

Graduating Student Nurses' and Student Podiatrists' Theoretical Wound Care Competence – a Cross-Sectional Study

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ABSTRACT

Objective: To explore and describe graduating student nurses' and student podiatrists' theoretical wound care competence and to describe students' own perceptions of their wound care competence as well as their opinions about the received wound care teaching.

Methods: A descriptive cross-sectional design was used. The data were collected in 2016 from five Finnish universities of applied sciences using a *Graduating student nurses' and student podiatrists' wound care competence* (WCC) questionnaire, which included a wound care knowledge test and wound care competence self-evaluation. In total, 213 students (response rate 86%) participated in the

study: 194 student nurses and 19 student podiatrists. Data were analysed statistically and with qualitative content analysis.

Results: Students correctly answered approximately half (48%) of the knowledge test questions (student nurses 46%, total score 14/29; student podiatrists 60%, total score 13/22). Student podiatrists' wound care competence was statistically significantly higher ($p < 0.0001$) than that of student nurses. Both groups self-evaluated their wound care competence to be deficient. Students who had more practical training in wound care during practical training periods scored statistically significantly better in the knowledge test. Students had positive attitudes towards wound care.

Conclusion: Graduating student nurses' and student podiatrists' theoretical wound care competence is limited. The results show that more wound care teaching, especially practical training, is needed in both student nurses' and podiatrists' curriculum to adequately respond to increasing needs for wound care.

Key words: wound care, competence, student nurses, student podiatrists

Introduction

Wounds, and especially chronic wounds, are a major challenge for health care systems around the world and place a significant burden on patients and society.¹⁻² It has been estimated that in industrialised countries, approximately 1–1.5% of the population will suffer a chronic wound at some point during their lifetime,³ which will also result in huge costs. For example, the daily costs for a one pressure ulcer may be up to hundreds of euros,⁴⁻⁵ and it has been estimated that the total costs of wound care account for 2–4% of the entire health care budget in European countries.³ Wounds may also decrease patients' quality of life,⁶ and incorrect treatment may lead to complications and increased costs.³

In this study, wound care is defined as the prevention of wound complications and the promotion of wound healing.⁷ It is one of the main fields in clinical nursing and podiatry. Nurses in general work with all possible kinds of wounds depending on the clinical placement, whereas podiatrists' work mainly focuses on chronic wounds, such as vascular (leg), neuropathic (diabetic) and pressure ulcers. Good wound care is important for the quality of patient care and for the prevention of possible wound complications.⁸ A health care professional with good skills and experience may increase the quality of care and even save costs.⁹ Competence and skills can be developed via education and experience.¹⁰

Background

In general, graduating student nurses' competence has become an essential issue related to professional standards, patient safety and quality of care, but only a few studies have assessed graduating student nurses' competence in European countries.¹¹ The concept competence can be defined as 'the application of complex combinations of knowledge, performance, skills, values and attitudes'.¹² According to Kajander-Unkuri et al.,¹³ graduating student nurses in Finland evaluated their overall competence to be good.

Previous studies conducted with nurses have shown that young and less experienced nurses' wound care competence is deficient.¹⁴ Also, nurses working at hospitals are less competent in wound care than nurses working in home care,¹⁵ and only a quarter of nurses and podiatrists feel that they have good knowledge of wound care.¹⁶ Likewise, nurses' knowledge of evidence-based wound care is lacking.¹⁷

Research on student nurses' (SNs) and student podiatrists' (SPs) wound care competence is scarce. While few international studies have been done on SNs' wound care competence, there are no existing studies on SPs' wound care competence,¹⁸ even though they are in a key position to care for or prevent wounds. Most of the studies addressed SNs' pressure ulcer competence. They have shown that such competence is limited^{19–20} and that students do not feel prepared for pressure ulcer care.^{21–22} However, students had demonstrated positive attitudes towards wound care.^{23–24} Previous studies have also shown that SNs with better wound care competence developed such competence as part of their extracurricular wound care education. For example, extracurricular activities in pressure ulcer care, such as wound care lectures and reading²⁵ and e-learning interventions²⁶ improved students' wound care skills. Still, students assessed that they did not receive enough wound care education on tissue viability during their studies.^{27,23}

The aim of this study was to explore graduating (final semester) SNs' and SPs' wound care competence and to describe students' own perceptions of their wound care competence as well as their opinions about the received wound care teaching. Competence was defined as 'the application of complex combinations of knowledge, performance, skills, values and attitudes'.¹⁶ However, performance and skills are difficult to measure without observation as they include practical components meaning that the study was decided to focus only on students' theoretical wound care competence using a knowledge test including their attitudes towards wound care.

The research questions for the study were as follows: 1) What is the graduating SN's and SP's theoretical wound care competence level, and are there any differences between SNs' and SPs' wound care competence? 2) What is SNs' and SPs' perceived (self-evaluated) wound care competence level, and did the students receive enough wound care teaching during their studies? And 3) What factors are related to graduating SNs' and SPs' wound care competence? The overall goal of this study was to fill in the knowledge gap on graduating SNs' and SPs' wound care competence by generating new knowledge about their level of wound care competence and factors related to it. Both SNs and SPs were included because wound care is inter-disciplinary work,²⁸ and inter-professional wound care can improve the overall quality of wound care²⁹ even though podiatrists are representing a minority as a profession compared to registered nurses in wound care.

Methods

Design

A descriptive cross-sectional design was used. The target population was SNs and SPs in their final semester of studies at Finnish universities of applied sciences (UASs). To be included in the study, students had to understand written Finnish fluently and be able to answer the questionnaire in Finnish. SNs were recruited from five Finnish UASs as a cluster sample. These UASs were selected as a convenience sample that represented larger and smaller Finnish cities in different parts of the country. Two UASs in Finland offer degree programme in podiatry and both were included in this study, and the intention was to recruit all graduating SPs (total sampling) as a census.

Graduating student nurse (SN) and *graduating student podiatrist* (SP) in this study designate a bachelor level student at a UAS in Finland in his/her last (seventh) semester. In Finland, the duration of bachelor's degree programmes in nursing and podiatry are both 3.5 years, and the extension is 210 ECTS (European Credit Transfer and Accumulation System).

