

Students' Performance in Venous Blood Specimen Collection Practice before Internship: An Observation Study

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How to cite this paper: Lämås, K., Härgestam, M., Jonsson, K., & Bölenius, K. (2022). Students' Performance in Venous Blood Specimen Collection Practice before Internship: An Observation Study. *Creative Education*, 13, 2340-2353.

<https://doi.org/10.4236/ce.2022.137149>

Received: June 27, 2022

Accepted: July 25, 2022

Published: July 28, 2022

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Abstract

Introduction: Newly trained nurses experience a lack of preparedness in practical skills, and research shows that students and newly trained nurses have deficiencies in performing practical skills such as venous blood specimen collection. There is a lack of knowledge regarding the level of accuracy reached by students after training at clinical training centres and before entering clinical practice. The aim of this study was to assess the performance of venous blood specimen collection among nursing students after regular education and training at the clinical training centre but before starting an internship. **Methods:** Twenty-three nursing students were observed and video-recorded. An observation protocol was developed based on a validated questionnaire measuring adherence to valid guidelines, and a model for practical skills performance. Data were analysed using descriptive statistics. **Results:** A large variation was found in students' performance with respect to information provided to the patient, patient identification procedures, and tourniquet procedures. The students gave adequate information in 39% of cases, accurately performed patient identification in 83% of cases, and accurately performed the tourniquet procedure in 22% of cases. **Conclusions:** Many nursing students are not prepared to practice on real patients. It is therefore important for university lecturers to develop more efficient teaching methods and to communicate students' skill levels to the supervisor at the clinic, in order for the clinical training to be adapted to a suitable level. There is a need for further research on how to close the gap between the university and internship in order to ensure patient safety.

Keywords

Accuracy, Clinical Training Centre, Education, Nursing, Task Performance

1. Introduction

Practical skills acquisition in nursing education involves learning technical skills and acquiring knowledge consisting of critical thinking, reflective learning, and clinical judgement (Benner, 2015; Jonsen et al., 2013). The complexity of learning practical skills of good quality has been highlighted elsewhere (Björk & Kirkevold, 1999; Aldridge, 2017), and necessitates high-quality education. Universities and colleges offer nursing education, parts of which are delivered at the college/university and other parts of which are performed during internships in clinical settings. However, there is a gap between the college/university and the clinical setting regarding the integration of theory and practice (Jonsen et al., 2013), which creates dissatisfaction and unmet expectations within both organizations. If students' learning process is suboptimal, there is a risk that their skills will remain insufficient after education, which in the long run will jeopardize patient safety.

In this study, students' practical skills performance and accuracy after education at the university were evaluated and described using a theoretical model (Björk & Kirkevold, 2000).

2. Background

Traditionally, practical skills are considered simple and easy to learn. However, several studies have shown the opposite, that practical skills based on scientific knowledge are complex and difficult to learn (Björk & Kirkevold, 1999; Benner, 2000). Björk and Kirkevold found that good-quality performance of clinical skills is complex and includes multiple dimensions, from accurate motoric performance to caring components. Therefore, teaching practical skills is an educational challenge (Björk & Kirkevold, 2000). Practical skills are often performed unsatisfactorily in clinics (Higgins et al., 2010), which can jeopardize the safety of patients and lead to infections, delayed diagnosis, and the need for a repeat procedure (Chopra et al., 2013; Söderberg et al., 2010). An important goal of good nursing care is to reduce errors and prevent complications (Alfredsdottir & Bjornsdottir, 2008; WHO, 2021). A systematic review evaluating the frequency of non-practical skills that enhance patient safety showed that communication, situational awareness, teamwork, decision-making, and leadership were the key categories to enhance patient safety in terms of non-technical skills (Fukuta & Iitsuka, 2018).

However, practical skills errors are latent and outside of direct control, and therefore often go unrecognized in health care (Peltonmaa, 2012). In addition, these errors can have several causes, such as outdated knowledge or failure to follow guidelines (Vaismoradi et al., 2020), lack of attentiveness, or inappropriate judgement (Benner et al., 2002), and failure to communicate (Weller et al., 2014). Repeated training during education has been shown to increase the knowledge and quality of skills performance and to ensure a minimum level of competence before the skills are used in working with patients (Aldridge, 2017; Nestel et al., 2011). It is therefore important to optimize the teaching of skills per-

formance.

