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Evaluation of An E-learning System to Support Self-Learning of Nursing Skills

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Abstract: Learning-support using video teaching materials is known to be effective in nursing education. In recent years, as video equipment or computer technology have advanced, learning systems providing nursing skill video images on the web have been investigated. However, because they are only shown the teaching materials, students cannot review their own skills using such materials. Therefore, we verify the effectiveness of reflective learning by comparison between the video of a nursing student's skill recorded while training and the video of skilled nurse's skill model, using the self-learning support system. We report the analysis of the nursing students' skill acquisition process was phased in their self-learning situation.

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

Introduction

In nursing education, it is necessary to acquire not only specialized knowledge but also appropriate nursing skills. Furthermore, because nursing evaluation is often judged by whether the nursing skill is good or not, learning support necessary for a nurse to become familiar with nursing skills is required. In recent years, although the study of learning support of the specialized knowledge using ICT in the field of education is well practiced, the study of the learning support system requiring skills (series of techniques related to physicality) has been underway.

Intravenous injection, which draws much attention among nursing skills, is a skill that is related to body invasiveness by inserting a needle and infusing medicine into a blood vessel. In recent years, after the change of new administrative interpretation to "intravenous injection conducted by a nurse is treated as the category of auxiliary action of medical treatment" in Japan (Health, Labour and Welfare Ministry, 2003), it has been noted that education related to intravenous injection must be improved (Japanese Nursing Association, 2003). Consequently, nursing students are now required to master the skills to administer intravenous injection safely. Nevertheless it has been found that "self-learning of intravenous injection" and "technical training in college" are less useful for skill acquisition of intravenous interjection of new nurses, presumably because many students do not feel that learning at college is useful in a field or because new nurses tend to be passive in skill acquisition. Moreover, "reviewing one's own failure" and "knowing one's own tendency by personal experience" are described as highly valued for skill acquisition. Therefore, it is regarded as important to encourage the support system to allow a nurse to review their own failures and know their own tendencies.

Consequently, the author holds that it is necessary to encourage students to think subjectively and find important points for themselves to improve the circumstances described above, including self-learning in skill education at college. Moreover, it is necessary to support their effective nursing skill acquisition. In this study, for supporting nursing skill acquisition for nursing students, we put forward the three-level skill-learning-support models of (1) practice, (2) comparison, and (3) reflection. Then we verified the models using intravenous injection skill as one example. Focusing attention on the difference in the thinking mode of "knack" of intravenous injection skill between nurses and nursing students, we developed a learning support system to allow nursing students, as beginners, to self-learn nursing skills. In this study, we verified that capability.

1. Present situation of nursing skill education

In conventional classes designed to teach nursing skills, first instructors explain the purpose, necessity, and procedures of nursing skills in lectures and then demonstrate them in technical seminars. Thereafter, nursing students gain skill training individually or in a group in a series of learning processes. In skill training, even if the students sometimes teach each other in a group, they often put questions directly to the instructor. In other words, they tend not to think well about their questions by themselves in many cases. There are not many teachers who can answer their questions sufficiently on the scene. Therefore, students might be unable to gain nursing skills sufficiently within college classes, given present conditions. Although some skills can be learned with knowledge that is prescribed in a manual, it is difficult to learn nursing skills, which include implicit knowledge, as physical knowledge, according to a manual. Knowledge acquired from experience or practice could be called experiential knowledge, or deep knowledge (meaning the expertise or special skills which proficient engineers or managers accumulate from their various experiences). For learners to obtain that kind of knowledge, they must acquire experience and reinforce that knowledge through additional learning including practice, observation, problem resolution, and experiments, especially under the guidance of instructors [1].

In the field of nursing education, the chances for learners to gain skills through on-the-job training (OJT) in the clinical training are offered. In the field of college education under the pressures of number of instructors or time, however, it is not easy to use the form of OJT for learning various skills. In addition, because nursing students have many skills to learn, it is difficult for them to take much time to master any one of them. Consequently, to support them in acquiring nursing skills, we shed light on what is an effective learning-support method and examine the skill-learning support model.

To produce a learning-support model, it is noteworthy that we must consider two kinds of cognition that are used by human beings: experimental cognition and reflective cognition [2]. The former includes reactive understanding of an overall situation without deep thinking and acting just then. The latter involves making decisions through consideration and comparison. Furthermore, it is noteworthy that learning with reflective cognition should be required at an early stage, suggesting that it is important for a learner to learn by careful independent reflection to promote more effective skill learning.