Data collection

Data were collected using the *Graduating student nurses' and student podiatrists' wound care competence* (WCC) questionnaire developed for this study. Since the aim of this study was to focus only on students' theoretical competence including their attitudes towards wound care, the developed questionnaire was divided into following four sections: 1) demographic data, 2) perceptions of wound care teaching and attitudes towards wound care, 3) wound care knowledge test and 4) students' self-evaluation of their wound care competence.

The first section consisted of five demographic questions: age, gender, institute (UAS), future profession and possible earlier education. The second section included three Likert-scaled (1–5) questions about students' perceptions of the amount of wound care teaching (1=very little, 2=little, 3=neither little nor much, 4=much, 5=very much) and two yes/no/can't say (1–3) questions about their attitudes towards wound care (1=yes, 2=no, 3=can't say).

The third section of the questionnaire contained a wound care knowledge test, which included 25 multiple-choice or correct/false questions (different wounds, wound care, wound prevention) and a patient case with four questions (arterial wound care), for a total of 29 questions. Graduating SNs answered all 25 multiple choice questions plus four patient case questions (wound identification, documentation, decision making and wound management), and graduating SPs answered only the

first 18 multiple choice questions and four patient case questions. The seven remaining multiple-choice questions covered acute wounds (e.g. surgical wounds and burn injuries) and pressure ulcers, both of which are uncommon wounds in podiatric practice and, hence, the education curriculum does not include acute wound care teaching.

In the fourth section of the questionnaire, students were asked to self-evaluate their wound care competence with five Likert-scaled (1–5) questions (1=I don't know at all, 2=I know quite poorly, 3=I neither know it poorly nor well, 4=I know well, 5=I know very well). In these questions, students were asked to evaluate how familiar they are with 1) wound products, 2) finding evidence-based information about wound care, 3) chronic wound care, 4) surgical wound care and 5) burn injury care. SPs answered only the first three questions. All students answered the last open-ended question, in which students could comment freely on their wound care competence and/or the received wound care teaching.

The questionnaire was developed specifically for this study. Eight of the knowledge test questions were adapted from the *Assessment and Documentation of Various Wounds* questionnaire (questions 12–18 and 23–25).³⁰ The questions used in the questionnaire were translated using forward translation from their original language (English) into Finnish and the answer choice 'I don't know' was added as a last answer choice to all its questions. No back-translation nor pre-testing only for the adapted questions were conducted.

The other knowledge test questions (1–11 and 19–22) were based on written basic wound care education material and the Finnish Nursing Research Foundation (NRF)³¹ and Finnish Current Care guidelines.³² The content validity of the knowledge test was evaluated by an expert panel of five health care professionals: 1) an authorised wound care specialist nurse, 2) a nurse educator, 3) a vascular surgeon, 4) a podiatrist and 5) a head nurse whose work encompasses wound care. Experts evaluated each question for its clarity, relevance and importance on a four-point scale. The content validity index (CVI) of the knowledge test was computed based on all of the experts' ratings. The average I-CVI for clarity was 0.88, whereas it was 0.97 for relevance and 0.96 for importance. The S-CVI/Ave (average of all the average I-CVIs) of the instrument was 0.94.³³ The whole questionnaire was piloted in a group of graduating SNs (n=16). No changes were made after piloting. No other statistical tests were used to measure the consistency of the items of the questionnaire.

Data were collected in 2016 using paper and pencil questionnaires either during a lecture related to students' compulsory studies or immediately after the lecture, so that the researcher or a teacher could monitor that students focused on their own forms and did not try to find answers elsewhere. The researcher collected part of the questionnaires and teachers another part. The survey was distributed to all students in the group. When the students had completed the questionnaire, they returned them to an envelope. If a student wished not to participate in the study, she/he returned the empty questionnaire. Students could not be identified from the questionnaires. No personalising questions were used.

The total number (N) of completed questionnaires was 213, of which 194 (91%) were from SNs and only 19 (9%) from SPs because of the small number of graduating SPs in Finland. The overall average response rate of the study was 86%; the overall response rate of SNs was 90% (n=194) and that of SPs 81% (n=19). One questionnaire was discarded because of a lack of informed consent.

Ethical considerations

This study conformed to the guidelines for responsible conduct in research by the Finnish Advisory on Research Integrity, as appointed by the Ministry of Education and Culture (TENK).³⁴ According to national guidelines and recommendations, no ethical approval was required to conduct the study because this study did not involve an intervention in the physical integrity of or expose exceptionally strong stimuli or harm to the participants. Participation in this study was voluntary, and the students signed an informed consent form. Written informed consent was obtained from all participants. Participating (or declining to participate) in this study did not have any impact on students' grades. Participants remained anonymous and they were free to leave the study at any point without having to give their reason for leaving.

Written permissions to conduct the study in all participating UASs were obtained before the data collection phase. Permission to use, translate and edit the *Documentation of Various Wounds* questionnaire³⁰ was granted on 31/1/2016 by the *Journal of Wound Ostomy & Continence Nursing*, which holds the copyright for the instrument.

Data analysis

Statistical analysis

Data were analysed statistically using the SAS 9.3 software package (SAS Institute Inc., Cary, North Carolina, USA). At first, the descriptive statistics were calculated. Next, the knowledge test scores were calculated. Each correct answer to the multiple-choice questions in the knowledge test gave the respondent one point, which means that the total possible score from the multiple-choice questions was 25 for SNs and 18 for SPs. Points in the patient case were counted as follows: for questions 1 and 3, students could answer either correctly (1 point) or incorrectly (0 points), whereas for questions 2 and 4 they could either answer correctly (1 point), partly correctly (0.5 points) or incorrectly (0 points). The maximum score for the patient case was four points, which means that the calculated total score in the knowledge test was 29 (25+4) for SNs and 22 (18+4) for SPs.

Total and mean scores for the whole knowledge (multiple choice questions plus patient case) test were analysed for both groups (SNs and SPs). Scores for multiple-choice questions only (25 or 18 points) and the patient case (4 points) were also analysed separately, as was the corresponding part (18 multiple-choice questions and the patient care) of the questionnaire, for both groups. The associations between the knowledge test scores and students' possible previous education, their received wound care teaching and students' self-evaluation of their wound care competence were also analysed.

