

## The results of using the arm model for nursing practices in blood drawing, intravenous injection and transfusion

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### Abstract

The purposes of this research were to 1) develop the arm model for nursing practices in blood drawing, intravenous injection and transfusion to reach the Efficiency of process (E1) and Efficiency of product to be equal to 80 and 80, respectively ( $E1/E2 = 80/80$ ), 2) compare performance achievement of aforementioned nursing practices between two groups of the students who studied the three nursing skills using the model which was constructed by the researcher and also with another one purchased from abroad and 3) compare the students' satisfaction towards these models. The 60 subjects recruited by selective matching, were the second year nursing students of Boromrajajonani College of Nursing, Ratchaburi who registered in the subject of Principles and Techniques in Nursing in the first semester, the academic year, 2016. The research instruments are consisted of 1) the arm model for nursing practices in blood drawing, intravenous injection and transfusion, 2) the performance assessment form of blood drawing, intravenous injection and transfusion and 3) the questionnaire of the satisfaction of the students towards the model uses. The constructed model was tried out with the students who were not the study subjects to develop the efficiency towards identified standard criteria. The experimental group studied with the model constructed by the researcher, whereas the control group studied with another one purchased from abroad. The data was then analyzed to find percentage, mean, standard deviation and t-test.

The research findings revealed that 1) the efficiency level of the model constructed by the researcher was higher than identified standard criteria ( $E1/E2 = 92.61/96.95$ ), 2) the average score on performance achievement of the experimental group was statistically significantly higher than that of the control group at 0.001 level and 3) the average score on satisfaction of the experimental group was statistically significantly higher than that of the control group at 0.001 level. These findings concluded that the constructed model can be used effectively as a media in nursing practice, it helps decrease cost for purchasing import model. However, the model should be developed to reach more efficiency such as producing the instruments to fix an arm model during practice, creating more vessels that were designed in various shapes and sizes both obvious and unobvious seen or selecting other materials for cost reduction.

**Keywords:** arm model, blood drawing, intravenous injection, transfusion

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### 1. Introduction

Education in nursing is the profession which is directly practiced with people's health and life that inevitably emphasizes the ability in self-learning in both theory and practicum. There should be accordance between practices in nursing laboratory and real situations to enable the students to apply knowledge to efficient and safe practice for clients [1]. Nursing skills are one of the aspects of practice environment that have been empirically linked to improve patients' outcomes and make them feel safe. Patients who perceived that staff who lacked of experience and inability to convey their competence to patient contributed them to feel unsafe [2].

Principle and Techniques in Nursing is one of the professional subjects in nursing curriculum, under the jurisdiction of Praboromrajchanok Institute, the

Ministry of Public Health. This subject aims at studying nursing principle and techniques concerning holistic care of the persons in every lifetime with normal and deviate health based on caring with humanized care, moral and human rights [3]. It composes of 2 and 1 credit of theory and experiment part, respectively. The students have to practice nursing skills such as blood drawing, intravenous injection and transfusion that are complex skills, the students have to stab the needle through the skin layer into blood venous which is inserted in the superficial veins that cannot obviously see the position from outside. Moreover, the students have higher risk of contact with blood, as for the study of practical incident of blood and secretion exposure at Bamrasnaradoon hospital, there were 72.40% of sharp injury incidents that mostly occurred with nurses (43.10%), during intravenous injection

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(22.20%), blood drawing and placing sheath over the needle (21.30%) [4]. Although, practicing with patients in real situations is a concrete learning experience, but there might be mistakes that endanger the patients which has some effect on body and mind of students as well. It is one of constraints in real practice, that related with the cone of experience principle (Edgar Dale) [5], notified that contrived experience comes from the learning that is resembled to the real situations which may be the simulation or model that the students have to practice repeatedly to induce skillful and experience to be the basis of practice with patients. John Dewey believed that knowledge comes from experiences, because during practice, problems tend to occur which can induce the students to have new learning and try to solve problems repeatedly which can make them skillful and confident [6]. Therefore, the model may diminish not only the risk for students, but also enhance the best care for the patients. Hence, the model use is an appropriate tool for training before real practice.

The model is the three dimension material composed of width, length and depth that constructed to imitate real things, it could help the students practice more easily and conveniently. Thus, the model has an important role to be used as educational media. It can urge attention, emphasizes system relation, represents real object that makes it easy to tangible understanding, be meaningful, be useful for a long period of time, and helps the students to reach the learning outcomes.