As previously mentioned, there seems to be a gap between education at the college/university and the internship in clinical settings. During the training of clinical skills in college/university, there is an emphasis on the guidelines to be followed; however, nursing students attending the final semester of nursing education have shown less guideline adherence than students in the penultimate semester (Nilsson, 2016). This decline in guideline adherence indicates that students are socialized into poor practical skills during internships, and often imitate their supervisor's way of performing these skills. The expectations placed on education remain unmet, as students during their internship in the clinical setting at the end of their formal education have been criticized for having insufficient knowledge in practical skills (Ewertsson et al., 2015a), and newly graduated nurses lack the competence to start working (Brown & Crookes, 2016). Moreover, students have criticized their nursing education for using outdated pedagogical methods (Jonsen et al., 2013; Ewertsson et al., 2015b; Nilsson, 2016) and their supervisors at the clinic for not being up to date with current guidelines and the latest research (Jonsen et al., 2013).

There are probably many explanations for these unmet expectations and the gap between different organizations involved in nursing education. To strive for coherence in education involving more than one organization demands mutual understanding and clear communication about the responsibility of each organization. In turn, clear communication requires a mutual language about students' level of knowledge. When analysing practical skills, it becomes obvious that much of the knowledge is "silent knowledge" (Gourlay, 2006) which is difficult to communicate.

Venous blood specimen collection (VBSC) is one of several skills learned in nursing education (Ewertsson et al., 2015a) and is also one of the most common procedures in health care (Kalra, 2004). In accordance with other practical skills, VBSC is a complex procedure that requires theoretical knowledge and manual skills, as well as accuracy, good caring conduct, and good interaction between phlebotomist and patient (Bölenius et al., 2013).

3. Rationale

There is a gap between learning at college/university and learning in clinical settings during internships, leading to all parties being dissatisfied. The gap may have a negative impact on students' opportunity to have a cohesive learning process regardless of training site (clinical training centre (CTC) vs. internship). There is a need for research that explores what components of practical skills students learn at the CTC and to what extent good practical skills are accomplished after training at the CTC. To the authors' knowledge, no previous study has examined this topic.

4. Aim

The aim of this study was to assess performance and accuracy of venous blood

specimen collection among nursing students after regular education and training at the clinical training centre but before starting internship.

5. Materials and Methods

Study design

We conducted an observational study using study protocols based on a national guideline (*The Handbook of Healthcare, 2021*) and a valid questionnaire (Bölenius et al., 2012).

Setting and research context

During nursing education at one University, Northern Sweden, students have the opportunity to practice practical skills with faculty teachers at the CTC as well as during voluntary open sessions with teaching assistants. One important function of the CTC is that it provides an opportunity for repeated practice to gain experience and learn from mistakes (Ewertsson et al., 2015b). During internship, students continue to practice with support from their supervisors at the clinic.

The CTC at one University in Northern Sweden, allows nursing students to translate their theoretical knowledge into practical skills. The pedagogical model used at the CTC is based on experiential learning as described by Kolb and Kolb (2005). This model requires the student to observe, act, and then systematically evaluate and reflect on their acting and experiences. The practical skills taught at the CTC are evidence-based and follow national guidelines, and the students are trained to adopt an approach that provides patients with the best care based on contemporary knowledge. Students are also encouraged to critically reflect on how actions are performed and whether an action is evidence-based.

Participants

In autumn of 2013, all first-year students (n = 80) in the Nursing Bachelor Programme at the University in northern Sweden, were informed about the project and invited to participate in the study. All students received verbal and written information about the study, gave their informed consent to participate. In total, 23 students were included and agreed to participate; 17 women and six men. Their ages ranged from 21 years to 49 years, with a median of 24 years. Students who already had practical knowledge in venipuncture were excluded.

