Medication Competence of Nursing Students in The Baltic Countries and Finland: eMedication Passport as A Learning Activity

Riitta-Liisa Lakanmaa[1], Hannele Kuusisto[1], Riikka Teuri[1], Ireen Bruus[2], Aiga Grauduma[3], Danute Golubeviene[4], Ilona Gurniene[4], Virpi Sulosaari[1]

[1]Turku University of Applied Sciences, Turku, Finland
[2]Tartu Health Care College, Tartu, Estonia
[3]P. Stradins Medical College of the University of Latvia, Jurmala, Latvia
[4]Kauno kolegija, Kaunas, Lithuania

Key words: nursing student, medication competence, competence evaluation, learning activity.

Summary. The purpose of this study was to describe the medication competence of nursing students in the Baltic countries and Finland, and to identify potential changes in medication competence and associated factors of the nursing students after the implementation of the learning tool eMedication Passport as a learning activity.

Methods. The study design was a cross-sectional quasi-experimental test. The setting was an educational setting in three nursing schools in Baltic countries and Finland. The sampling was purposive. The Medication Competence and Associated Factors tool was used. Students participating in the study answered the web-based questionnaire before and after the use of eMedication Passport. Finland participated only in the pre-survey as a reference school. The data were analysed statistically.

Results. Altogether, 288 students participated in the pre-survey and 109 students in the post-survey. There was no significant change in the medication competence evaluated by the knowledge and medication calculation test, and patient vignettes between the evaluations. The students' activeness and self-confidence in the studies related to medication management increased from the pre-survey to post-survey in the Baltic countries when using eMedication Passport as a learning activity.

Principal conclusions. Learning activities are helpful, but students need support and help in the use of them.

Introduction

As the nursing profession evolves and clinical environments become more complex, the preparation of undergraduate nurses for practice that can provide safe evidenced-based care at the bedside is imperative (1–3). Medication management as a professional task is a complex and high-risk activity (4, 5). Registered nurses and nursing students are involved in a medication administration process and work under current legislation (6). Medication management as a nurse's task encompasses many responsibilities including patient assessment and evaluation, pharmacology knowledge, medication preparation, medication calculations, medication administration, and patient education about medications (1, 7–8). Medication management consumes a significant portion of a nurse's working day and is therefore a significant concern for students approaching graduation (1). Furthermore, medication administration is one of the most critical nursing duties related to patient safety (9). Nurses, amongst other healthcare professionals, can make medication errors and students are also at risk to commit a medication error in the clinical practice (4, 9–10).

Safe administration of medication has been identified as a major area for focus in improving health care, as medication errors continue to be a consistent challenge (5, 11). Nurses have an essential role in preventing medication errors and ensuring the safety of care (3). There are many reasons behind the medication errors, one of which is the lack of adequate competence of nurses and students (12–16). Therefore, medication competence and the prevention of medication administration errors are critical skills for students to learn during their education (4, 7, 10).

Recent studies have highlighted the need to develop and ensure the content of undergraduate nursing curricula on pharmacology (14, 16), medication safety (4, 9), medical dose calculation (17) and practice possibilities during nursing education (13, 15). Further, new education methods are needed to be developed, e.g., simulation (18,19), three-

Correspondence to Riitta-Liisa Lakanmaa, Joukahaisenkatu 3, 20520 Turku, Finland.
E-mail: riitta-liisa.lakanmaa@turkuamk.fi

dimensional visualisation possibilities (20) and other active learning strategies such as gaming and social media (21) and online interventions (17).

Nursing students have reported dissatisfaction with the amount of pharmacology in their programmes, leading to uncertainty in critical decision-making and increased anxiety related to medication management (8, 14). Moreover, students have expressed critique towards nurse mentors' competences to teach pharmacology (13) or insufficient learning opportunities (15) during clinical practice. Student satisfaction is an important assessment variable for researchers and educators since it can spotlight areas of success and areas requiring further improvement in a curriculum (2). The development of medication competence is an important part of developing the education of nurses ready to take their role in medication management (22, 7). It is important that students feel adequately prepared for medication management and confident to undertake this responsibility (1, 23).

