Evaluation of Nursing Skills Acquisition of Reflective e-Learning System for Nursing Students by Different Learning Methods

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Abstract: We have been developing the reflective e-learning system for nursing skill acquisition by comparison between the video of a nursing student's skill and the video of a nurse's skill model. This system is intended to support learners' skill acquisition by (1) the procedure-learning function, by which learners can confirm their own procedures; (2) the image-comparing function, by which they can make a comparison between their own video and a skilled nurse's model video; (3) the text-entry function, by which they can describe their finding; and (4) the learning portfolio output by the text-output function. We verified their respective learning effects and the actual skill acquisition through the following learning methods: the "comparative learning of own images and the nurses' images (A)", the process of "peer review (sharing peer nursing students' awareness, opinions, and thoughts)";"comparative learning of others' images and nurses' images (B)" or "learning from others' descriptions of awareness (C)" by using this e-learning system. The results of score increase and success-failure change of the procedure and its caution items were better in groups as the compared than in group 1 as the control group. We suggest that this reflective e-learning system was confirmed to be effective.

Keywords: Nursing Skill, Learning Model, Self-learning Support System, Nursing Student, Reflective, e-Learning

Introduction

In nursing education, acquiring appropriate nursing skills is necessary along with acquisition of specialized knowledge. Nursing skills are direct actions with a sense of purpose for security, comfort, and self-help of subjects based on specialized nursing knowledge, which reflects practitioners' views of nursing and levels of skill acquisition. Nursing skills of different types can be categorized into classes such as "skills for interpersonal relationships", "skills for developing the nursing process", "skills for living assistance", and "skills for assistance associated with medical care". The acquisition process of nursing skills is said to comprise three phases by which the improvement can be promoted: "the phase of knowing", "the phase of mastering", and "the phase of using".

Learning with videos is known to be effective for nursing skill acquisition [1][2]. Now that information communication technology development and users' competence to use such technology have advanced, we have been able to use videos, which are available on the web, showing nursing skills. Nevertheless, only educational materials are presented through films. Such films might not always and directly engender technical learning activities for the improvement of nursing techniques. Therefore, we conducted step-by-step system development and formative evaluation to develop e-learning systems with

which users can improve their nursing skills through self-training from aspects of knowledge and techniques. This paper reports the e-learning system developed [3][4] and the verification of learning effects by different learning methods, and considers an e-learning system model for nursing skills' acquisition.

1. Concept of an e-learning system for self-learning of nursing skills

To date, we have analyzed characteristics of skilled nurses' techniques in intravenous injections from perspectives of technical implementation methods and sight lines in implementation, focusing attention on the tacit nature of "techniques" in nursing skills. Results revealed that sight lines were different between beginners (nursing students) and experts (nursing personnel) and that experts shifted their sight lines toward the next practice (prior processing). Many nurses think that once they have identified a vein they can perform an intravenous injection in most cases and often linguistically express the moment at which they did it well as "feeling like entering a blood vessel 'quickly (kukutto)' or 'smoothly (sutto)'"[5]. However, they think that it is difficult to tell exactly how they feel. Beginner nursing students think that remembering procedures is a technical knack or item of know-how. As the process of learning support, it is considered important to master procedures first before trying to bring techniques similar to characteristics of experts.

The use of CAI and e-learning in nursing skills education has shown a certain level of effectiveness in intelligent learning, but many learners thought negatively as to whether it would enable them to implement nursing skills in actual practice. Therefore, this study proposed an e-learning system model to support the aspect of technical learning, in addition to that of intelligent learning. Particularly, we considered an e-learning system model with which users can learn "tacit knowledge" and "skilled techniques" in nursing skills, which we have been able to learn only through experience, through "self-learning". Furthermore, in self-learning, we included the preparation of the environment for self-evaluation and self-reflection as an important function.

2. E-learning for nursing skill learning support

2.1 Four functions supporting intelligent learning

This learning support system is intended for the acquisition of learn nursing skills through self-evaluation and comparative self-reflection [6]. The system comprises four functions as shown Figure 1.