Presently, the models used for nursing practices in blood drawing, intravenous injection and transfusion are very expensive because they have to be imported from abroad with high cost, the price of the model without circulation pump set is about 30,000 Baht, whereas the model with circulation pump set is about 100,000 Baht. Therefore, they cannot be bought in large quantities which can result in the overall lack of practice of all the students which will affect them in real situations. Additionally, due to the opinions of the teachers, some models purchased from abroad cannot provide all needs of uses. Thus, to decrease the cost and obstacles in learning process, the researcher, as the role of the nursing instructor, Boromrajonani College of Nursing, Ratchaburi, under the jurisdiction of Praboromrajchanok Institute, interests in producing the arm model for nursing practices in blood drawing, intravenous injection and transfusion by applying the materials that are easily available, cheap and can be applied for actual uses for efficiency enhancement in self-learning of students.

## 2. Research objectives

2.1 To develop the efficiency of the arm model used for nursing practices in blood drawing, intravenous injection and transfusion, to reach the Efficiency of process (E1) and Efficiency of product (E2) to be equal to 80 and 80, respectively ( $E1/E2 = 80/80$ ).

2.2 To compare the performance achievement between two groups of students who studied with the

two different models, the constructed model by the researcher and another one purchased from abroad.

2.3 To compare the students' satisfaction between two groups of the students who studied with the models constructed by the researcher and another one purchased from abroad.

## 3. Methods

### 3.1 Population and samples

3.1.1 Population was 73 second year-class room 2 nursing students of Boromrajonani College of Nursing, Ratchaburi who registered in the subject of Principles and Techniques in Nursing in the first semester, the academic year 2016.

3.1.2 Samples were 60 second year-class room 2 nursing students of Boromrajonani College of Nursing, Ratchaburi who registered in the subject of Principles and Techniques in Nursing in the first semester, the academic year 2016, recruited by sampled matching by using learning competency scoring system (grade point average) and then equally divided into the experimental group and the control group.

### 3.2 Research instruments

The research instruments consisted of 1) the arm model for nursing practices in blood drawing, intravenous injection and transfusion, 2) the performance assessment forms of blood drawing, intravenous injection and transfusion and 3) the questionnaire of the satisfaction towards the model uses and 4) the quality assessment form assessed by the experts. The details of these instruments were notified as follows:

3.2.1 The arm model for nursing practices in blood drawing, intravenous injection and transfusion, its size resembled the real arm that showed the important 3 vessels; cephalic vein, basilic vein and median cubital vein that are able to connect with circulation pump set. Those steps in the model construction were as follows:

1) Studying the structures, characters and circulation of superficial vein including the process of producing model.

2) Designing the model to be used as the real arm.

3) Operating the model production, there were 6 steps as follows:

The first step: producing the arm model with silicone rubbers that composed of 2 parts, the first part was made to be the plate of the outer sheath that resembled to the skin layer and the second part was the plate of the inner sheath that resembled to the subcutaneous tissue, in this part, the grooves were made to put down the rubber tube to become the vein of model.

The second step: producing the model plate with the resin, then, the model was painted with the resin, wait for it to get dry and then peeled off, we have the model templates of two parts.

The third step: casting the two parts of the model with soft silicone rubber by pouring silicone

into the plate, after it was dried, pull out the rubber from the template, we have two sheathes of the model.

The fourth step: assembling the model by taking the rubber tube and lay it down on the grooves in the inner sheath, then, covers the inner sheath with the outer one.

The fifth step: producing the arm axis by pouring the resin into the assemble sheath, Then, tumbling the model to make the resin spread all over the model to make the shape of the arm to be stable.

The sixth step: producing the blood tank with circulation pump set by applying reserve tank for washing mirror of the car to be the blood pressure controller and use the inverter for apply with electrical AC 220 volts including creating the resin box that connected the blood tank to imitate veins.

The quality of the model was tested through the quality assessment form by 5 experts who have the experiences in ward practice for at least 10 years, the quality was at good level ( $\bar{X} = 4.17$ , S.D. = 0.80), after adjusted accordingly by the suggestion of experts, the model was tried out and improved again and again until reaching the efficiency criterion of process and efficiency criterion of the product [7] as followings:

Efficiency of process (E1) is defined as the percentage of means assessed from practice during the study.