Medication competence is a fundamental part of the professional competence of nurses. Medication competence has been defined by Thelen (2022) as "a comprehensive skill that develops from the assimilation of pharmacology knowledge, pathophysiology, and anatomy awareness, pharmacogenetic integration, medication calculation and administration skills, clinical judgment, collaboration, and utilization of information technology" (24). In this study, the concept of medication competence refers to a definition by Sulosaari (7). It consists of theoretical, practical, and decision-making competence. Medication competence of nursing students has been examined widely in recent years. However, research in the field has mainly focused on medication calculation competence (7, 8). Gill et al. (2) recognised in their recent review that many researchers still focus intently on dosage calculation skills rather than pharmacotherapeutics, although dosage calculation knowledge may only reflect the students' mathematical skills and not necessarily their pharmacology knowledge.

The purpose of the study was to evaluate medication competence of the nursing students in Estonia, Finland, Latvia, and Lithuania and to identify potential changes in the medication competence and associated factors of the students in the Baltic countries after the implementation of a learning tool, eMedication Passport, as a learning activity. The evaluation of the Finnish nursing students' medication competence was used as a reference to assess the difference between Finland and the Baltic countries at the beginning of the study since the learning activity tested (eMedication Passport) has been in use since 2012 in Finland. According to the national literature review in the participating countries, there is a lack of research of medication competence in the Baltic countries. There is variation within nursing education related to medication competence in terms of the number of credits, used learning methods, or passing the tests (medication calculation) (25). The research questions were:

1. What is the medication competence and factors associated with it in the Baltic countries and Finland?

2. What is the impact of the eMedication Passport as a learning activity in the Baltic countries?

Methods

The study design was a cross-sectional quasi-experimental test. The setting was an educational setting in three nursing schools in Baltic countries and in Finland. All nursing schools participated in the pre-survey and three of them participated in the post-survey. The sampling was purposive. Finland participated only in the pre-survey as a reference school. Participating nursing students had completed the basic courses of medication administration. The student groups were selected by representative teachers at the universities. Further, the students were educated similarly to use the eMedication Passport as an educational learning activity in their nursing studies. The clinical nurses were informed as well. The study was coordinated by a multinational research group. The pre data gathering took place in Finland during autumn 2018 and in Baltic countries during spring 2019. The post data gathering took place in autumn 2019 in Baltic countries. Between these data gatherings, they were using the eMedication Passport.

The eMedication Passport was used in this study as a learning activity. It is an electronic learning workbook which is developed originally nationally in Finland for nursing students for enhancing students' learning of medication care during their clinical practice periods. The eMedication Passport includes learning tasks on medication management. The eMedication Passport describes the entirety of medication competence and makes the required medication competence transparent to students, teachers, and supervisors. The eMedication Passport is a nurse student's personal document, which contains a record of studies completed in pharmacology, medication management and medication calculations (26). For this project, the content and cultural validity was tested.

To evaluate the medication competence of the students, the MCAF test (Medication Competence and Associated Factors) was used, developed, and modified by Sulosaari. The instrument was shortened and adapted culturally to local legislation. A back-forward translation process was used

into four language versions (English, Estonian, Latvian, and Lithuanian). The evaluation of the theoretical medication competence consisted of four subcategories and 25 items: *legislation and guidelines including the common abbreviations used* (5), *pharmacology* (5), and *handling and preparation of medications ready for use and medication administration* (5). *The practical medication competence* was evaluated by medication calculations (5). The evaluation of *decision-making competence* consisted of short patient vignettes (5) (Table 1).