2.1.1 Procedure-learning function

This is the function to check technical procedures. Because nursing students consider precise implementation of procedures as a technical knack, we have them start with the learning method by which they can remember procedures. The function supports self-evaluation for skills and procedure checks by checking radio buttons on the "learning procedures" screen.

2.1.2 Image-comparing function

This function can play and compare two images simultaneously, or alternately. The function supports learners' clarification of the differences, such as bodily sensations in the different times required, by comparing the skilled nurses' technical images with their own technical images.

2.1.3 Text-entry function

This is a function by which nursing students can input sentences through answering questions. Comparing images, learners can freely write what they think and become aware of. Writing onto the system supports encouragement of thinking back (reflection) and thinking. Questions are set for learners to compare the procedures of intravenous injection one by one.

2.1.4 Text-output function

This function outputs the procedures and awareness of which the learners have inputted. This can be used as a learning portfolio for the skill acquisition process. It enables students to move on to the next learning task after they became conscious of awareness.

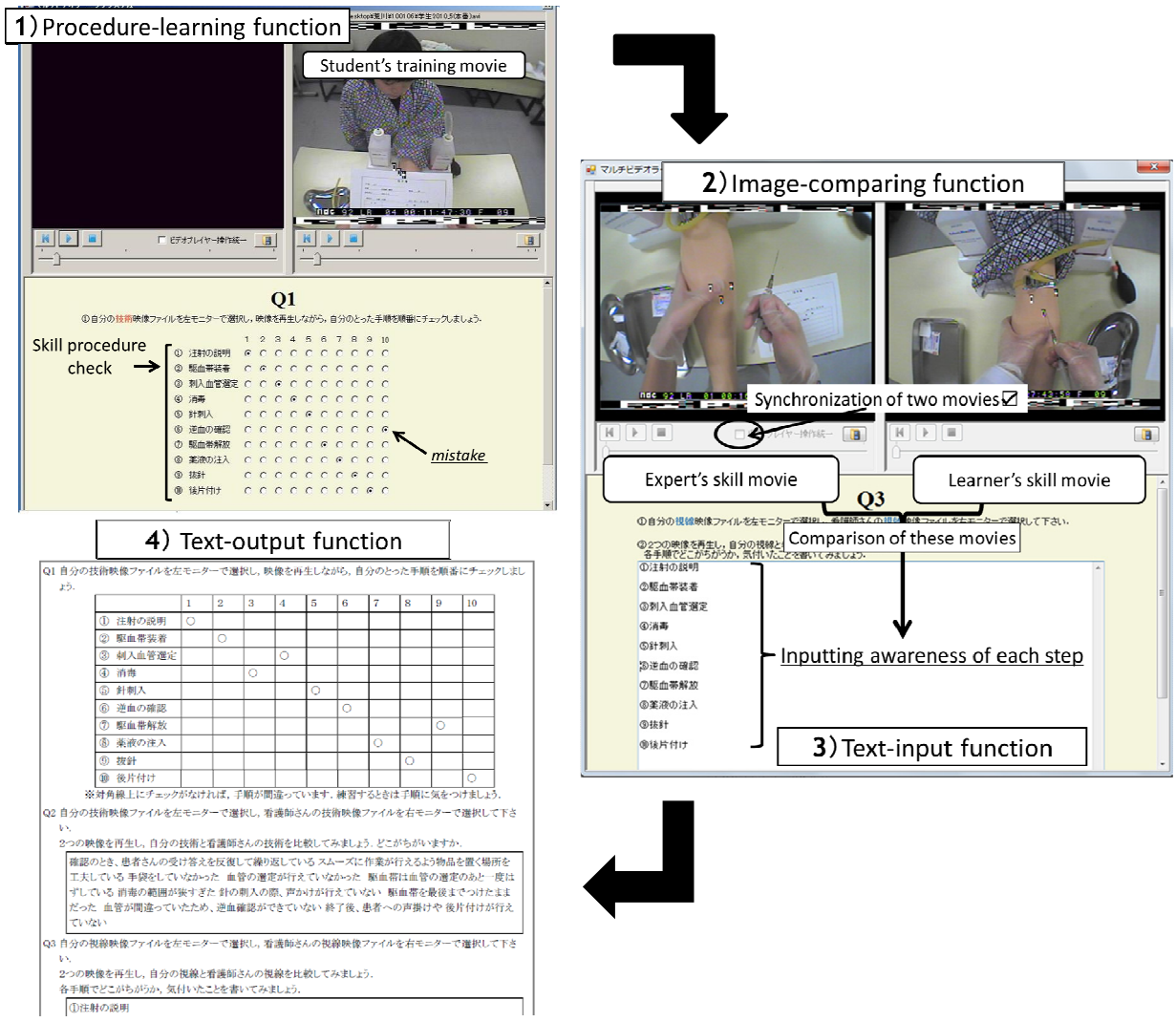


Figure 1. E-learning for nursing skill learning

2.2 Verification of learning effects

In the aspect of support for intelligent learning, we performed the verification among third-year and fourth-year students who had already completed credits for nursing skills practice, including intravenous injection skills.

2.3 Previous experiment

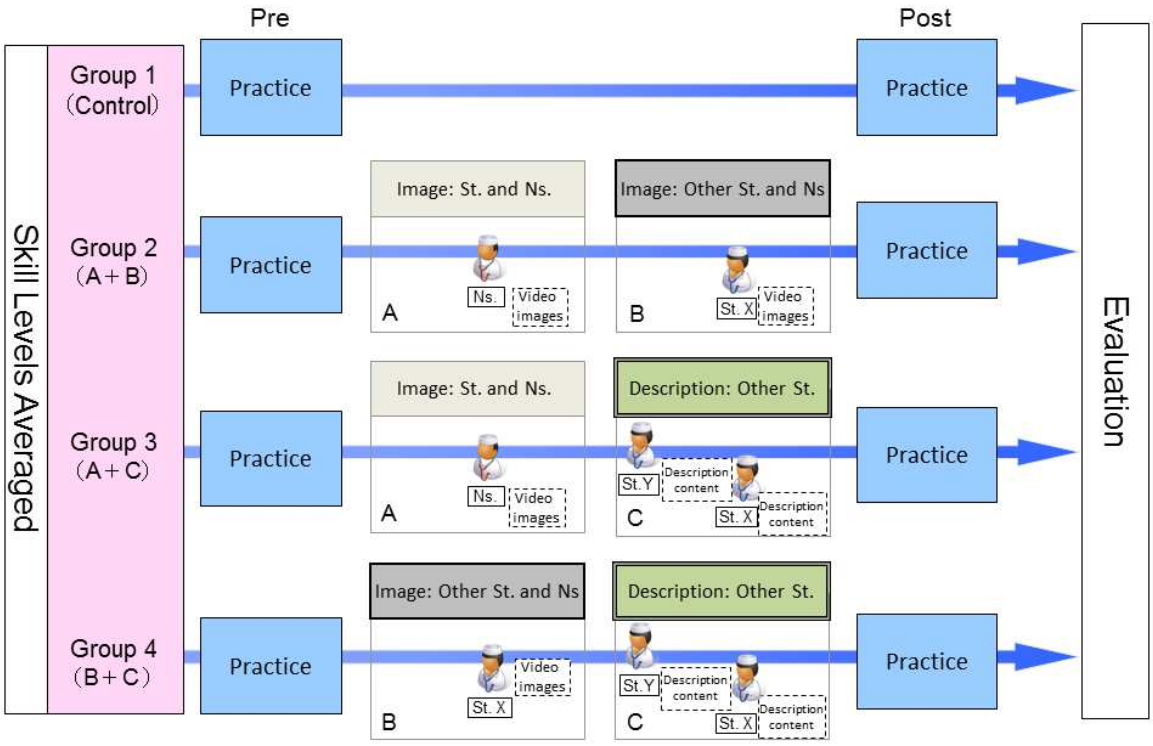
We have already reported about the previous experiment in ICCE 2011[6]. We described the abstract of experiment as follows. For five nursing students, we compared technical images obtained before and after technical training for intravenous injections and after using the learning support system, and analyzed the learning effects. The results revealed almost no improvement related to the procedures before and after the training by themselves. However, after learning through comparison of students' own images and nurses' images, improvement was observed by which all students were able to implement intravenous injection using the correct procedure. Students apparently became able to imagine and understand the flow of the procedures easily through watching their own images and comparing them to the nurses' images.