Efficiency of product (E2) is defined as the percentage of means assessed from practice after finishing the study.

As for this study, the researcher notified the efficiency criterion of process and efficiency criterion of the product were 80 and 80, respectively (E1/E2 = 80/80).

The model was tried out by the 31 second year-class room 1 nursing students of Boromrajonani College of Nursing, Ratchaburi who registered in the subject of Principles and Techniques in Nursing in the first semester, the academic year 2016, recruited by simple random sampling. These students were not the research subjects and had no experiences in those skills through 3 steps of experiment; individual, small group and field experiment [8].

- As for the individual, 3 subjects were recruited by simple random sampling, the teacher demonstrated the skills through the arm model, after that the subjects demonstrated the 3 skills in return and the researcher rechecked and sought the weakness of model by observing and interviewing the students and then adjusted it before trying it with the small group.

- As for the small group, 8 subjects were recruited by simple random sampling, at first, the teacher demonstrated each skill by using the model as a media, then the students tried themselves. The teacher tested the students during practice to assess efficiency of process (E1). After the students completely practiced all skills, the teacher tested the students during practice to assess efficiency of

product (E2). The result of E1/E2 was 79.48/91.75 that was lower than the notified criteria. Afterwards, the researcher collected the data from performance and then adjusted the model upon the suggestions before trying it out in the field experiment.

- As for the field experiment, 20 subjects were recruited by simple random sampling and the process was operated as similar as individual experimentation. The result of E1/E2 was 92.61/96.95 that was higher than the notified criteria. The weakness of model was found out to be adjusted before real uses.

3.2.2 The performance assessment forms of blood drawing, intravenous injection and transfusion, were the observation instruments created by the researcher and evaluated by the teachers. The first form composed of the 20 item-assessment form for blood drawing (60 points), the 15 item-assessment form for intravenous injection (45 points) and the 18 item-assessment form for intravenous transfusion (54 points) which have 3 level rating scales as follows:

Good defined as correctly performed by oneself (3 points).

Medium defined as correctly performed after receiving suggestion (2 points).

Improved defined as incorrectly performed after receiving suggestion (1 point).

The content validity was tested by 3 experts to verify the language clarification and accuracy of practice in each skill. The reliability tested by interrater correlation, the reliability of 3 assessment forms was 0.71, 0.80 and 0.77, respectively, which has shown high level of relation [9].

3.2.3 The questionnaire of the satisfaction towards the model uses was constructed by the researcher from related literature review, there were 20 items divided as 15 items of application aspect and 5 items of media designation aspect, the interpreting of 5 level rating scale revealed as follows:

The mean score 4.51 - 5.00 defined as very good level of satisfaction.

The mean score 3.51 - 4.50 defined as good level of satisfaction.

The mean score 2.51 - 3.50 defined as medium level of satisfaction.

The mean score 1.51 - 2.50 defined as poor level of satisfaction.

The mean score 1.00 - 1.50 defined as very poor level of satisfaction.

The content validity was tested by 3 experts to verify the language clarification and content accuracy, improved toward the suggestion before trying out. The reliability tested by Cronbach's alpha coefficient was 0.90.

3.2.4 The quality of model assessment form, 5 level rating scale, constructed by the researcher from related literature review, there were 20 items divided as 13 items of application aspect and 7 items of media designation aspect, the interpreting of 5 level rating scale revealed as follows:

**Table 1** The steps of experiment among the experimental group and the control group

| The experimental group                                                                                                                                                                                                                           | The control group                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. The students studied nursing practices in blood drawing, intravenous injection and transfusion with the teacher who is responsible on that topic by demonstrating the skills through the constructed model, taking 10 minutes per each skill. | 1. The students studied nursing practices in blood drawing, intravenous injection and transfusion with the teacher who is responsible on that topic by demonstrating the skills through the purchased model, taking 10 minutes per each skill.                    |
| 2. The students individually self-practiced in blood drawing, intravenous injection and transfusion using the constructed model, especially repeatedly in the step of stabbing needle, taking 15 minutes per each skill.                         | 2. The students individually self-practiced in blood drawing, intravenous injection and transfusion using the arm model purchased from abroad, repeatedly in the step of stabbing needle into the vein until having confidence, taking 15 minutes per each skill. |
| 3. The instructor evaluated the students' practices after finishing self-practiced in each skill using the constructed model, taking 10 minutes per each skill.                                                                                  | 3. The instructor evaluated the students' practices after finishing self-practiced in each skill using the arm model purchased from abroad, taking 10 minutes per each skill.                                                                                     |

The mean score 4.51 - 5.00 defined as very good level of quality.

