs, and implementation processes of PBL, operating instructions, and the use of standardized learning systems. To familiarize nursing students with the system functions, experimental group M allowed time for students to actually operate the system. To implement the PBL teaching strategy, experimental groups P and M divided students into four subgroups (three persons per group). The second day began with PBL teaching activities. The PBL approach is flexible enough to allow various instruction designs and procedures based on curriculum objectives and learning concepts.[14,19]

This study considered and integrated various previous teaching modes, and finally proposed five teaching steps to match the goal of the public health nursing practical course:

1. Preparation

In this step, the nurse educator explained each of the PBL steps and what the nursing students needed to do in each step and provided client information necessary for home visits and health education. With the guidance of the nurse educator, each group of nursing students selected and confirmed the visiting client through the process of diffused

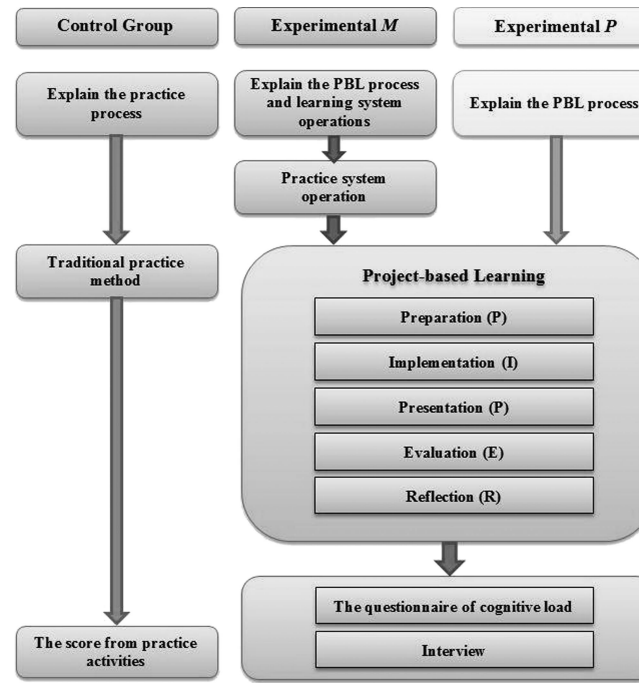


FIGURE 2. Flow of the experiment process.

thinking to convergent thinking. Then, using the intergroup communication and discussion, each group developed project research steps, data search method, work content distribution, and a progress table.

2. Implementation

The nursing students in experimental group M used their cognitive knowledge to prepare health education materials for home visits using the proposed learning system. Each group collected and organized materials according to the client and used the system to annotate the parts important to, or requiring need special interpretation for, the clients. Through the collection and analysis of materials from the Internet and intergroup communication and discussion, the nursing students learned how to solve organizational problems, how to problem solve, and how to construct knowledge. The students in experimental group P engaged in the same learning activities as experimental group M. The difference is that experimental group P used pen and paper during the activity process (Figure 3).

The role of the nurse educator was as counselor, guide, and assistant to the nursing students in conducting exploration activities. The nurse educator guided the nursing students to process materials effectively and conducted further observation to see if their data analysis was correct and complete. They also provided suggestions, questions, and direction at the appropriate times and cared for nursing students, tracked their learning, and helped resolve their problems. The nurse educator even observed from the sidelines and assessed the students' learning process in the evaluation step.

3. Presentation

When the implementation step was finished, the group members used an information software program to conduct a meaningful conversion of the collected data, and annotated and organized information. Students presented their reports using a variety of methods. After each group finished their presentation, peers gave immediate feedback and suggestions regarding the content of the report. By sharing these reports, the students exhibited their learning outcomes and achieved the goal of knowledge exchange, which provided the opportunity to observe each other. At this stage, the nurse educator was concerned about integrated knowledge, comprehensive knowledge, and the learning transfer ability of the nursing students and further helped the nursing students develop critical thinking and problem-solving abilities.

4. Evaluation

One of the PBL evaluation goals is the assessment of learning outcomes to understand the learning effectiveness of nursing students and the progress of knowledge and skills. Second, an assessment of the learning process is necessary to help understand the nursing students' problem-solving skills and interpersonal interaction situation.[20] Self-assessment and peer assessment are common evaluation methods in PBL activities. Nursing students can reflect on themselves and enhance self-learning effectiveness through self-assessment and learn to accept multiple perspectives through the feedback of peer assessment.[15] Therefore, this study used self-evaluation (25%), peer evaluation (25%), and teacher evaluation (50%) to assess PBL learning outcomes.

5. Reflection

The nursing students reflected on the improvement in the presented project based on the feedback from the evaluation step and self-reviewed their communication, coordination, cooperation, and judgment abilities during the PBL activities. This helped nursing students enhance their introspective potential and self-adjustment learning ability. In addition, the nurse educator could better understand the advantages and shortcomings of each learning activity based on the nursing student's presentation and learning portfolio, allowing the educator to make adjustments to future learning activities.