Total scores and demographic variables were compared with t-tests when there were two categories to be compared. Analysis of variance (ANOVA, F-test, p-value) was used to compare the means between groups. Pairwise comparisons between the groups via the Tukey-Kramer post hoc test were done to adjust for multiple comparisons. The results were verified with non-parametric tests (Wilcoxon two-sample test and Kruskal-Wallis test) if a normal distribution was not achieved. The relation between numeric variables (teaching, practical training) and the knowledge test were examined using Pearson's and Spearman's correlation coefficients. Finally, students' received knowledge test points were analysed together with students' perceived Likert-scaled competence level using Spearman's correlation coefficients. A significance level of <0.05 was selected for all tests.

Text analysis

In the last question on the questionnaire, students were asked to comment on and/or share their experience with the wound care teaching they had received during their studies and/or their perceived

wound care competence. In total, 111 (52%) SNs and SPs answered the open-ended question, of whom 97 were SNs (50%) and 14 SPs (74%).

The qualitative analysis was based on inductive-deductive content analysis.³⁵ The main themes, *teaching* and *competence*, were deductively formulated based on the question. The inductive analysis was carried out using NVivo 11 software (QSR International Pty Ltd., UK). First, the 50 most frequently repeated words were sought from the students' comments. The most frequently used word in the dataset was *few or little*, the second most frequently used word was *more* and the third most frequently used word was *teaching*.

The first step of the coding process was open coding based on the most frequently used words. Comments were coded according to similarities in the words and their meanings, and synonyms and specific nodes representing their similarities were created (e.g. *theoretical teaching*). Then, componential coding of the nodes was carried out, in which connections and relationships between the different nodes were sought (e.g. between *slight amount* and *theoretical teaching*). The final step was selection, in which nodes were organised into final groups.³⁶ The comments provided by the SNs and SPs were analysed separately. However, identical index trees were created for both groups' nodes (Figure 1).

Results

The absolute majority (n=194, 91%) of the respondents were SNs. The mean age of the respondents was 27 years (SD 6.4), the majority (n=184, 86%) of the respondents were women and one third (n=73, 34%) of them had a prior health care profession (Table 1).

Students' wound care competence according to the knowledge test and their attitudes towards wound care

The average percentage of correct answers by students was 48% for all knowledge test questions (minimum 10%, maximum 79%). SNs' average percentage of correct answers was 46% (total score 14/29), and while it was 60% for SPs (total score 13/22) (Table 2; Table 3). SPs' demonstrated knowledge on the knowledge test was statistically significantly higher than that of SNs ($p < 0.0001$, t-test).

The mean score for correct answers to the multiple-choice questions was 12/25 (median 10) for SNs (A, Table 3) and 10/18 (median 10) for SPs (B, Table 3). The lowest score for SNs was 1/25, while for SPs it was 7/18. The highest score for SNs was 20/25 (2 students), while it was 13/18 (5 students) for SPs. When comparing the identical multiple-choice questions responded to by SNs and SPs (first 18 questions) on the knowledge test, SNs scored 8/18 (45%) and SPs 10/18 (57%) (B, Table 3). When comparing the identical parts of the knowledge test (first 18 multiple-choice questions and the patient case), SNs scored 10/22 (43%) and SPs scored 13/22 (60%) (D, Table 3.) SPs' knowledge was also significantly better than that of SNs in the identical parts of the knowledge test ($p=0.0002/<.0001$, t-test).

The highest scores for SNs on related to the pressure ulcer risk factors (94%), debridement (88%), pain management (85%), silver dressings (83%) and surgical wounds (80%). The lowest scores had to do with pressure ulcer risk management (10%), wound infection (10%), foot ulcers (11%), the healing process (11%) and burn injuries (16%) (Figure 2).

The highest scores for SPs, in contrast, related to maceration (95%), silver dressings (95%), debridement (90%), high exudate wounds (84%), venous leg ulcers (79%), arterial ulcers (79%) and wound size measurements (79%). The lowest scores had to do with the wound healing process (0%), wound proliferation (16%), pain management (16%), wound infection (26%), hydrophobic dressings (26%) and wound healing (26%) (Figure 2).

The mean score for SNs in the four-point patient case was 1.5 (37%), while for SPs it was 2.8 (71%) (C, Table 3). Three SNs and one SP received the full four points on the patient case. One in ten ($n=19$, 10%) SNs received 0 points (Figure 2).

Students had positive attitudes towards wound care; the majority (78%) of the students answered that they were interested in wound care and almost all (99%) of them said that nurses and podiatrists should be competent in wound care.

Students received wound care teaching and their self-evaluated wound care competence

Most of the students answered that they had received little (50%) or very little (18%) theoretical wound care teaching during their studies. Most of the students had also received either little (45%) or very little (42%) practical wound care teaching. However, the amount of practical wound care

training provided during students' practical training periods varied: more than one third (34%) of the students had received much practical training in their opinion, but less than a third (29%) of the students said that they had received little training and 27% of the students answered that they had received neither a little nor much training. (Figure 3.)

One fifth (n=44, 22%) of the students answered that they were quite familiar with wound products, while one student said that he/she knew products very well. However, almost half (n=82, 42%) answered that that they knew wound products quite poorly, while some (n=14, 7%) said that they were not at all familiar with such products (Likert 1–5). We compared students' self-evaluated wound care competence to their knowledge test results. We discovered a positive correlation ($r_s=0.33$, $p < 0.0001$) between their perceived knowledge and the objectively measured knowledge (Figure 4).

Most of the students knew how to search for evidence-based wound care information: Almost half (n=89, 45%) reported that they were quite good at it, while every tenth (n=20, 10%) student answered that they were very good at it. One fifth (n=38, 19%) evaluated their skills to be quite poor. Only a few (n=9, 5%) reported that they could not search for evidence-based information at all (Likert 1–5) (Figure 4).

Some (n=27, 14%) of the students evaluated their chronic wound care competence as being quite good. However, only one student reported that he/she could care for such wounds very well. Almost half (n=78, 40%) answered that they were quite poor at treating chronic wounds, while some (n=24, 12%) evaluated that they could not treat such wounds at all (Likert 1–5). We discovered positive correlations ($r_s=0.19$, $p=0.007$ and $r_s=0.17$, $p=0.025$) between their perceived knowledge and the objectively measured knowledge of caring for chronic wounds (Figure 4).

Half (n=86, 48%) of the SNs evaluated their surgical wound care competence as being quite good, while only a few (n=9, 5%) suggested that it was very good. One fifth (n=34, 19%) evaluated their surgical wound care competence as being quite poor, while only a few (n=4, 2%) reported that they could not treat such wounds at all (Likert 1–5) (Figure 4).