The mean score 3.51 - 4.50 defined as good level of quality.

The mean score 2.51 - 3.50 defined as medium level of quality.

The mean score 1.51 - 2.50 defined as poor level of quality.

The mean score 1.00 - 1.50 defined as level that should be improved.

The content validity was tested by 3 experts to verify the language clarification and accuracy of practice in each skill. The reliability tested by Cronbach's alpha coefficient was 0.91.

### 3.3 The steps of research

The researcher took the arm model that reached the efficiency according to E1/E2 standard criteria to try with the 60 subjects who had no experiences in blood drawing, intravenous injection and transfusion by simple random sampling and equally divided into the experimental group and the control group ( $n = 30$ ), using randomized controlled-group posttest-only design [10], and then operated as Table 1.

The students' satisfaction on the arm model uses were then evaluated after finishing all practices approached by the questionnaire of students' satisfaction including additional suggestions.

### 3.4 Data collection

The model was tried out and improved the weakness until reaching the efficiency towards standard criteria. Afterwards, it was used with the 60 subjects who were equally divided into 2 groups; the experimental group that studied with the model constructed by the researcher and the control group that studied with the arm model purchased from abroad. The students' satisfaction on the arm model uses were then taken into consideration after finishing studies approached by the questionnaire of students' satisfaction including additional suggestions.

### 3.5 Data analysis

The Efficiency of process (E1) and Efficiency of product (E2) were analyzed for finding the percentage of mean score assessed from practical test, analyzing comparison of performance achievement and analyzing the students' satisfaction on the model between the experimental group that studied with the model constructed by the researcher and the control group that studied with the arm model purchased from abroad by using independent t-test.

### 4. Research findings

The study results were concluded in 3 parts as follows:

#### Part 1 The development of the arm model used for nursing practices in blood drawing, intravenous injection and transfusion to reach the efficiency towards standard criteria

The model improved towards the suggestion of 5 nursing experts was tried out with the 31 second year-class room 1 students who were not the subjects but registered in the subjects of Principle and Techniques in Nursing, the academic year 2016, recruited by simple random sampling.

The experiment was divided into 3 steps as follows:

1) As for the individuals (3 subjects), this step was approached by observation and interview to be the guideline for improvement. The results were found out to be the weakness of model in the weight that was too light which was easily movable during practice, the thin skin induced was easily torn, plaster sticking cannot be adhered to the skin of model well, the circulation blood pump had too low level of blood pressure, the veins were fixed with skin, hence, the defective part could not be changed, although only one part was leaked.

2) As for the small group, after adjusting the arm model upon the suggestion taken from the experiment in the individuals, then was tested for the efficiency in the small group ( $n = 8$ ) approached by the

**Table 2** The efficiency of the arm model for nursing practices in blood drawing, intravenous injection and transfusion in the small group (n = 8)

| Skills                     | During study evaluation |           |      |        | After study evaluation |           |      |        |
|----------------------------|-------------------------|-----------|------|--------|------------------------|-----------|------|--------|
|                            | full marks              | $\bar{X}$ | S.D. | % (E1) | full marks             | $\bar{X}$ | S.D. | % (E2) |
| 1. blood drawing           | 60                      | 45.75     | 4.33 | 76.25  | 60                     | 56.38     | 1.60 | 93.96  |
| 2. intravenous injection   | 45                      | 38.25     | 2.66 | 85.00  | 45                     | 40.75     | 2.25 | 90.56  |
| 3. intravenous transfusion | 54                      | 42.38     | 2.39 | 78.48  | 54                     | 48.75     | 2.05 | 90.28  |
| Total                      | 159                     | 126.38    | 5.48 | 79.48  | 159                    | 145.88    | 2.17 | 91.75  |