Procedure and data collection

Before students enter the CTC, they need the type of knowledge that can be described as “knowing that”; in other words, the theoretical underpinning and factual knowledge of the relevant practical skill which many nursing students lack (Ravik, 2019). In this study, all students were told to learn factual knowledge before entering the CTC, by reading the literature and the national guidelines (*The Handbook of Healthcare, 2021*) and by using a web-based educational program including a knowledge exam (Willman et al., 2018). At the CTC, the students were divided into three groups. The above mentioned pedagogical model by Kolb was used to encourage the students to reflect upon their former and new

knowledge, and to critically observe their own and others' attempts during the training session. The teaching was carried out similarly as in other higher education institutions in Sweden. The students practiced venipuncture five times during one 4-hour lesson, following the national guidelines (*The Handbook of Healthcare, 2021*) for VBSC. These guidelines are similar to the international guideline (*Clinical and Laboratory Standards Institute, 2017*), and literature in the field. The materials used were a needle, two test tubes, a tourniquet, disinfection material, gloves, a tube holder, and a waste container. During the training session the students used two types of training products: a venepuncture arm and a vein manikin tied onto a fellow student's arm.

After practising on the training products, the students collected a vein specimen from a fellow student. They therefore trained five times in total: four times on manikins and the fifth time on a fellow student. The venipuncture collection from a fellow student was video recorded. During the procedure one student simulated being a patient and the other student performed the whole procedure of vein puncture, from presentation and patient identification to cleaning up afterwards. The video recording captured the words spoken, the venepuncture performance, the simulated patient, and the equipment used. One of the authors "KJ" was present at all sessions.

An observation protocol was compiled based on the national guidelines (*The Handbook of Healthcare, 2021*) and international standard (*Clinical and Laboratory Standards Institute, 2017*), for VBSC and a validated published questionnaire (*Bölenius et al., 2012*) measuring adherence to national guidelines for venous sampling. The guidelines and questions were transformed into statements that were possible to confirm or reject on the basis of observing video recordings. Face validity of the protocol was assessed by the authors experienced in VBSC "KB", "KL", and "MH". Interrater reliability was also assessed by "KB", "KL", "MH". The authors observed the same recording separately and used the protocol to assess the performance. The assessments were compared, and differences discussed until consensus was reached on how to judge performance. The final protocol contained 49 items divided into eleven domains: 1 identification procedures (five items), 2 hygiene procedures (seven items), 3 venipuncture procedures (eight items), 4 handling of test tubes and needle (seven items), 5 information procedures (five items), 6 use of the tourniquet (five items), 7 ergonomics (four items), 8 establishing relations (two items), 9 overall impression (three items), 10 questions to/feedback from the teacher (two items), and 11 time (one item).

In addition, the authors evaluated accuracy for the first six domains, using a dichotomous judgment answered in the protocol by "yes" or "no". The students' performance was rated on a Likert scale from 0 (unacceptable) to 2 (accurate), and was judged to be unacceptable if the teacher needed to remind the student about some procedures within the domain that are important for patient safety and had not been performed satisfactorily. The performance was judged to be

acceptable if the students performed at least two skills within each domain and satisfactorily performed all skills that are important for patient safety. The students were judged to be accurate if all procedures within the domain were performed correctly.

Data analysis

The video recordings were analysed according to the items in the protocol by three authors independently “KB”, “KL”, “MH”. Each recorded session was viewed several times. There was a high level of agreement between the three authors. Where ratings differed, the authors discussed the score until consensus was achieved. The data were analysed using descriptive statistics, and are reported as percentages. Version 22.0 of SPSS for Windows was used for all statistical analyses (IBM Corp, 2013).

Ethics

This study was approved by the Regional Ethical Review Board (ref: 2013/336-31). All the included students gave their informed consent to participate. The students were informed that all information was handled confidentially and that they had possibility to stop participation if they wished.

The CTC has established routines, and the systematic work environment follows the regulations of the Swedish Work Environment Authority. The venipuncture exercises are on a voluntary basis, and so carriers of blood infection can refrain from the exercise without being questioned. Students receive teacher-led instruction in practical skills that are part of their education. The exercises are based on science and proven experience, and offer students the opportunity to translate theory into practical exercises. Collecting a venous blood specimen from a fellow student is less difficult than collecting one from a patient. Thus, training in a calmer environment can improve students’ skills and contribute to increased patient safety and comfort.