When the nursing students engaged in PBL activities, they also participated in primary healthcare activities in the regional health center and learned the scope of public health nursing services, operation, and development from these activities. On the last day of the second week, a cognitive load scale was distributed to experimental groups P and M to compare their cognitive loads and determine whether the introduction of the mobile assistant learning

FIGURE 3. Learning status of experimental group M.

Table 1

Analysis of Learning Effectiveness

	N	Mean	SD	Levene	*F*	*P*
Experimental group M	12	88.020	0.808	1.511	94.247	.000[a]
Experimental group P	12	84.916	0.587			
Control group	12	83.000	1.206			

[a] $P < .05$.

system created pressure on the nursing students during the PBL activities. The cognitive load scale used subjective self-evaluation, including subjective mental load and subjective mental effort, and was revised from a cognitive load scale proposed by Kalyuga[21] and Cerpa et al.[22] To further determine whether technology-assisted learning can enhance learning effectiveness during the public health nursing practical course and what difference there is from traditional teaching methods, this study randomly picked three students from experimental groups P and M and one fully participating nurse educator. In-depth interviews were conducted with seven people to determine their perception and acceptance of the learning system.

RESULT AND DISCUSSION

Evaluation of Learning Effectiveness

Nursing students in experimental groups P and M received a score based on the three evaluation approaches discussed in the teaching step of evaluation. However, the students in the control group received a score determined by the nursing educator. This study uses one-way analysis of variance to evaluate learning performance and uses descriptive statistics to explain the results of statistical analysis. Table 1 shows the results. The value of the Levene test was greater than 0.05 (Levene = 1.511 > 0.05), indicating acceptable homogeneity of variance, which means that the three groups had normal distribution and similar discrete state. Moreover, the *P* value was smaller than .05 ($P = .000 < .05$), indicating that the learning performance between the three groups showed significant difference. The average scores of the three groups showed that the scores of the two experimental groups were significantly higher than that of the control group, indicating that the PBL strategy effectively promoted learning performance. The average score in experimental group M was higher than that in experimental group P, indicating that although both groups engaged in PBL activities, experimental group M (which used the proposed learning system) had better learning performance than experimental group P did. These results indicate that introducing information technology into traditional public health nursing practical courses can address the drawbacks of traditional learning and effectively improve the learning effectiveness of practical course.

Table 2 shows the differences between the two experimental groups based on three evaluation methods. In both groups, peer evaluation had the lowest score among the three evaluation methods. However, the scores of self-evaluation and teacher evaluation were similar. These results are consistent with the study of Sung et al[23] and Sadler et al.[24] Based on observations by the nurse educator, competition among students is the major reason for lower peer evaluation outcome because the students scored each other more strictly and cautiously. Overall, the three evaluation scores of experimental group M were still higher than those of experimental group P.

Evaluation of Cognitive Load

In terms of reliability analysis of cognitive load scale, the Cronbach's α of experimental group M was .863 and that of experimental group P was .802. The Cronbach's α values of both groups were greater than .07, showing that the questionnaire of cognitive load achieved reliability and internal consistency. This study also uses an independent-sample *t* test to analyze the cognitive load scale. Table 3 shows that *P* value is greater than .05 ($P = .142 > .05$), indicating that cognitive load had no significant difference between the two experimental groups. Therefore, the introduction of the learning system did not increase the cognitive load of the nursing students. Further analysis of the average value shows that the average score of experimental group M is slightly higher than that of experimental group P, but the gap was small. This result shows that the proposed system did not create significant learning pressure for the nursing students. Although the score of the cognitive load in experimental group M was slightly higher than that in experimental group P, it was still in the students' acceptable range.

Table 2

Three Evaluation Methods of the Two Experimental Groups

	Self-evaluation	Peer Evaluation	Teacher Evaluation
Experimental group M	88.41	85.66	89.00
Experimental group P	84.91	83.41	85.66

Table 3

Analysis of Cognitive Load

	N	Mean	SD	*t*	*df*	*P*
Experimental group M	12	4.166	0.717	1.520	22	.142
Experimental group P	12	3.750	0.621			

Analysis of Interview

This study included in-depth interviews to acquire a more in-depth understanding of the nurse educator and nursing student perspectives on using this learning system, PBL, and technology-assisted education. Based on these interviews and analysis results, this study presents important trends and provides the following integration description.