SNs reported that their competence in burn injury care was worse than competence in surgical wound care: some (n=26, 15%) SNs reported that they had quite good competence in burn injury care, while only a few (n=3, 2%) evaluated that their competence in burn injury care as being very good. One third (n=61, 34%) of SNs evaluated their competence in burn injury care as being quite poor, while

some (n=29, 16%) reported that they could not care for burn injuries at all (Likert 1–5). However, the results did not quite reach statistical significance ($p < 0.05$), which means that SNs evaluated their knowledge of both surgical wound care ($p = 0.0883$) and burn injury care ($p = 0.0736$) too optimistically compared to their knowledge test scores (Figure 4).

The main themes of the open-ended question were *wound care teaching* and *wound care competence*. The subthemes of *wound care teaching*, according to inductive content analysis, were *insufficient theoretical and practical teaching* and that *students learn more at practical trainings than at school* (Figure 1). Both SNs and SPs wished they had received more wound care teaching in their studies, both during the theoretical teaching and practical training components. Students also reported that they had learned more about wounds and wound care during their practical training periods than at school.

‘This [wound care] has been practised at school almost not at all. Everything I’ve learned about wound care comes from practical training periods.’ – SN

‘I hope for broader and more encompassing wound care teaching for podiatrists’ education or optional courses for those who are interested in wounds. I am very interested in wounds.’ – SP

The subthemes of *wound care competence*, according to inductive content analysis, were *insufficient knowledge* and *little practical experience* (Figure 1). Students felt that their wound care knowledge was poor and that they were not prepared to care for wounds. Some students had had the chance to care for actual wounds during their practical training periods, but most of them felt that they did not have enough practical experience with wounds and wound care.

‘Wound care teaching is downright non-existent. As a matter of fact, I don’t know anything about wound care.’ – SN

‘At school, there is hardly any practical training, but [there is] some theory [theoretical teaching], yes. However, the wound care course was arranged after the hospital training period, which was absurd. During the practical training period at a hospital, I had a chance to care for some wounds.’ – SP

Factors related to students’ wound care competence

Students who had received either much or very much practical training in wound care during their practical training periods had significantly higher ($r_s=0.23$, $p=0.0007$, Spearman correlations) percentages of correct answers on the knowledge test than those who had received either a little or a very little amount of practical wound care training. However, students' reported amount of theoretical or practical wound care teaching at school did not correlate significantly with the knowledge test results.

One third ($n=69$, 32%) had a prior health care profession degree as a practical nurse. The average percentage of correct answers was also 48%, which means that there was no difference in the knowledge test results based on whether or not a student had a prior nursing degree.

Discussion

The aim of this study was to explore and describe graduating SNs' and SPs' wound care competence and to describe students' own perceptions of their wound care competence. The results indicate that graduating SNs' and SPs' theoretical wound care competence level is deficient: the percentage of students' correct answers on the wound care knowledge test was less than 50%, and the students rated their wound care skills as inadequate. The amount of theoretical and practical wound care teaching most of the students had received at school had been too little according to the quantitative data. The qualitative data supported these findings, as students reported that they had not received enough wound care teaching, and some students even argued that there had been no wound care teaching whatsoever during their studies. In Finland, UASs has an autonomy to design their curricula based on the European Union directive (2013/55/EU)³⁷ and national recommendations, which means that the amount and type of wound care teaching may have varied between the participating UASs.

Previous studies have suggested that graduating SNs' wound care competence, and especially their competence in pressure ulcer care, is inadequate.^{19,26,38,20} Previous studies have also shown that English student nurses also do not receive enough wound care or skin integrity education during their studies.^{27,23}

Modern teaching methods in addition to traditional lecturing should likely be considered. Also, both extracurricular wound care courses for students interested in deepening their knowledge and postgraduate courses for registered nurses and podiatrists managing wounds in their work should be

offered. Those students who do not have the opportunity to practice wound care during their practical training periods could practice wound care in simulation centres or in web-based learning platforms. Inter-professional courses could also be useful because wound care, especially chronic wound care courses. SNs and SPs could also study wound care together because, in the future, they may work together, and by learning and practising together, they would become more familiar with each other's practice and tasks and learn from each other.

The amount of wound care practical training varied among students, which can at least partly be explained by differences in the practice fields, as there will be more patients with wounds in certain hospital wards than in others. Those students who had received more practical training in wound care during their practical training periods had significantly higher scores on the knowledge test. This may be explained by the effectiveness of the combination of theoretical and practical learning. When the ability of combining theoretical and personal knowledge increases, confidence also increases.³⁹ Health care educators should make sure that students receive enough practical training in wound care even if they do not receive it during their practical training placements.

Students also showed positive attitudes towards wound care. Our results support earlier evidence. Studies have shown that SNs have a positive attitude towards pressure ulcer prevention.^{40,20} The explanation for why students generally have positive attitude towards wound care, regardless of their self-evaluated limitations in wound care competence, might be that students are aware of the importance of wound care and prevention, but that the practice is seen as more complicated and demanding.

SPs' better scores on the knowledge test may be explained by the content of the teaching they receive. Podiatrists' work focuses on feet, which means that they are more likely to be familiar with the anatomy and physiology of the foot as well as the typical health problems related to feet. It is also worth noting that SPs scored significantly better in the patient case. Almost all SPs recognised that the wound in question was an arterial wound, whereas only a little more than a quarter of SNs knew the correct answer. This indicates that more teaching on foot health care should be added to the nursing curriculum as well.

Students' self-evaluation and objective knowledge correlated in areas addressing wound care products and chronic wounds, but SNs' self-evaluation of surgical wounds and burn injuries did not correlate with their objective knowledge, as students self-evaluated their competence in these areas

too optimistically. This discrepancy may be due to the preconception that acute wounds can be managed in a quite straightforward manner, whereas chronic wounds are more readily perceived as being more complicated to manage since such wounds do not always heal so well. The results from previous studies on graduating SNs' perceived wound care competence have been somewhat controversial. For instance, in one study most SNs felt confident in undertaking most wound care procedures,²⁷ but in another study most of the SNs did not feel well prepared in tissue viability.²³

Limitations

The limitations of the study have to do with design, sampling, instrumentation and data collection. This was a descriptive cross-sectional study focusing mostly on graduating SNs' and SPs' theoretical competence and knowledge at a certain point in time. We used convenience sampling for the participating UAS and cluster sampling as the sample selection method for participating students. It is possible that this decreased internal validity because the selection was not randomised.⁴¹ However, the sample of graduating SNs was selected from five Finnish UAS in heterogeneous (larger and smaller) cities. The sample of graduating SPs was small. However, the sample was gathered from all graduating SPs in Finland, which increases the internal validity concerning the data for graduating SPs.