6. Results

There was a large variation in the extent to which the nursing students were prepared to perform VBSC after theoretical education and one practical training session at the CTC. Overall, more than 70% of the students had acceptable or accurate performance of VBSC in three of the eleven domains: identification procedures, hygiene procedures, and venepuncture (Figure 1). Less than 70% of students had acceptable or accurate performance in the other three domains that were assessed for accuracy: handling of test tubes and needle, information procedures, and use of the tourniquet (Figure 1).

In the following section, the results are presented in relation to the six domains where accuracy was assessed.

Identification procedures

Thirteen of the students (57%) asked for the patient’s first name and surname, 21 (91%) asked for the patient’s personal ID number, and 20 (87%) checked the patient’s name or personal ID number against the referral.

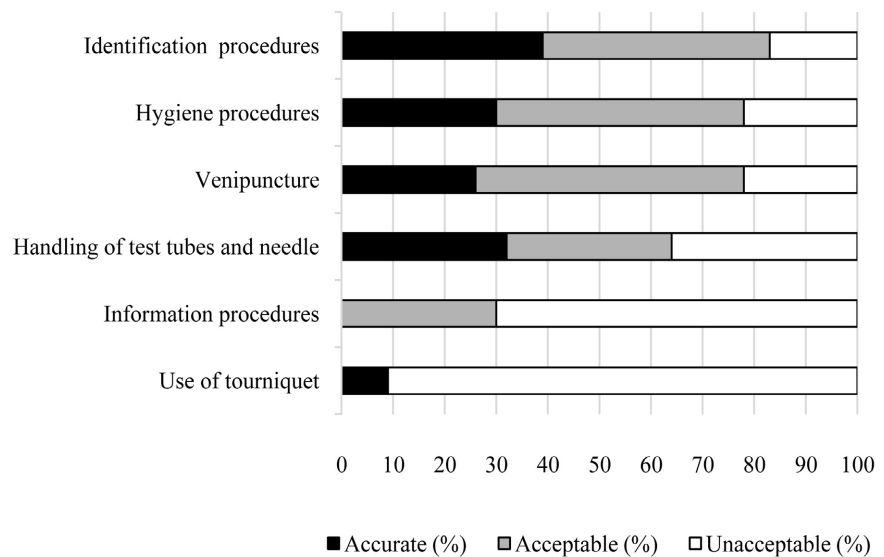


Figure 1. Percentage of students with a level of accurate practical skills performance.

Hygiene procedures

All students used gloves, and 21 (91%) of them disinfected their hands before sampling. All students disinfected the patient's skin, and 18 (78%) waited for the disinfecting agent to dry before sampling. Twenty-two students (96%) placed the materials in the intended place and not on the patient's bed.

Venipuncture procedures

Twenty-one (91%) of the students stretched the patient's skin during puncture, 15 (65%) inserted the needle firmly, 12 (52%) had a steady hand during the procedure, and 22 (95%) removed the test tube before removing the cannula. Twenty-two students (96%) removed the cannula before attaching a plaster and 20 (87%) used puncture protection.

Handling of test tubes and needle

Twenty (87%) of the students used a hazardous waste bin and correctly inverted the test tubes. Three students (13%) reversed the test tubes gently and 19 (84%) labelled the test tubes.

Information procedures

None of the students informed the patient how the VBSC would be performed. However, 13 (56%) informed the patient what tests would be performed and one (4%) informed them of the purposes of the analyses.

Use of tourniquet

All students placed the tourniquet correctly according to recommendations. Seven (32%) released the stasis as soon as blood flowed into the first test tube, and eight (35%) released the stasis within 60 seconds.

Additional results

Additional results showed that eleven (48%) of the students established a relationship with the patient by introducing themselves to them, and ten (43%) students asked about previous experience of venipuncture.

7. Discussion

This study assessed nursing students' performance of the practical skill of VBSC before they had begun their internship. The main results showed that students' performance varied between the different domains. There was a large variation in the extent to which the students were prepared to perform VBSC before attending internship. Over 70% of the students demonstrated acceptable performance in identification procedures, hygiene procedures, and venipuncture, while the students generally showed poorer performance in handling of test tubes and needles, information procedures, and use of the tourniquet.