Nursing students in experimental group M expressed satisfaction with the learning system, and they thought that other practical courses also should incorporate advanced technologies and learning styles. Students felt that the proposed learning system accelerated data collection and preparation, allowing them to immediately mark and search for important and specific points on the Internet to prepare explanatory documents. These useful functions not only helped them prepare the materials conveniently but also supported them in displaying and explaining the data during their health education activities. In addition, students thought using digitized information facilitated the storage, exchange, and management of video and audio recordings in learning portfolio, making the portfolio a valuable reference and reflection tool after school. For the PBL strategy, students indicated that the cooperative learning they used in the traditional practical course was similar to part of the PBL, allowing them to immerse themselves in PBL activities. Although part of the PBL is like cooperative learning, students emphasized that the PBL activities were more constructive and procedural; therefore, they were able to follow the PBL steps to arrange learning content and plan learning programs. The students received opinions and feedback through different evaluation methods, effectively broadening their horizons and opening their minds. Some nursing students mentioned that they felt a little cognitive stress when first using the system because of unfamiliarity with its operation, but they were satisfied that using the system in their learning activities improved with time. The students also proposed using the same system for assistance when going out to home visits for health education.

The nursing students in experimental group P stated that feedback, evaluation, and reflection are the features of the PBL strategy. Through feedback, they can identify their own undiscovered deficiencies and learn to accept multiple perspectives. The three evaluation methods offer better assessment in measuring high level of cognitive and practical skills. The nursing students used different viewpoints and orientations to discuss and consider problems. They found that reflection helped them achieve self-regulated learning, develop critical thinking, and promote acquisition of knowledge about noninert knowledge. Although the nursing students said that they liked using the PBL strategy, using paper and pencil hindered their learning process and even caused difficulties in data collection, sharing, and storage. Therefore, they hoped they could have related tools to provide assistance in the future.

The introduction of the proposed learning system also reduced the nurse educator's burden. The nurse educator expressed the need to play the role of the mentor, providing guidance and assistance at appropriate times. The nurse educator emphasized the need to immediately understand the learning situation and process of nursing students and was able to effectively grasp the progress of the overall teaching and learning activities using the recorded learning portfolio. The assistance of information technology solves the problem of not getting immediate feedback in traditional practical courses. The nurse educator also said that PBL is a structured learning strategy that promoted student cooperation, communication, independence, and critical thinking skills. Each learning step included specific learning content and goals that the students must complete. Nursing students followed the PBL teaching process to plan their future work, and the nurse educator only needed to monitor the learning process of each group and to assist each group arriving the next teaching step. Based on the nurse educator's observation, experimental group M's performance and presentation in PBL activities was livelier and more active because experimental group M used the proposed system. Therefore, the nurse educator hoped that future students would use this method and system.

LIMITATIONS

The participants in this study were all women. Thus, future research should use male and female participants in practical courses as exploration subjects. In addition, because this was a pilot study, the sample of participants was not large. However, on the basis of the positive analysis results, the authors will conduct large-scale studies in the future.

CONCLUSION AND FUTURE WORK

Practical courses represent an important part of nurse education and development. Using information technology to assist practice training has become an important and popular discussion topic in nursing education.[25] However, previous studies on this topic have used medical institutions as trainee places and primarily used learning systems for information retrieval, query, and recording. These studies rarely focused on design and planning for regional

healthcare units and learning activities. In addition, previous systems failed to provide complete information or provided information that did not match the real environment. This gap obstructs or interrupts the cognitive learning process and increases the working pressure on the nursing students.[26,27] Therefore, this study used a mobile assistant learning system to facilitate the public health practical course. Using the proposed system, nursing students can organize and prepare health education data for home visits and achieve their learning objectives using a PBL strategy.

The statistical analysis presented in this study indicates that adopting a mobile assistant learning system can enhance the effectiveness of nursing student learning. Through the proposed system, nursing students can speedily collect and integrate health education information and use various types of annotations to present and explain important and relevant information to clients. Introducing the learning system not only reduced the burden of traditional paperwork but also improved information sharing, storage, transmission, and application. A nurse educator can use the learning portfolio to quickly grasp the status of the nursing students and provide the appropriate feedback. Based on the observations of the nurse educator, the proposed highly autonomous PBL teaching strategy can further enhance nursing students' learning motivation, cooperation, problem-solving abilities, resource management skills, and critical thinking skills. Because students have daily use and operating experience with the information system, the leaning system is not a direct burden on nursing students' learning. Instead, the students' cognitive load gradually decreased as the number of operations increased and they became familiar with the system. In addition, interview results show that both teacher and nursing students had a positive perception of the learning system and PBL teaching strategies and hoped that it will be used in other practical courses in the future. Moreover, because this experiment is still ongoing, follow-up analysis can reveal more information gathered from home visits. More detailed and in-depth exploration can be performed to investigate the nursing students' learning portfolios, individual characteristics, and teaching strategies.