**Table 3** The efficiency of the arm model for nursing practices in blood drawing, intravenous injection and transfusion of the field experiment (n = 20)

| Skills                     | During study evaluation |           |      |        | After study evaluation |           |      |        |
|----------------------------|-------------------------|-----------|------|--------|------------------------|-----------|------|--------|
|                            | full marks              | $\bar{X}$ | S.D. | % (E1) | full marks             | $\bar{X}$ | S.D. | % (E2) |
| 1. blood drawing           | 60                      | 53.30     | 1.90 | 88.83  | 60                     | 58.10     | 1.62 | 96.83  |
| 2. intravenous injection   | 45                      | 42.90     | 1.07 | 95.33  | 45                     | 43.80     | 1.51 | 97.33  |
| 3. intravenous transfusion | 54                      | 51.05     | 1.85 | 94.54  | 54                     | 52.25     | 1.33 | 96.76  |
| Total                      | 159                     | 147.25    | 2.10 | 92.61  | 159                    | 154.15    | 2.32 | 96.95  |

**Table 4** The comparison of means on nursing practices in blood drawing, intravenous injection and transfusion between the experimental group (n = 30) and the control group (n = 30)

| Skills                     | full marks | $\bar{X}$              |                   | S.D.                   |                   | t    | p-value |
|----------------------------|------------|------------------------|-------------------|------------------------|-------------------|------|---------|
|                            |            | The experimental group | The control group | The experimental group | The control group |      |         |
| 1. blood drawing           | 65         | 55.33                  | 49.10             | 3.88                   | 3.10              | 6.87 | 0.000   |
| 2. intravenous injection   | 45         | 43.37                  | 42.30             | 1.03                   | 1.80              | 2.81 | 0.007   |
| 3. intravenous transfusion | 54         | 51.50                  | 49.93             | 1.43                   | 2.60              | 2.89 | 0.005   |
| Total                      | 159        | 150.20                 | 141.33            | 5.24                   | 5.36              | 6.48 | 0.000   |

assessment form of nursing performance, it was found that the total efficiency of the model (E1/E2) was 79.48/91.75 which was lower than the 80/80 standard criteria, when considered each aspect, the efficiency of blood drawing was 76.25/93.96, lower than standard criteria, intravenous injection was 85.00/90.56, higher than standard criteria and intravenous transfusion was 78.48/90.28, lower than standard criteria (Table 2).

There were the results from observation and interview that needed to be improved such as the vein that easily is movable when stabbing a needle by students, induced difficulty in sticking the needle into the vein, plaster sticking could not be adhered to the skin of model well, when drawing blood in closed system, the blood pressure in the vein was too high which made more blood volume flew into the syringe.

3) The field experiment, after adjusting the arm model upon the suggestion which was taken from the experiment in the small group, then was tested for the efficiency in the field experiment, it was found that the total efficiency of the model (E1/E2) was 92.61/96.95, when considered each aspect, the efficiency of blood drawing, intravenous injection and transfusion were 88.83/96.83, 95.33/97.33 and 94.54/96.76, respectively which were higher than identified standard criteria (Table 3).

There were the results from observation and interview such as plaster sticking which couldn't be adhered to the skin of model, however, as overview,

the model could be used for nursing practice as similar as real arm. The model was improved again before real use.

#### **Part 2 An analysis of comparing the performance achievement of nursing practices in blood drawing, intravenous injection and transfusion between the experimental group and the control group**

The researcher collected data from the samples, the experimental group that studied with the model constructed by the researcher and the control group that studied with the arm model purchased from abroad. Then the students' performances were evaluated after finishing studying. The total mean score on performance achievement of the experimental group ( $\bar{X}$  = 150.20, S.D. = 5.24) was statistically significantly higher than that of the control group ( $\bar{X}$  = 141.33, S.D. = 5.36) at the 0.001 level. In this regards, the total mean score on each skill was statistically significantly higher than that of the control group at the level of 0.001, 0.05 and 0.01, respectively (Table 4).

#### **Part 3 An analysis of comparing the satisfaction on the arm model used for nursing practices in blood drawing, intravenous injection and transfusion between the experimental group and the control group**

1) The satisfaction of the students on the arm model constructed by the researcher was at very good level ( $\bar{X}$  = 4.64, S.D. = 0.53), the three first ranks of