Below, these findings are discussed against the background of earlier research and the Model of Practical Skill Performance (Björk & Kirkevold, 2000), which was developed to highlight the fact that practical skills involve more than a technical psychomotor skill. The impetus to develop this model was based on the concern frequently raised in the literature (Brown & Crookes, 2016) and in practice about newly graduated nurses' lack of proficiency in practical nursing skills. The model aspired to present practical skills in nursing as complex actions (Björk et al., 2013).

The Model of Practical Skill Performance illuminates the components necessary to perform practical skills with good quality, and contains five components described as layers in a circle. The first and central component is *substance and sequence*, where *substance* refers to the different actions needed to perform the skill and *sequence* is the logical order of the actions. *Accuracy* is related to the exactness of the actions and the correctness of instructions and information given during the actions; *fluency* refers to performance characterized by easiness and good organization; *integration* is about performing parallel actions, for example giving necessary information at the same time as performing a certain action; and *caring conduct* refers to the creation of a respectful, accepting, and encouraging atmosphere during skills performance. *Substance and sequence* is seen as the core component; this means that the performance of the other components, in no hierarchical order, depends on and is linked to the core component (Björk & Kirkevold, 2000).

In the present study, identification procedures and hygiene procedures were two domains that showed acceptable performance, which may be because these domains are generic knowledge and are continuously practiced during the nursing education. This means that the model's components *substance and sequence* and *fluency* have been taught in many of the practical skill sessions at the CTC, for example when teaching blood transfusion procedures or handling of central venous catheters. However, only 30% - 40% of students demonstrated a high compliance level regarding *accuracy* in performance of the same procedures. This may be problematic, because after this practice session the students will be using their VBSC skills in real situations, and it is important that the procedure be performed accurately. High accuracy in practical skills ensures patient safety, and appropriate patient identification is an important element (The

Joint Commission, 2021).

In health care, deficiencies in communication have been identified as an important factor that leads to mistakes (Fukuta & Iitsku, 2018). The students in the present study did not perform well in the domain of information procedures during VBSC. None of the students informed the patients how the VBSC would be performed, and only a few students told their patients why the blood tests had to be taken. It should be noted, however, that the students were at the beginning of their learning process and the focus was on *substance and sequence*. Their instructors at the CTC may have been mainly concerned with the students' technical skills at the expense of information about the tests and communication with the patient. This could be interpreted as meaning that students have limited time to practice their information skills at the CTC. Another explanation is that first-year students have limited knowledge of the tests, and therefore give insufficient information. Patient safety could be enhanced by an increased focus on communication elements in nursing education, including verbal and non-verbal communication, contextually-adapted communication, sending/receiving information, and clear and concise information (Fukuta & Iitsku, 2018). Giving crucial information to the patient, for example concerning correct preparation for certain blood tests by fasting and resting before the VBSC, is important for a correct diagnosis and treatment (Simundic et al., 2018).

The findings of this study raise questions not only about accurate performance, but also about the students' understanding of the principles underpinning some of the guidelines. Assessment of hygiene routines among the students showed a relatively high compliance with guidelines. A noteworthy discrepancy was seen among some students, who followed the steps in the guidelines and seemed to have understood the hygienic principles but then suddenly put the sampling equipment on the patient's bed. This shows that it may be easy to learn different steps in a routine, but true understanding of the theories behind the guidelines requires deeper knowledge.

This suggested discrepancy between learned routines and the understanding of underlying principles can be understood as the difference between superficial learning and deep learning in processing information. Superficial learning focuses on learning facts and details with the intention to reproduce knowledge; deep learning, by contrast, concerns underlying principles or ideas (Marton & Säljö, 1976). Learning strategies are complex, and have been suggested to be a function of the student's personal characteristics and motivation along with the teacher's attitude and enthusiasm (Beattie et al., 1997). Learning sessions require structured skill practice that includes skill refinement, reflection, and feedback to ensure high quality of skill performance (Johnson et al., 2020).