The instrument was developed for this study. The instrument development process was conducted systematically, and the questions of the knowledge test were based on previous literature. Due to limited testing, validity and reliability of the instrument could be questioned. However, we confirmed the face validity of the instrument with a subjective evaluation of the instrument's content area.⁴² Then, a group of experts (5) evaluated the questions on the knowledge test that support content validity. The CVI of the knowledge test was acceptable, and the entire questionnaire was piloted in a group of SNs.⁴³

Data were for the most part collected by teachers, and data collection were supervised by a contact person. The researcher gave detailed instructions for data collection, but it is still possible that data were not collected in a similar way at every UAS, which may decrease the internal validity of the study.⁴⁴

Statistical analysis was conducted by a statistician in cooperation with the researcher. However, there were some cases of missing data, especially in the patient case. The number of participants in the groups varied a great deal, which means that we could not make reliable comparisons between groups. However, the total response rate was high (86%), which, in contrast, increases the internal validity.⁴⁵

Qualitative analysis was run by the researcher with NVivo software computer program. The use of NVivo increased the internal validity of the analysis because a computer program works objectively regardless of the researcher's expectations or prior thoughts.³⁶

This study was conducted in Finland, which means that the results cannot be generalised to all countries. However, Finnish nursing education is based on the European Union directive (2013/55/EU),³⁷ and the framework for the qualifications is based on the European Higher Education Area (EHEA)⁴⁶ guidelines, which means that the results may be generalizable at some level to other European countries that follow the directive and EHEA guidelines for graduating SNs. Finnish podiatry education is based on Finnish law recognising professional qualifications, and the framework for the qualifications is also based on EHEA⁴⁶ guidelines. Still, there are no specific wound care qualifications or curricula in bachelor's degree nursing or podiatry programmes in Finland or in other European countries.

Conclusions

The results of this study suggest that the theoretical wound care competence of graduating SNs and SPs is insufficient. Graduating SPs' wound care competence was significantly better than that of graduating SNs. According to this study, practical wound care training had a positive correlation with students' wound care competence, which means that further developing wound care teaching, both theoretical but especially the practical training, would be beneficial for improving students' wound care competence. New teaching methods should also be considered that combine theory and practice. Further research on this topic is also needed. Students' wound care skills could be studied, by observing their performance. An intervention could be used to study the effectiveness of wound care education, and wound care competence could also be studied by evaluating the cross-cultural differences between SNs and SPs. Also, valid and reliable instruments are needed for measuring both graduating students' as well as registered nurses' and podiatrists' wound care competence. The better wound care education leads to higher competence which may lead to better quality of care for patients with various wounds as well as better patient safety and patient satisfaction.

References

1. Richmond, N., Maderal, A., Vivas, A. Evidence-based management of common chronic lower extremity ulcers. *Dermatologic Therapy*. 2013. 26: 3, 187–196.
2. Järbrink, K., Ni, G., Sönnergren, H. et al. Prevalence and incidence of chronic wounds and related complications: a protocol for a systematic review. *Systematic Reviews*. 2016. 5: 1, 152.
3. Gottrup, F., Apelqvist, J. & Price, P. Outcomes in controlled and comparative studies on non-healing wounds: recommendations to improve the quality of evidence in wound management. *Journal of Wound Care*. 2010. 19: 6, 239–268.
4. Demarré, L., Van Lancker, A., Van Hecke, A. et al. The cost of prevention and treatment of pressure ulcers: A systematic review. *International Journal of Nursing Studies*. 2015. 52: 11, 1754–1774.
5. Demarré, L., Verhaege, S., Annemans, L. et al. The cost of pressure ulcer prevention and treatment in hospitals and nursing homes in Flanders: A cost-of illness study. *International Journal of Nursing Studies*. 2015. 52: 7, 1166–1179.
6. Hopman, WM., VanDenKerkhof, EG., Carley, ME., Kuhnke JL. & Harrison, MB. Factors associated with health-related quality of life in chronic leg ulceration. *Quality of Life Research*. 2014. 23: 6, 1833–1840.
7. Medical Dictionary. Wound care. (2009). <http://medical-dictionary.thefreedictionary.com/wound+care> (Accessed January 2017).
8. Posnett, J., Gottrup, F., Lundgren, H., Saal, G. The resource impact of wounds on health-care providers in Europe. *Journal of Wound Care*. 2009. 18: 4, 154–161.
9. Robinson, S., Griffiths, P., Maben, J. Calculating skill mix: implications for patient outcomes and costs. *Nursing Management (Harrow)*. 2009. 16: 8, 22–23.
10. Eskes, AM., Maaskant, JM., Holloway, S. et al. Competencies of specialised wound care nurses: a European Delphi study. *International Wound Journal*. 2014. 11: 6, 665–674.
11. Kajander-unkuri, S., Salminen, L., Saarikoski, M., Suhonen, R., Leino-Kilpi, H. Competence areas of nursing students in Europe. *Nurse Education Today*. 2013. 33: 6, 625–632.
12. Cowan, D., Norman, I., Coopamah, V. Competence in nursing practice: A controversial concept – A focused review of literature. *Nurse Education Today*. 2005 25: 5, 355–362.
13. Kajander-Unkuri, S., Metetoja, R., Katajisto, J. et al. Self-assessed level of competence of graduating nursing students and factors related to it. *Nurse Education Today*. 2013. 34: 5, 795–801.
14. Ayello, E., Baranoski, S., Salati, A. Survey of Nurses' Wound Care Knowledge. *Advances in Skin & Wound Care*. 2005 18: 5, 268–275.