**Table 5** Mean, standard deviation and the satisfaction level of the experimental group towards the arm model constructed by the researcher (n = 30)

| Orders | Items                                                                              | $\bar{X}$   | S.D.        | The satisfaction level |
|--------|------------------------------------------------------------------------------------|-------------|-------------|------------------------|
|        | <b>Application</b>                                                                 | <b>4.66</b> | <b>0.53</b> | <b>Very good</b>       |
| 1      | Can find the position of veins                                                     | 4.57        | 0.50        | Very good              |
| 2      | Practice in binding the rubber band above the position that needle will be stabbed | 4.67        | 0.48        | Very good              |
| 3      | Practice in needle stab into vein                                                  | 4.57        | 0.57        | Very good              |
| 4      | Blood returned when needle stabbed into vein                                       | 4.43        | 0.63        | Good                   |
| 5      | Practice in collecting blood specimen by opened system                             | 4.67        | 0.48        | Very good              |
| 6      | Practice in collecting blood specimen by closed system                             | 4.60        | 0.62        | Very good              |
| 7      | Practice in drug injection into vein                                               | 4.67        | 0.61        | Very good              |
| 8      | Practice in intravenous transfusion                                                | 4.73        | 0.52        | Very good              |
| 9      | Practice in adjusting drop of intravenous fluid according to the plan of treatment | 4.60        | 0.56        | Very good              |
| 10     | Fix the needle on the skin with plaster                                            | 4.37        | 0.52        | Good                   |
| 11     | Promote the skill in blood drawing                                                 | 4.80        | 0.41        | Very good              |
| 12     | Promote the skill in intravenous injection                                         | 4.83        | 0.38        | Very good              |
| 13     | Promote the skill in intravenous transfusion                                       | 4.77        | 0.43        | Very good              |
| 14     | Satisfy practice with the model                                                    | 4.77        | 0.43        | Very good              |
| 15     | Take advantage from the model use                                                  | 4.83        | 0.83        | Very good              |
|        | <b>Designation</b>                                                                 | <b>4.59</b> | <b>0.53</b> | <b>Very good</b>       |
| 16     | Shape and size of the model is appropriate                                         | 4.57        | 0.50        | Very good              |
| 17     | Weight of the model is appropriate                                                 | 4.53        | 0.57        | Very good              |
| 18     | the model is convenient to use                                                     | 4.63        | 0.56        | Very good              |
| 19     | The model is interesting                                                           | 4.53        | 0.57        | Very good              |
| 20     | The model induced learning motivation                                              | 4.70        | 0.47        | Very good              |
|        | Total                                                                              | 4.64        | 0.53        | Very good              |

the highest score were the items as follows; promote the skill in intravenous injection ( $\bar{X} = 4.83$ , S.D. = 0.38), take advantage from the model use ( $\bar{X} = 4.83$ , S.D. = 0.38) and promote the skill in blood drawing ( $\bar{X} = 4.80$ , S.D. = 0.41). Whereas, the three first ranks of the lowest score were the following items; fix the needle on the skin with plaster ( $\bar{X} = 4.37$ , S.D. = 0.72), blood returned when needle stabbed into vein ( $\bar{X} = 4.43$ , S.D. = 0.63), weight of the model is appropriate and interesting ( $\bar{X} = 3.87$ , S.D. = 0.73) (Table 5).

2) The satisfaction of the students on the arm model purchased from abroad was at good level ( $\bar{X} = 4.31$ , S.D. = 0.75), the three first ranks of the highest score were the following items; promote the skill in intravenous injection and take advantage from the model use ( $\bar{X} = 4.70$ , S.D. = 0.60), practice in drug injection into vein and promote the skill in blood drawing (Table 6).

3) The comparison of means on the satisfaction of the arm model between the experimental group that used the model constructed by the researcher and the control group that used the model purchased from abroad, it was found that, the total mean score on the satisfaction of the experimental group was statistically significantly higher than that of the control group at the 0.001 level (Table 7).

## 5. Discussion

5.1 The development of the arm model for nursing practices in blood drawing, intravenous injection and transfusion to reach the Efficiency of process (E1) and Efficiency of product (E2) to be equal to 80 and 80, respectively (E1/E2 = 80/80).