Moreover, new nurses learn practicing intravenous injections through first "following the instructors' model," "benefiting by their experience," and "repetitive practice" [3].

Additionally, in a traditional learning method, at first, it is common that the nursing student imitates the technique of the expert nurse [4]. In the another point of our previous study, we found that linguistic expressions differed among nurses in terms of the sensation of fingers that nurses recognize at perceiving blood vessels by touch or inserting an injection needle.

This suggests that formal knowledge by visualization would be better than that by verbalization to share and use know-how of nursing skills which cannot be verbalized [5]. For that reason, seeing video images from the viewpoint of skilled persons (nurses) and learning by following their model or by comparing one's own skills to theirs, a new nurse can promote reflective thinking, leading to the acquisition of effective skills.
Consequently, in this study, using the learning-support system [6] developed for comparison between the video of a nursing student's nursing skill recorded while training and the video of skilled nurse's skill model, we first verify the effectiveness of reflective learning of nursing students' skill acquisition by making a comparison between both video images.

2. General outline of the learning-support system

Learning-support using video teaching materials is known to be effective in nursing education. In recent years, as video equipment or computer technology have advanced, learning systems providing nursing skill video images on the web have been investigated. However, because they are only shown the teaching materials, students cannot review their own skills using such materials. Therefore, we verify the effectiveness of reflective learning by comparison of how nursing students acquire their skills, using the following learning-support system [6].
The developed e-learning system described assigns importance to handling images to enable visual learning. In addition, because many nursing students consider precise implementation of procedures as technical "knacks", the instructional design consists of the following four phases:
1) Identification of one's own technical procedures;
2) Comparison of model images with one's own technical images;
3) Comparison of each image in one's own practice progressions; and
4) Output and identification of learning results.
The system comprises four functions. In the following, we explain the functions sequentially.

2.1 Procedure-learning function

It enables nursing students to learn technical procedures. Nursing students understand that the knack of skills should be to conduct the procedures precisely, suggesting that learning methods allowing learners to remember the procedures among others are good for them. The illustration of Figure 1 below shows that this function is a type by which a user can confirm procedures by checking a radio button.

2.2 Image-comparing function

This is a function by which a user can play two video images simultaneously or alternately to compare them (Figure 2). If the learners use this function, then they are helped by comparison to experience and think about the difference of time between that required by a skilled nurse and by themselves.