In terms of the identification of whether being able to inject into a vein correctly, which is a technical aspect, four students were able to perform an injection correctly after implementing the self-training, but it did not lead to improvement of the procedure. However, it became clear that intravenous injection skills had improved after comparing the images. All five students were able to perform an injection into a vein correctly by following the correct procedure.

2.4 Experiment method

Subjects were 16 nursing students. We verified their respective learning effects and the actual skill acquisition through the following learning methods: the "comparative learning of own images and the nurses' images (A)", the process of "peer review (sharing peer nursing students' awareness, opinions, and thoughts)";"comparative learning of others' images and nurses' images (B)" or "learning from others' descriptions of awareness (C)" by using this e-learning system. The procedure is shown Figure 2.

1) To form as few groups as possible and to allocate as many students as possible to each group, we used an orthogonal array, which is used for the design of experiments, and defined the groups as follows: Group 1 as a control group, Group 2 as a group to learn "A and B", Group 3 as a group to learn "A and C", and Group 4 as a group to learn "B and C".
2) To equilibrate the groups' skill levels, what was done first was to measure the skill levels of all subjects. Next, they were sorted randomly so that each group's skill level was more or less equal. Then, the judgment was made by two teachers with nursing licenses.
3) The nursing students wore a camera and then performed injection procedures. Thereafter, they conducted learning appointed in each group. The learning time was about 60 min in total, during which they were obligated to finish two processes of learning. Subjects in Group 1 (Control group) spent freely the same time of 60 min. For "learning from the findings described by other learners," the descriptions of five students, which were gained from the first experiment [6], were used.
4) We had the students conduct the intravenous injection again.



A: student's self-video and a nurse's video images
B: other student's and a nurse's video images
C: findings described by other students

Figure 2. Method of experiment

3. Results

To measure the effects of skill learning, we represented the skill in the form of scores based on the success and failure of the intravenous injection procedure and its caution items. The procedure was subdivided into 17 items and their caution items were 39 in total. By analyzing the video images, we investigated each item's successes and failures. When an item was considered a success, it was assigned a 1 score; failure garnered a 0 score. Subsequently, we analyzed the results, the scores they were assigned, how the second injection's score differed from the first, and interviews after the experiment.

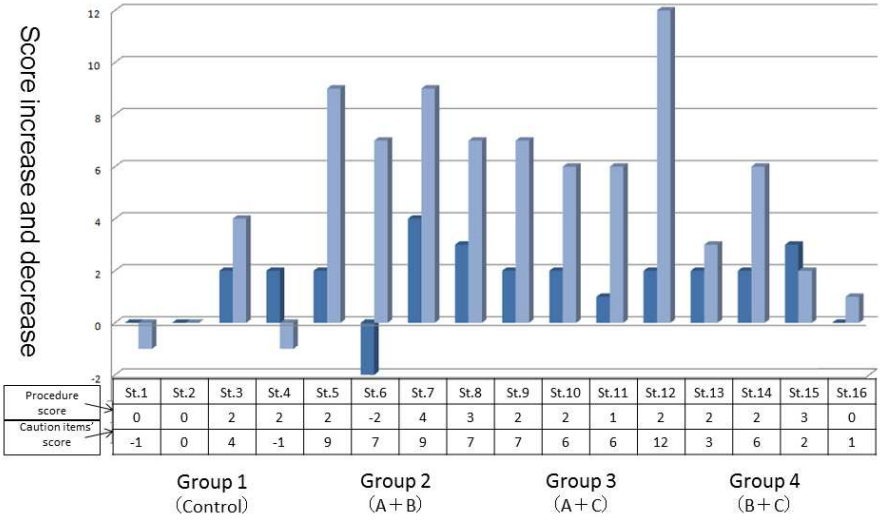
3.1 Scores from the viewpoint of the procedure and its caution items