As for the result of model development, its total efficiency (E1/E2) was 92.61/96.95, when considered each skill; blood drawing, intravenous injection and transfusion were 88.83/96.83, 95.33/97.33 and 94.54/96.76, respectively which were higher than the 80/80 standard criteria. It was shown that the constructed model was an efficient learning media that completed with evident structures and details that induced more attention. In this regards, this model was assessed by the experts and adjusted along with their suggestions to enable more quality before using. Additionally, there was a process to verify and improve the weakness and it was passed through three steps of experiment; individuals, small group and field experiment. After each step of experiment, the researcher adjusted the model due to the suggestions and the data observed during practice to enable better quality and completion that related with the study of the previous researcher Chaiyong Phromwongse [7], and that the efficiency was tested step by step to help the teacher

**Table 6** Mean, standard deviation and the satisfaction level of the control group towards the arm model purchased from abroad (n = 30)

| Orders | Items                                                                              | $\bar{X}$   | S.D.        | The satisfaction level |
|--------|------------------------------------------------------------------------------------|-------------|-------------|------------------------|
|        | <b>Application</b>                                                                 | <b>4.36</b> | <b>0.73</b> | <b>Good</b>            |
| 1      | Can find the position of vein                                                      | 4.17        | 0.70        | Good                   |
| 2      | Practice in binding the rubber band above the position that needle will be stabbed | 4.37        | 0.67        | Good                   |
| 3      | Practice in needle stab into vein                                                  | 4.37        | 0.63        | Good                   |
| 4      | Blood returned when stab a needle into vein                                        | 4.43        | 0.90        | Good                   |
| 5      | Practice in collecting blood specimen by opened system                             | 3.53        | 0.62        | Good                   |
| 6      | Practice in collecting blood specimen by closed system                             | 4.40        | 0.72        | Good                   |
| 7      | Practice in drug Injection into vessel                                             | 4.37        | 0.56        | Very good              |
| 8      | Practice in intravenous transfusion                                                | 4.63        | 0.57        | Good                   |
| 9      | Practice in adjusting drop of intravenous fluid according to the plan of treatment | 4.10        | 0.80        | Good                   |
| 10     | Fix the needle on the skin with plaster                                            | 4.03        | 0.89        | Good                   |
| 11     | Promote the skill in blood drawing                                                 | 4.63        | 0.56        | Very good              |
| 12     | Promote the skill in intravenous injection                                         | 4.70        | 0.60        | Very good              |
| 13     | Promote the skill in intravenous transfusion                                       | 4.57        | 0.68        | Very good              |
| 14     | Satisfy practice with the model                                                    | 4.40        | 0.67        | Good                   |
| 15     | Take advantage from the model use                                                  | 4.70        | 0.60        | Very good              |
|        | <b>Designation</b>                                                                 | <b>4.15</b> | <b>0.79</b> | <b>Good</b>            |
| 16     | Shape and size of the model is appropriate                                         | 3.87        | 0.73        | Good                   |
| 17     | Wight of the model is appropriate                                                  | 3.83        | 0.79        | Good                   |
| 18     | the model is convenient to use                                                     | 4.03        | 0.81        | Good                   |
| 19     | The model is interesting                                                           | 4.47        | 0.68        | Good                   |
| 20     | The model induced learning motivation                                              | 4.53        | 0.68        | Very good              |
|        | Total                                                                              | 4.31        | 0.75        | Good                   |

**Table 7** The comparison of means on the satisfaction of the arm model between the experimental group (n = 30) and the control group (n = 30)

| Samples                                                        | $\bar{X}$ | S.D. | t     | p-value |
|----------------------------------------------------------------|-----------|------|-------|---------|
| The group used the constructed model (experimental group)      | 4.64      | 0.53 | 3.337 | 0.00    |
| The group used the model purchased from aboard (control group) | 4.31      | 0.75 |       |         |

receive the learning media which enhanced worthy teaching along with the standard criteria. Moreover, it related with the study of another researcher Chalongchai Surawatanaboon [11], which stated that “In producing media, punctilious and careful operation based on academic principle in the three procedures such as planning, operating and evaluating should be concerned to reassure the effectiveness and efficiency of applying media in teaching and learning process”.

5.2 As for the comparison of performance achievement in three skills between the experimental group and the control group, the total mean score of the experimental group was statistically significantly higher than that of the control group at the 0.001 level. Because of the qualification of media that the details were as similar as the real arm, realized applicable, the vessel was easy to see and stab the needle through skin into vessel in subcutaneous tissue, showed blood returned into syringe and fluid really flowed into vessel. Therefore, practicing with this model enhanced the students' better understanding and enabled them to

have better skills whenever they face problems that related with the mention of Montree Yamkasikorn [12], that “learning media is the important factor that promote the efficiency of learning, because good media makes the complex thing becomes easy to understand and shorten the time of the long process and fasten more comprehension”.