15. Zarchi, K., Latif, S., Haugaard, V., Hjalager, I. & Jemec, G. Significant Differences in Nurses' Knowledge of Basic Wound Management – Implications for Treatment. *Acta Dermato-Venereologica*. 2014. 94: 4, 403–407.
16. McIntosh, C., Ousey, K. A survey of nurses' and podiatrists' attitudes, skills and knowledge of lower extremity wound care. *Wounds UK*. 2008. 4: 1, 59–68.
17. Ylönen, M., Stolt, M., Leino-Kilpi H. & Suhonen R. Nurses' knowledge about venous leg ulcer care: a literature review. *International Nursing Review*. 2014. 61: 2, 194–202.
18. Kielo, E., Salminen, L., Stolt, M. Graduating student nurses' and student podiatrists' wound care competence – An integrative literature review. *Nurse Education in Practice*. 2018. 29 (in press).
19. Beeckman, D., Vanderwee, K., Demarré, L. et al. Pressure ulcer prevention: Development and psychometric validation of a knowledge assessment instrument. *International Journal of Nursing Studies*. 2010. 47: 4, 399–410.
20. Simonetti, V., Comparcini, D., Flacco, M.E., Di Giovanni, P., Cicolini, G. Nursing students' knowledge and attitude on pressure ulcer prevention evidence-based guidelines: A multicenter cross-sectional study. *Nurse Education Today*. 2005. 35: 4, 573–579.
21. Snarska, K., Jarocka, I., Sierzantowicz, R., Lagoda, K., Jurkowska, G. The knowledge of bedsores prevention among Health and Nursing Department students of Medical University of Bialystok. *Roczniki Akademii Medycznej w Białymstoku*. 2005. 50: supp1, 193–195.
22. Carvalho Moura, E.C., Larcher Caliri, M.H. Simulation for the development of clinical competence in risk assessment for pressure ulcer. *Acta Paulista de Enfermagem*. 2013. 26: 4, 369–375.
23. Stephen-Haynes, J. Preregistration nurses' views on the delivery of tissue viability. *British Journal of Nursing*: 2013. 22: 20, S18–S23.
24. Florin, J., Bååth, C., Gunningberg, L. & Mårtensson, G. Attitudes towards Pressure ulcer Prevention: a psychometric evaluation of the Swedish version of the APuP instrument. *International Wound Journal*. 2016. 13: 5, 655–662.
25. Larcher Caliri, M., Miyazaki, M., Pieper, P. Knowledge of Pressure Ulcers by Undergraduate Nursing Students in Brazil. *Ostomy Wound Management*. 2013. 49: 3, 54–63.
26. Beeckman, D., Schoonhoven, L., Boucqué, H., Van Maele, G., Defloor, T. Pressure ulcers: e-learning to improve classification by nurses and nursing students. *Journal of Clinical Nursing*. 2008 17: 13, 1697–1707.
27. Ousey, K., Stephenson, J., Cook, L., Kinsey, L., Batt, S. Final year student nurses' experiences of wound care: an evaluation. *British Journal of Community Nursing*. 2013. 18: supp3, 7–12.
28. Gottrup, F. A specialized wound-healing center concept: importance of a multidisciplinary department structure and surgical treatment facilities in the treatment of chronic wounds. *The American Journal of Surgery*. 2004. 187: 5A, 38S–43S.

29. Granick, M.S., Long C.D. Outcome Assessment of an In-Hospital Cross-Functional Wound Care Team. *Plastic and Reconstructive Surgery*. 2004. 113: 2, 671–672.
30. Huff, J. Adequacy of Wound Education in Undergraduate Nursing Curriculum. *Journal of Wound, Ostomy and Continence Nursing*. 2011. 38: 2, 160–164.
31. NRF (Nursing Research Foundation) (2015). Pressure ulcer prevention and identification in adult patient care. http://www.hotus.fi/system/files/SUOSITUS_PAINEHAAVA_ENGLANTI_15_3_16%20%283%29.pdf (Accessed March 2017).
32. Current Care Guidelines (2014) Chronic leg Ulcer. Working group set up by the Finnish Medical Society Duodecim and the Finnish Dermatological Society. www.kaypahoito.fi/web/english/guidelineabstracts/guideline?id=ccs00036&suositusid=hoi50058 . (Accessed January 2016).
33. Polit, D., Beck, C., Owen, S. Is the CVI an Acceptable Indicator of Content Validity? Appraisal and Recommendations. *Research in Nursing & Health*. 2007. 30: 4, 459–467.
34. TENK: Finnish Advisory Board on Research Integrity (2012) Responsible conduct of research and procedures for handling allegations of misconduct in Finland. http://www.tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf (Accessed January 2016).
35. Elo, S., Kääriäinen, M., Kanste, O. et al. Qualitative Content Analysis: A Focus on Trustworthiness. *SAGE Open*. January-March 2014, 1–10.
36. Leech, N., Onwuegbuzie, A. Beyond Constant Comparison Qualitative Data Analysis: Using NVivo. *School Psychology Quarterly*. 2011. 26: 1, 70–84.
37. European Union: (2013/55/EU) The recognition of professional qualifications. <http://eurlex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0055&from=EN> (Accessed February 2017).
38. Gunningberg, L., Mårtensson, G., Mamhidir, A-G. et al. Pressure ulcer knowledge of registered nurses, assistant nurses and student nurses: a descriptive, comparative multicentre study in Sweden. *International Wound Journal*. 2013. 12: 4, 462–468.
39. Voldbjerg, S.L., Grønkjær, M., Sørensen, E.E., Hall, E-O.C. Newly graduated nurses' use of knowledge sources: a meta-ethnography. *Journal of Advanced Nursing*. 2016. 72: 8, 1751–1765.
40. Cullen Gill, E., Moore, Z. An exploration of fourth-year undergraduate nurses' knowledge of and attitude towards pressure ulcer prevention. *Journal of Wound Care*. 2013. 22: 11, 618–627.
41. Hammer, G., du Prel, J-B., Blettner, M. Avoiding Bias in Observational Studies. *Deutsches Ärzteblatt International*. 2009. 106: 41, 664–668.
42. DeVon, H.A., Block, M.E., Moyle-Wright, P. et al. A Psychometric toolbox for testing validity and reliability. *Journal of Nursing Scholarship*. 2007. 39: 2, 155–164.

43. Polit, D., Beck, C. *Nursing Research: Generating and Assessing Evidence for Nursing Practice*. 8th Edition. Lippincot Williams & Wilkins, 2008.
44. Grimes, D., Schulz, K. Bias and causal associations in observational research. *The Lancet*. 2002. 359: 19, 248–252.
45. Grove, S., Burns, N., Gray, J. *The Practice of Nursing Research: Appraisal, Synthesis, and Generation of Evidence*. Seventh Edition. Elsevier, 2013.
46. EHEA (European Higher Education Area) (2009) The frameworks of qualifications. <http://www.ehea.info/pid34260/tools.html> (Accessed February 2017).