The first and second scores of the injection procedure and its caution items of each student are portrayed in Figure 3. Except for the control group, all subjects' scores increase of the second injection procedure was conspicuous.

3.2 Success and failure of the procedure and caution items

In terms of the success and failure of the procedure and its caution items, comparison of items before and after learning showed that Group 2 to Group 4 improved considerably in the procedure of "injection confirmation". Therefore, regarding caution items of "prescription, drug solution amount, and needle direction," they also showed improvement in the following items: "injection confirmation work," "to place a pus basin (bolus) at the right side," "to confirm the patient's birth date," "to call to the patient," "palpation,"

"gloves," "preparation and placement of dry cotton and antiseptic cotton," "to try to confirm reversed vascular flow," "to confirm the patient's facial color (by calling to the patient)," "explanation of astriction."



A: student's self-video and a nurse's video images, B: other student's and a nurse's video images
C: findings described by other students

Figure 3. Score increase and decrease of nursing skill

3.3 Interview contents

From the students of Group 1, we gained the following responses: "I was able to find that I forgot the procedure"; "Though I tried to review it, I ended up finding no answer." From students who had conducted "the learning of seeing their own video image" of Group 2 and Group 3, we gained the following responses: "I ascertained well what I had not achieved or what had lacking in my understanding"; "I was able to find my errors of procedure and where and how to place some goods"; "I was able to find differences in my speed of a series of work from the other nurses' and the resultant diffidence of mine, which might have some effects on my patients' sense of security.

The students who had conducted "learning of seeing others' video images" of Group 2 and Group 4 said: "I felt that I had to understand the meaning of each procedure, finding that they make the same mistakes as mine"; "Seeing what the other students had failed, I came to know of such possible mistakes, which I had happened not to make this time, and discovered additional points to which I should devote attention in the future." Another student said "I watched the video images of others, overlapping it with mine."

From the students who had conducted "learning of reading what is described by others" in Group 3 and Group 4, we gained the following responses: "I was able to learn how to confirm the patient or how to give an account for injection"; "By reading the findings described by others, I was able to find what I had never found (to place goods or to stop bleeding by folding a sheet of dry cotton into four)"; "I was able to discover what I had missed because I had succeeded in doing it as well as what I had failed to do"; "What is written by others in form of description easily soaked into my head." Additionally, the students in Group 2, Group 3, and Group 4, turned out to approach the second experimental injection devoting attention to such caution items as "response to the patient (calling to the patient or confirming the patient's facial color)," "placement of goods," "selection of blood vessel" and "reduced burden on the patient" by considering the time

for applying a tourniquet bandage as well as the procedure.

4. Discussion

Both the results of score increase and success-failure change of the procedure and its caution items were better in Group 2, Group 3, and Group 4 than in Group 1 as the control group. In addition, investigating the deed of "unfastening the tourniquet bandage after blood vessel selection and then wearing gloves and preparing for sterilization to fasten the tourniquet bandage again" for reducing the burden on the patient, the scores of all the students except for Group 1 were improved. Consequently, the learning of the present learning support system was confirmed to be effective.

However, in terms of "confirmation of reversed blood" in the caution items, although all the students in Group 2, Group 3, and Group 4 tried to confirm it in this experiment, a student only succeeded in confirming the reversed blood when they had actually inserted a needle. They trained by themselves according to the results of Experiment I and then they confirmed the reversed blood. Therefore, the skill for confirming the reversed blood in inserting a needle is regarded as greatly affected by training. In other words, to acquire some skills, actual training with trial and error was found to be essential.