Moreover, veins and skin of this model were designed to be more flexible, the students can repeatedly practice to be skillful and confident that according to the study of Nalinpat Ratanaviboonsook [13], which determined the result of the model use in blood drawing for the first year-class pathology students of Kanchanapisek Institute of Medical and Public health technology, “the model can be relearned for many times if the students do not understand or lack of confidence with posture when stabbing needle, they can repeatedly practice to be more skillful.

5.3 As for the comparison of the students' satisfaction on the arm model used for nursing practices in blood drawing, intravenous injection and

transfusion between the experimental group and the control group, it is as follows:

The satisfaction of the experimental group was statistically significantly higher than that of the control group at the 0.001 level. The control group concluded that the model purchased from abroad had a large shape and size that induced the difficulty during binding the rubber band before stabbing a needle, and there is another difficulty of this arm model for being movable and not fixed to the desired position and which demands the need of someone to hold this arm model. As for the skin of the model, it was rather thick and rough, which made it more difficult to stab needle with infusion catheter, because the plastic on outer part would be crumpled from friction during needle stab. Besides, there were repeatedly failed stabs due to the fact that veins could not be clearly seen which was caused mainly by the depth of the veins.

As for the satisfaction level of the experimental group, the three first ranks of the lowest score were the items as follows; fixing the needle on the skin with plaster ( $\bar{X} = 4.37$ , S.D. = 0.72), this issue was difficult to solve because to construct the model that is almost realistic, the materials to make the skin have the same characteristic as human beings skin that cannot be stuck with plaster. However, this step was not complex and not dangerous for patient, the students can deal with it in further real situation. The next was the item; blood returned after needle stab ( $\bar{X} = 4.43$ , S.D. = 0.63), it can be explained that the experiment used the plastic syringes which had friction, when the students stabbed needle, there was not enough blood pressure to have blood flow into syringe which can be found in real situation, hence, the students had to slightly pull up plunger to draw enough blood. The last item was the weight of the arm model which was appropriate and interesting ( $\bar{X} = 4.53$ , S.D. = 0.57), it can be explained that the weight of the model was almost realistic, but based on the data from behavioral observation of the students during practice, it was also found that the arm model had actually the same problem as a purchased model in a control group. Therefore, the model should be designed in a much practical way to have something to hold into.

## 6. Conclusions

The limitation of this study was that the researcher could not measure the students' competencies before studying because all subjects had no experience in such practices, so randomized control-group posttest only design and simple random sampling (matching) by using grade point average from the past 1 year needed to be operated for similarity. As a conclusion, the efficiency of the constructed arm model used for nursing practices in blood drawing, intravenous injection and transfusion would enhance high achievement of nursing skills due to it can present the important

components correctly upon the learning objectives, in addition, it is easy to practice in virtual reality, it shows the important parts of 3 veins; cephalic vein, basilic vein and median cubital vein, these imitates veins can be connected with circulation pump set that made its blood circulation resemble to the real arm. When stabbing needle through skin into vein, there was venous blood return into the syringe, used for practice in blood drawing from intravenous both opened and closed system that the blood pressure can be controlled, push medication through vein and keep intravenous transfusion by connecting the blood tank with imitate veins. Moreover, the model can be used repeatedly to improve skills. If there are some leakages from frequently stabbing needle into the vein, the defect part can be changed. Therefore, it is appropriate to use it as media for learning and self-review, besides, as significantly low costs rather than those very expensive purchased import models. The price of the model without circulation pump set is about 30,000 Baht, whereas the model with circulation pump set is about 100,000 Baht but that of the constructed model with circulation pump set is about 8,000 Baht.

## 7. Recommendations

7.1 According to the research findings, this arm model is of a high efficiency and appropriate to use as a learning media, hence, there should be larger production of this type of media for utilization in learning process.

7.2 To produce the model, the operation should be planned carefully to minimize mistakes and work time period, including making the plate of model need expenses, and repeated mistakes only makes more cost. Furthermore, there should be cooperation among the persons who have various skills in order to produce the quality and worthy media.

7.3 The budget should be subsidized in model construction for assembly in learning process because it costs lower than import procurement.

7.4 The research and development should be done to enable high capacity of the model such as the production of instruments to fix an arm model during practice, creation of more veins that were designed in various shapes and sizes both obvious and unobvious seen for practicing both easy and difficult in needle stabbing or selecting other materials for cost reduction.

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