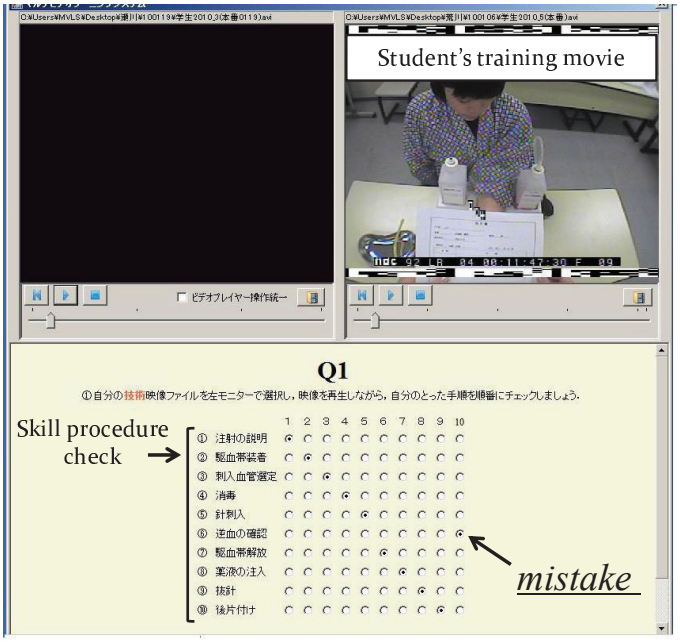

Figure 1. The screen of technical procedures check

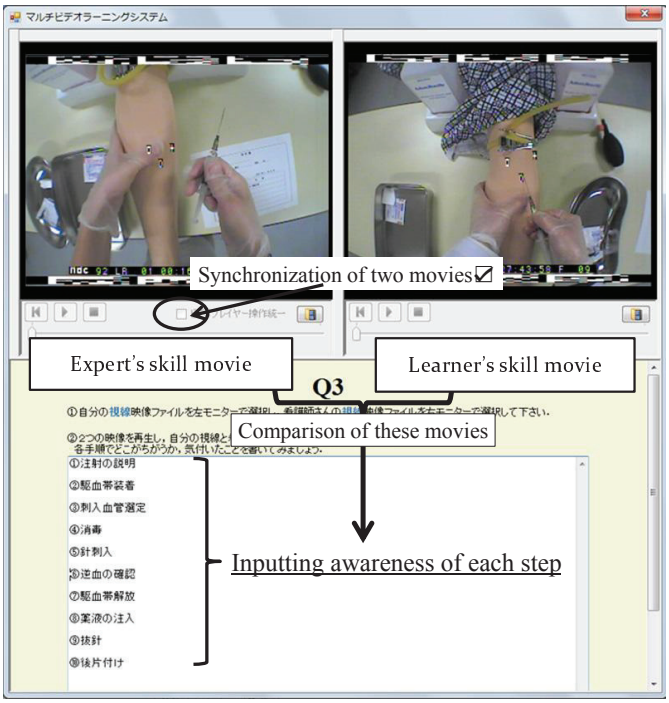

Figure 2. The screen of comparing images and inputting awareness

2.3 *Text-entry function*

With this function, nursing students can enter text through answering questions (see the lower illustration in Figure 2). Learners can think by themselves through comparison and freely describe what they have found. It helps learners to promote their reflection and think by writing using the system. The questions are set so that learners can make a comparison in every procedure of intravenous injection.

2.4 Text-output function

With it, users output the procedures that they have input by themselves or describe what they have found. It is also used as a portfolio of the process of skill acquisition, by which the learners can be conscious of their own findings and advance their own learning.

3. Research method

3.1 Experimental method

To verify reflective learning by video comparison on nursing students' skill acquisition, the experiment was conducted using the system described above. The experimental procedures are shown as follows. The experiment was conducted in January 2010.

1) A student wears a camera and conducts intravenous injection according to the simulation model of intravenous injection (Fig. 3), shooting a video (video A before training) from his perspective. The video images are portrayed in Figure 4.
2) After the student conducts training, the student shoots a video (video B after training).
3) Using the system, the student confirms the procedure and then describes findings after comparing video A (taken personally before training) with a skilled nurse's model.
4) Using each function of the system, the students confirm the procedure, comparing their own video images before and after training (video A and B) and theirs after training (video B) with the skilled nurse's video. Then they input their own findings.
5) Finally, they conduct intravenous injection again to shoot a video (video C after learning by the learning-support system).

Figure 3. An experimental picture

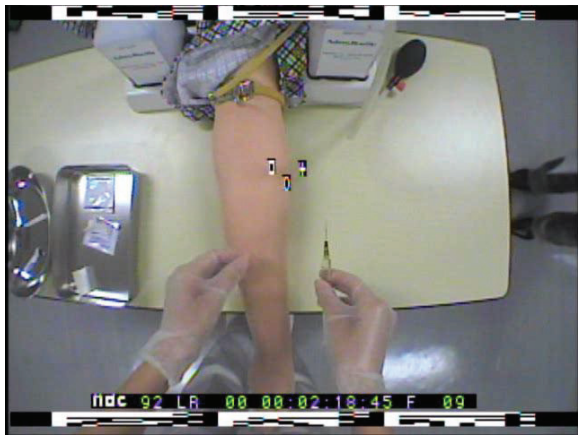

Figure 4. A nursing skill image

3.2 Subjects

The experimental subjects are five senior students who received credit in nursing technique training, including intravenous injection skills, and whose consent to participate in this experiment has been obtained.

4. Results

We analyzed (1) the procedure video shot by the nursing students, (2) the confirmation of whether they succeeded in inserting the needle into a vein precisely, and (3) the content of the interview which we conducted with them. The obtained results are presented as follows.

4.1 Procedures conducted by the nursing students

The numbers of students who made mistakes in the intravenous injection skills are shown in Table 1. The column of items in Table 1 represents the precise procedures used to conduct intravenous injection. The numbers in Table 1 presents the numbers of students who made mistakes while conducting respective procedures (say, skipped it or conducted in reverse order). The result of each situation is explained step-by-step in the following:

1) Before self-training
   Before the students conducted self-training, many procedural mistakes were found overall.
2) After self-training
   Taken altogether, the numbers of mistakes even after training were not so different from those before training.
3) After experiencing the self-learning support system developed
   After comparing video images and learning by the self-learning support system that we have developed, no students exhibited mistakes overall from explanation of injection in procedure (1) to cleanup in procedure (10).