The students participating in the project answered the web-based questionnaire before and after the use of eMedication Passport. The questionnaire had three parts. Section A included background variables about the studies, student's age, gender, country, previous work experience in health care and perceptions of the studies related to medication management including their own self-assessed perception of their activeness on studies and self-confidence on medication management. Section B included questions about students' perceptions of learning medication management in the clinical practice. These results are reported elsewhere (27). Section C included the MCAF test about medication competence. The questionnaire was evaluated by the multinational research group and piloted prior to the data gathering.

The data were analysed statistically using IBM SPSS Statistics versions 24, 25 and 27 (IBM Corp.) Cronbach's alpha coefficient was used to assess the internal consistency of the students' perceptions of the studies related to medication management and the sub-parts of the MCAF instrument. Sum variables were calculated taking the mean of items. Descriptive statistics, such as frequencies, means and standard deviations (SD) were used to describe the data. The Pearson (r) correlation coefficient was used to evaluate the correlations between sum-variables and continuous background variables. The normality of the variables was not tested as, according to Central limit theorem, violation of the normality is not a major issue with sample size 100 or more observations, and therefore normality is rarely tested with sample size like this. The associations of categorical background variables with sum-variables

Table 1. Subcategories and items of Medication Competence and Associated Factors

Subcategory: Legislation and abbreviation commonly used in medication management
1. Generic name 2. Supervision authority 3. Nurses right to prescribe/change a medicine form 4. Abbreviation of a drug form 5. Generic substitution
Subcategory: Pharmacology
6. Drug tolerance 7. Pharmacokinetic medicine interaction 8. Agonist drug 9. Drug absorption 10. Absorption and a drug form
11. Subcategory: Medication administration
12. A score line in a tablet 13. Administering of infusion concentrate 14. A drug form and time to get effect 15. The Z track technique 16. Administering of enterotablets
Subcategory: Practical medication competence (medication calculations)
17. Dosage (injection) 18. Number of tablets needed for a day (based on prescription and available medicine product) 19. Dosage received (infusion) 20. Drop rate (ml/hour) for infusionDilution
Subcategory: Decision-making competence (short patient vignettes)
21. Patient intracerebral hemorrhage symptoms: identify infusion fluid to be avoided or used in caution 22. Identify optimal goal for INR-level in most patients with chronic atrial fibrillation 23. Patient has hepatic insufficiency: identify analgetic to be avoided 24. Giving instruction for a patient on tablets patient forgot to take 25. Identify risk of Antabus reaction on specific antimicrobial medicine and alcohol

were examined using the Mann-Whitney U test. As students were not identified as individuals, potential changes in medication competence scores were analysed only as two Baltic student cohorts using linear mixed model analysis. *P* values less than 0.05 were considered statistically significant.

Ethical approval statement was applied from a Finnish partner university for the overall study. The research permission process was conducted according to the guidelines of each university. The participants were informed about the purpose of the study and voluntary participation. Their anonymity and confidentiality were guaranteed. The study did not have any special ethical issues and the participants were also informed that they could stop their participation in the study at any time without giving any explanations. The permission of using the MCAF test was obtained.

Results

Altogether 288 ($N_{Estonia}$ = 75, $N_{Finland}$ = 84, N_{Latvia} = 58, $N_{Lithuania}$ = 68 and $N_{missing\ country}$ = 3) students participated in the pre-survey and 109 ($N_{Estonia}$ = 44, N_{Latvia} = 16, $N_{Lithuania}$ = 47 and $N_{missing\ country}$ = 2) students participated in the post-survey. In this study, it was not possible to calculate the exact response rate because of the constant changes in student groups. Most of the students were female (88% in the pre-survey and 87% in the post-survey). Their average age was 25 years (variance 19–53, SD 6.9) in the pre-survey and 24 years (variance 20–53, SD 6.9) in the post-survey. At the time of the pre-survey, the students were mainly 2nd-year students with 2 clinical practice periods, and at the time of the post-survey, they were mainly 3rd-year students with 4 or 6 clinical practice periods (average 4.7). About a fifth of them had previous work experience in health care and over 90% had passed the medication calculation exam at least once. Over 60% had good or excellent grades in the examination on the theoretical basis of pharmacotherapy in both surveys.