Table 1: Demographic data of the participants (N=213)

Demographic data	Total		Student nurses		Student podiatrists	
	n	%	n	%	n	%
Mean age (years)	27 (SD 6.4)		29 (SD 6.5)		25 (SD 5.1)	
Gender						
Female	184	86	170	88	14	74
Male	29	14	24	12	5	26
Prior health care profession	73	34	70	36	3	16

Table 2: Students' correct answers on the knowledge test (multiple choice questions plus patient case)

Students	n	Correct answers (mean)	Std. Deviation	Minimum	Maximum	Theoretical min – max
SNs	194					
Score		14	3.6	3	23	0–29
%		46	12.4	10	79	0–100
SPs	19					
Score		13	2.3	9	17	0–22
%		60	10.3	39	75	0–100

Table 3: Students' total mean scores and percentages of correct answers in various parts of the knowledge test, by student group

	A	B	C	D	Total score
SNs (n=194)	12 (48%)	8 (45%)	1.5 (37%)	10 (43%)	14 (46%)
SPs (n=19)		10 (57%)	2.8 (71%)	13 (60%)	13 (60%)

A: Multiple-choice items: max 25 points (SNs only).

B: Multiple-choice items: max 18 points (all students).

C: Patient case: max 4 points (all students).

D: Multiple-choice items: first 18 questions + patient case: max 22 points (all students).

Total score: max 29 points for SNs and 22 for SPs.

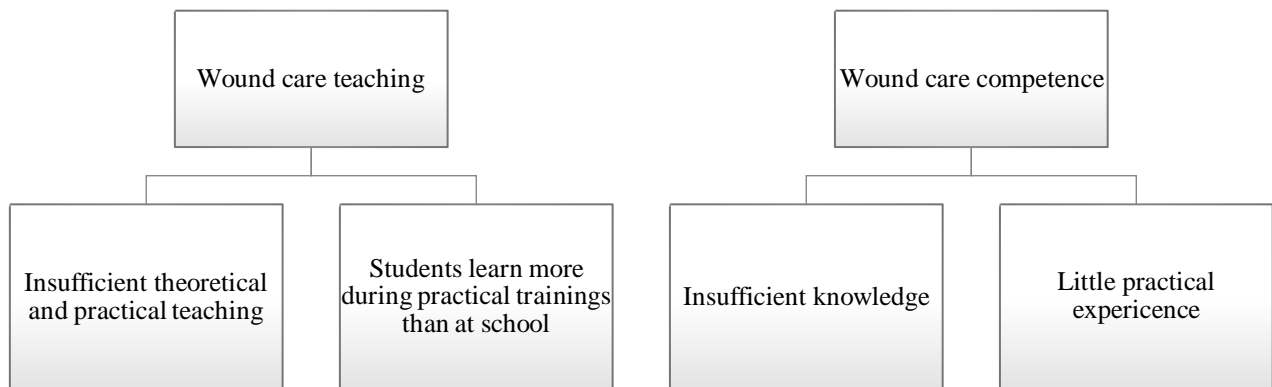


Figure 1: Index trees of qualitative analysis.

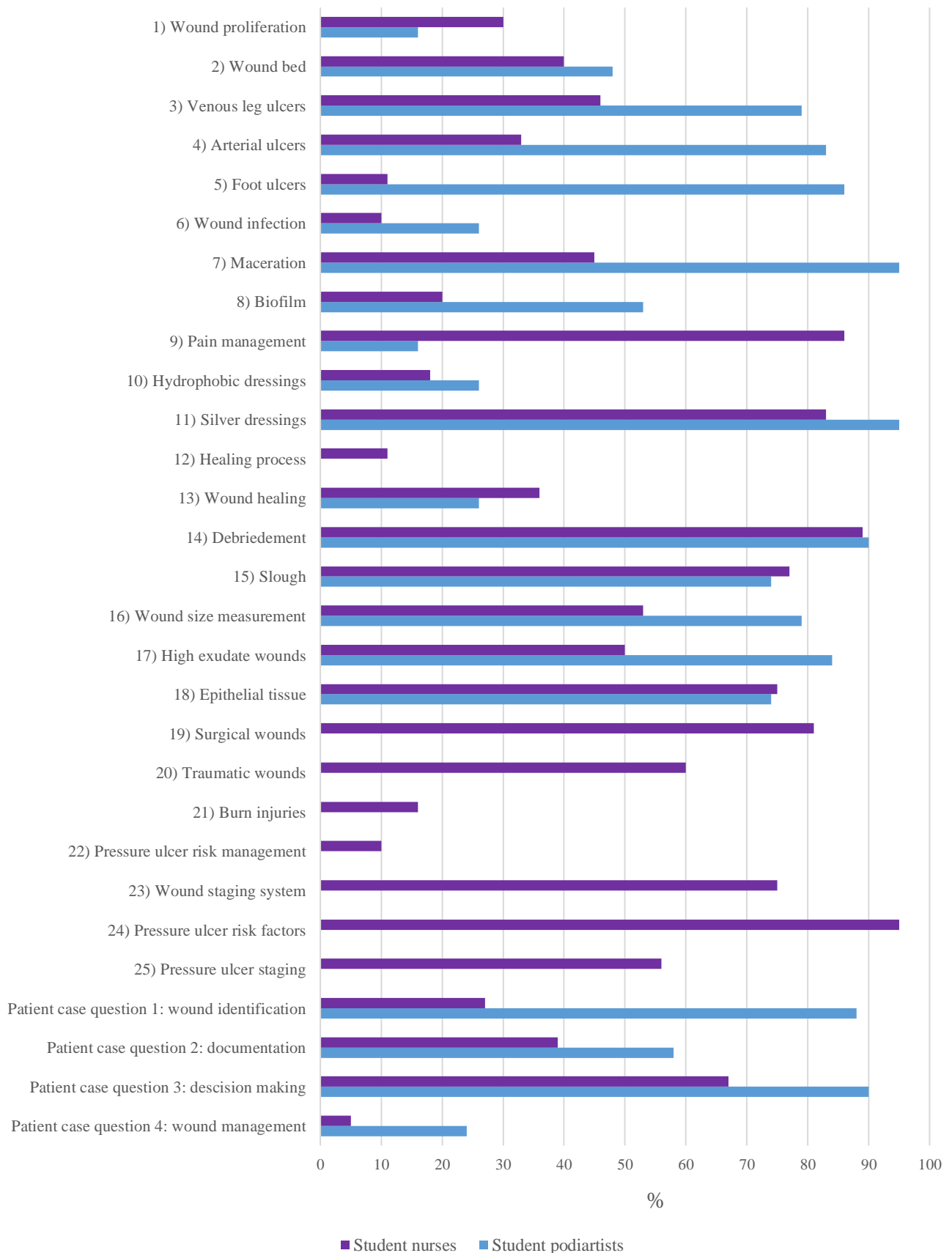


Figure 2: Percentages of students' correct knowledge test answers for each question (questions 19–25 for SNs only)