Table 1: Number of nursing students who made mistakes during procedures

proc.	items	before skill training	after skill training	after learning support system
(1)	**explanation of injection**	1	1	0
(2)	**wearing tourniquet**	0	1	0
(3)	**selection of a vein to insert a needle**	1	2	0
(4)	**sterilization**	1	1	0
(5)	**insert of a needle**	0	0	0
(6)	**check of reversed blood**	0	0	0
(7)	**undoing tourniquet**	3	2	0
(8)	**infusion of medical solution**	3	2	0
(9)	**removal of a needle**	2	1	0
(10)	**cleanup**	0	0	0

4.2 Check whether the needle is precisely inserted into a vein

The students who were confirmed to have succeeded in inserting a needle into a vein precisely were 0 before training, 4 after training, and 5 after comparing video images using the learning-support system.

4.3 Content of the interview which we conducted on the subjects

Regarding the question of what were the key points of intravenous injection skills or what they were careful of while conducting it, all five participants answered, "to confirm the procedure" before training. In contrast, after the video comparison, all participants described not only the procedure but also the content about "selection of blood vessel and support to a patient." Regarding the question as to what they found when comparing their own video and a skilled nurse's, we obtained the comment "I was able to find my mistake clearly. I understood the process of procedures. I was able to see my video objectively." Regarding the comparison between self-videos before and after training, a student answered, "There was almost no change. I know well on what points I failed, even if I tried after self-training. I can understand what I did not do well."
Asked whether they feel their skill was improved through comparing video images, all five participants answered that they think so. In addition to the question about whether they want to learn in the future, we obtained the request "I'd like to use the system that I used this time. After practicing the intravenous injection skill, I'd like to learn from listening to the opinions of the professor and my friends; I want concrete advice from them."

5. Discussion

Regarding procedures, results show almost no improvement after self-training. In contrast, after learning by comparison of the self-video and the model video produced by a skilled nurse, improvement was shown by all participants. They became able to do intravenous injection precisely according to the procedure. It might be that seeing the self-video and then comparing it and the nurse's encouraged participants to have a clear image of the whole process of procedure and to understand it better. Regarding confirmation of whether they succeeded in inserting a needle into a vein precisely, after self-training, four participants were able to do it but they did not improve their procedures. After comparing the video images, however, all five participants succeeded in inserting a needle into a vein according to the precise procedure, suggesting that their skills of intravenous injection were improved. Results of interviews of participants as to what they kept in mind while doing intravenous injection revealed an important change: they have become conscious not only of procedures but also more practical and concrete contents (how to select a blood vessel or support for patients). That might be true because the learners were able to learn by seeing their own skill objectively and by being mindful of their own mistakes or what they had failed by describing their findings and recognizing it formally through video comparison. In other words, video comparisons and finding descriptions, which promoted the nursing students' reflective learning, were found to be effective for skill acquisition support in intravenous injection.
From the explanation presented above, even if self-training exerts some effect on improvement of the skill of "inserting a needle into a vein precisely," it was found to be less effective for improvement of procedures. Furthermore, learning through video comparison had effects not only on knowledge-level improvement such as procedures but also on skill-level improvements such as "selection of a blood vessel and support for patients." Therefore, results suggest that conventional learning using only training can only insufficiently facilitate learners to acquire the procedures of intravenous injection and more practical skills.
Moreover, based on results of the interview after comparing video images, we came to learn that the participants want to know peer nursing students' opinions and thoughts. They examined themselves through video comparison and their questions therefore became

clarified. Consequently, they might have come to know of other people's opinions and learned about them more deeply. Furthermore, they might have come to want to know about their friends with skills of the same level as their own.

6. Conclusion

Results of this study confirmed that conducting a "procedure check, video comparison, and finding description" using the system enabled nursing students to obtain new findings and that it has effects on improvement of intravenous injection skill acquisition. Future tasks are to investigate the effectiveness of the system on more nursing students, evaluate the efficiency of the system in skills other than the intravenous injection, and to facilitate skill learning support for nurses using the system. From these experimentally obtained results, we also know that the nursing students who examined themselves by comparing video images have come to accept better listening to people around them. That is true probably because learners who were more conscious of their questions through introspection, might have wanted to know others' opinion and learn the subject more deeply. Therefore, we must investigate whether it is necessary that learners should share in others' findings after they obtain experience and findings through comparison and subsequent reflection.

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