REFERENCES

1. Jeng YL, Wu TT, Huang YM, Tan Q, Yang SJH. The add-on impact of mobile applications in learning strategies: a review study. *Educ Technol Soc*. 2010;13(3):3–11.
2. Wong LH. A learner-centric view of mobile seamless learning. *Br J Educ Technol*. 2012;43(1):19–23.
3. Johansson PE, Petersson GI, Nilsson GC. Nursing students' experience of using a personal digital assistant (PDA) in clinical practice—an intervention study. *Nurs Educ Today*. 2013;10(33):1246–1251.
4. Hudson K, Buell V. Empowering a safer practice: PDAs are integral tools for nursing and health care. *J Nurs Manage*. 2011;19(3):400–406.
5. Koeniger-Donohue R. Handheld computers in nursing education: PDA pilot project. *J Nurs Educ*. 2008;47(2):74–77.
6. Kuiper R. Use of personal digital assistants to support clinical reasoning in undergraduate baccalaureate nursing students. *Comput Inform Nu*. 2008;26(2):90–98.
7. George LE, Davidson LJ, Serapiglia CP, Barla S. Technology in nursing education: a study of PDA use by students. *J Prof Nurs*. 2010;26(6):371–376.
8. Secco ML, Jamieson B, Profit S, et al. A survey of nursing students' perspectives on use of nursing central information software in clinical learning. *Can J Nurs Inform*. 2010;5(3):2–20.
9. Wu CC, Lai CY. Wireless handhelds to support clinical nursing practicum. *Educ Technol Soc*. 2009;12(2):190–204.
10. Girot EA. Graduate nurses: critical thinkers or better decision makers? *J Adv Nurs*. 2000;31:288–297.
11. Weinstein CE, Mayer RE. The teaching of learning strategies. In: Wittrock MC, ed. *Handbook of Research on Teaching*. New York: Macmillan; 1986:315–327.
12. Pryor CR, Kang U. Project-based learning. In: Capraro RM, Capraro MM, Morgan JR, eds. *STEM Project-Based Learning*. Rotterdam: Sense Publishers; 2013:129–138.
13. Thomas JW. (2000). A review of research on project-based learning. http://www.k12reform.org/foundation/pbl/researc. Accessed May 5, 2014.
14. Hou HT. Exploring the behavioural patterns in project-based learning with online discussion: quantitative content analysis and progressive sequential analysis. *Turk Online J Educ Technol*. 2010;9(3):52–60.
15. Stefanou C, Stolk JD, Prince M, Chen JC, Lord SM. Self-regulation and autonomy in problem- and project-based learning environments. *Active Learn High Educ*. 2013;14(2):109–122.
16. Wu TT. Using mobile annotation system in public health practice course based on project-based learning. In: Chang RS, Jain LC, Peng SL, eds. *Advances in Intelligent Systems and Applications*. Berlin Heidelberg: Springer; 2013;20:349–357.
17. Solomon G. Project-based learning: a primer. *Technol Learn*. 2003;23:20–30.
18. Kiteleyb RJ, Ormrod G. Towards a team-based, collaborative approach to embedding e-learning within undergraduate nursing programmes. *Nurs Educ Today*. 2009;29(6):623–629.
19. Tamim SR, Grant MM. Definitions and uses: case study of teachers implementing project-based learning. *Interdiscip J Problem Based Learn*. 2013;2(7):71–101.
20. Rienties B, Willis A, Alcott P, Medland E. Student experiences of self-reflection and peer assessment in providing authentic project-based learning to large class sizes. In: Bossche PV, Gijselaers WH, Milter RG, eds. *Facilitating Learning in the 21st Century: Leading through Technology, Diversity and Authenticity*. Netherlands: Springer; 2013;5:117–136.
21. Kalyuga S. When using sound with a text or picture is not beneficial for learning. *Aust J Educ Technol*. 2000;16(2):161–172.
22. Cerpa N, Chandler P, Sweller P. Some conditions under which integrated computer-based training software can facilitate learning. *J Educ Res*. 1996;15(4):345–367.
23. Sung YT, Chang KE, Chiou SK, Hou HT. The design and application of a Web-based self- and peer-assessment system. *Comput Educ*. 2005;45(2):187–202.
24. Sadler P, Good E. The impact of self- and peer-grading on student learning. *Educ Assess*. 2006;11(1):1–31.
25. Doswell W, Braxter B, DeVito Dabbs A, Nilsen W, Klem ML. mHealth: technology for nursing practice, education, and research. *J Nurs Educ Pract*. 2013;3(10):99–109.
26. Bardram JE, Bossen C. Mobility work: the spatial dimension of collaboration at a hospital. *Comput Supported Coop Work*. 2005;14:131–160.
27. Dunphy H, Finlay JL, Lemaire J, MacNairn I, Wallace JE. Hands-free communication technology: a benefit for nursing? *J Nurs Adm*. 2011;41(9):365–368.