In terms of the results of interview, in "the learning by comparing others' video images and the nurses (B)" and "the learning by reading the findings described by others (c)," they were inclined to say that they were able to find what they had missed or what they had been not conscious of because they had succeeded in doing it. Consequently, the "peer review" is regarded as having some effects on learning by enabling learners to find something new. In addition, one student reported watching video images of others by overlapping it on their own experience. The learning method turned out to enable the learner to learn from the multifaceted viewpoint covering both other's standpoint and his or hers. In other words, the peer review is regarded as effective for skill acquisition because it calls a learner's attention to what other people devote attention to; thereby, it promotes new findings. However, it is a limit of this learning method that the learning depends on the quality of a peer's description content.

Based on results of the two experiments conducted this time, in the nursing skill self-learning environment, we were able to confirm that we were able to support self-learning with the following four learning models in this learning support system: (1) practice, (2) comparison (between the learner's self-video image and practiced nurses'), (3) self-reflection (reviewing the learner's self-practice by describing their own findings), and (4) peer review (sharing the video images and described findings from others' viewpoints).

Moreover, we think that the top priority is for a beginner to remember the precise procedures. Therefore, we think that a good design of self-learning support system should be the design with which learners can satisfy their learning needs and advance their learning in stages by repeating the four processes: (1) practice; (2) comparison (between the learner's self-video image and practiced nurses') and (3) peer review; and (4) self-reflection (reviewing the learner's self-practice by finding description).

The results of these evaluations reveal the necessity of a function by which users can receive self-training to acquire skills by actually trying and failing. Therefore we added "checkpoint learning" as a new function into the intelligent learning support e-learning system, in addition to "procedure checks", "image comparison study", "awareness input", and "output of learning results". This leads to making a proposal of an e-learning system model by which users can perform self-learning of nursing skills spirally along with intelligent learning support, technical learning support, and intelligent learning support.

5. Conclusion

In this study, we conducted step-by-step system development and formative evaluation to develop e-learning systems with which users can improve their nursing skills through self-training from aspects of knowledge and techniques. Furthermore, based on examination of the results, we will add “checkpoint learning” into the e-learning system to support intelligent learning, in addition to “procedure checks”, “image comparison study”, “awareness input”, and “output of learning results”, and proposed an e-learning system model with which users can learn nursing skills through self-learning. In future studies, we will examine the effectiveness of the e-learning system model.

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References

[1] Holland A, Smith F, McCrossan G, Adamson E, Watt S and Penny K. (2012). Online video in clinical skills education of oral medication administration for undergraduate student nurses: A mixed methods, prospective cohort study. *Nurse Education Today. 2012 Feb 16. In press*.

[2] Cardoso AF, Moreli L, Braga FT, Vasques CI, Santos CB and Carvalho EC. (2012). Effect of a video on developing skills in undergraduate nursing students for the management of totally implantable central venous access ports. *Nurse Education Today. 32(6) (pp.709-713).*

[3] Yukie M., Masato S. and Yasuko M. (2010). Development of an E-learning System to Support Self-learning of Nursing Skills, P*roceedings of the IADIS International Conference, WWW/INTERNET 2010 (pp. 400-402).*

[4] Yukie M., Masato S. and Yasuko M. (2010). Development of an E-learning System to Support Reflectional Nursing Skills Training, *Japan Journal of Medical Informatics Supplement, 30 (pp.256-259).* (in Japanese).

[5] Yukie M. and Yasuko M. (2009). Comparative Analysis of Vein Injection Skill Difference Between Skilled Nurses and Nursing Students: Focus to Radial Motion and Skill Procedures. *Proceedings of the 33rd Annual Conference of Japanese Society for Information and System in Education, JSiSE2008 (pp. 28-29).* (in Japanese)

[6] Yukie M., Masayuki S., Yasuko M. and Masato S. (2011). Evaluation of an E-learning System to Support Self-Learning of Nursing Skills, *Proceedings of the 19th International Conference on Computers in Education (pp.523-530).*