After they completed their theoretical and practical training, over 70% of the students in this study had acceptable to accurate performance of VBSC in three of the domains. It is important to note that these students are not fully trained, and need more opportunity to practice these skills under supervision; the internship plays a major role in readying students for their career in nursing.

Clearly, the challenge will also be to improve the collaboration and communication between the college/university and the clinical setting. The students' level of knowledge can vary, and might not always be captured during an examination. It is important to create ways to communicate a student's level of knowledge to their clinical supervisors. The present results suggest that the students focused on substance and sequence at the CTC, but they also need to have the opportunity to practice accuracy, fluency, integration, and caring conduct during their internship.

In sum, VBSC is one of many practical skills that are included in the nursing education programme and are practiced at the CTC before the students enter clinical practice. The findings in this study demonstrate the students' level of theoretical and practical knowledge in the different steps of venous sampling. As a suggestion for the future, the practical skills learned during nursing education might be taught and assessed differently. For example, theoretical knowledge, skills that are generic for several different procedures, and *substance and sequence* in relation to specific skills could be taught early in the nursing curriculum. The progress in each specific skill, including accuracy, integration, and caring conduct, can be integrated into the learning process in the later part of the education.

Methodological considerations

VBSC is a complex procedure, and one of several practical skills that nursing students perform during their first year of education at the CTC. The nurses' basic education and training follows the Swedish national guidelines for VBSC, which are based on international guidelines. VBSC is performed in a similar way worldwide, and so the present results may be of interest to an international audience. However, the practical skills training of nursing students elsewhere, nationally and internationally, is not necessarily designed in the same way and may differ from the training provided here. Moreover, there are international differences in the distribution of work tasks, and VBSC is not always included in nurses' job descriptions. The results of this study may therefore be of interest for other professions as well. In this study, the practical skill of VBSC was chosen to demonstrate how a model can be used to understand how nursing students learn in stages. The study protocol was developed in accordance with a valid instrument (Bölenius et al., 2012).

In this study, all students were told to complete a web-based educational program before entering the CTC. A recent literature review reported that video pods and digital movies appear to be promising in improving the quality of clinical skills education (Stone et al., 2020). The students in this study practiced on each other, and there is currently a discussion underway in Sweden on whether the practical training should be performed on students or on phlebotomy practice kits only. However, the present authors believe that practising with fellow students involves a deeper learning process based on the need to adapt to and care for a real person.

Participation in this study was voluntary, which affected the number of participants. Finally, an approval level of 70% was used in the domains, as this is the

level required for a pass in the practical skills examinations.

8. Conclusion

The results of this study show that many nursing students are not prepared to practice on real patients without the support of supervisors. It is therefore important for university lecturers to verbalize and communicate their students' skill level to the supervisor at clinics in order for the clinical training to be adapted to a suitable level regarding practical skills. Schools must look for more effective and efficient teaching methods. During students' internship, the students continue to practice the performance of *substance and sequence* while adding training on *accuracy, integration, and caring conduct*, which are complex issues and hence difficult to learn at the CTC. Supervisors at internships should be aware of their educational assignment and that the educational assignment is part of the clinical work. Supervisors could continuously check students' performance of practical skills before students are allowed to practice independently. There is a need for further research on how to close the education gap between the university/college setting and the clinical setting, in order to ensure patient safety.

Acknowledgements

The authors would like to thank the students and the teacher involved, Sonja Nordin and Karin Nilsson for video-taping the venipuncture procedure, and the Department of Nursing at Umeå University.

Data Availability Statement

The questionnaire we used as a base for the study protocol has been published and is available for use by others (see the Methods section). Further, the data generated and analysed in the presented study are available from the corresponding author on request.

Authors' Contributions

K.B. is the project leader of this study. K. L., M. H. and K.B. initiated the study and developed the original idea together with K. J. All authors collected the data and K. L., M. H., and K. B. carried out the statistical analyses together. All authors actively and continuously participated in the discussion and interpretation of the results. K. L. and K. B. drafted the article which all authors then read critically before approving the final draft.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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List of Abbreviations

CTC = Clinical Training Centre; VBSC = Venous Blood Specimen Collection.