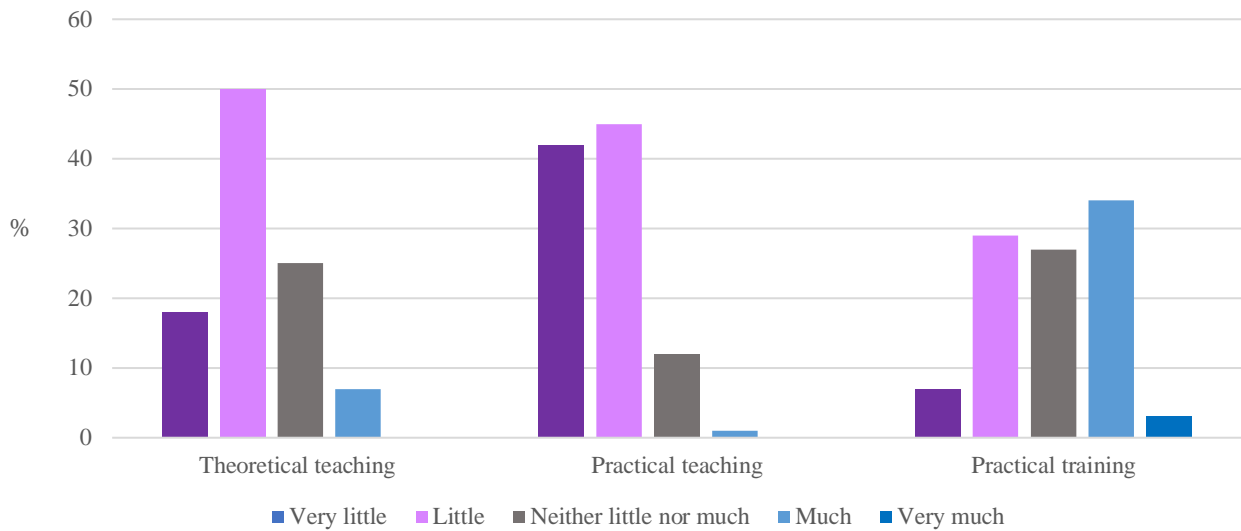


Figure 3: Students' received wound care teaching during their studies

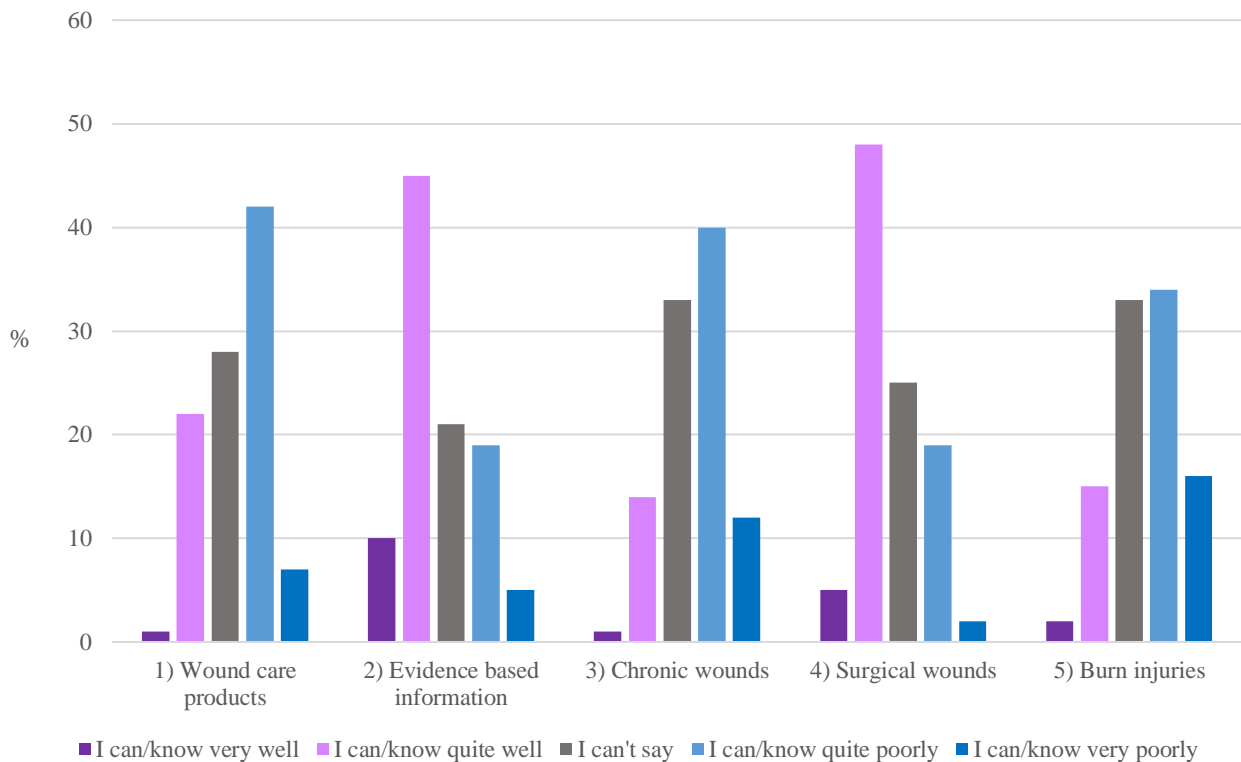


Figure 4: Students' perceived wound care competence areas (questions 4–5 for SNs only).