The average points of the Baltic students in medication competence MCAF test were 13.7 out of 25 i.e., 55% correct (variance 4–22 points, SD 3.8) in the pre-evaluation and 13.6 points (variance 2–21, SD 4.3) in the post-evaluation. Therefore, there was no significant change in the medication competence between the evaluations when considering the total medication competence scores only. The highest scores, when considering all the Baltic students together, they achieved in medication calculations pre-evaluation were on average 3.2 points out of 5 (Fig. 1). For reference, the average points of the Finnish students were 17.3 (variance 5–25, SD 3.7) and the medication calculations were the best-known category also in the Finnish students.

The percentage of correct answers per question varied in the Baltic countries from 10.0% to 90.5% in the pre-evaluation and from 11.9% to 91.7% in the post-evaluation. For reference, the percentage of correct answers in Finland varied from 43.4% to 96.4% and the percentage of correct answers per question was mainly higher than in the Baltic countries (Fig. 2).

There were differences in the medication competence between the Baltic countries. In Estonia, the medication competence increased from pre-evaluation to post-evaluation, but in Latvia the

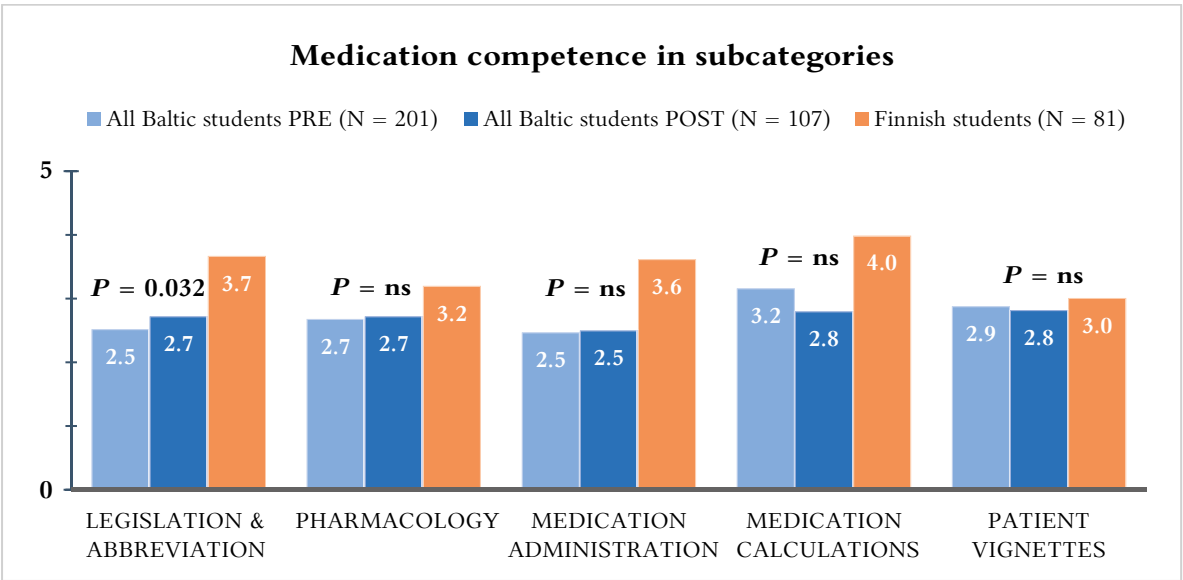

Fig. 1. Medication competence average points in subcategories

P = statistically significant difference with the average points of all the Baltic students PRE vs POST test evaluation, ns = statistically non-significant difference

scores decreased and in Lithuania the medication competence was almost the same in both evaluations (Table 2). There were also differences between the medication competence subcategories. In Estonia, the medication competence scores increased in every subcategory. In Latvia, the scores decreased in all the subcategories except the patient vignettes category. In Lithuania, the scores increased in the legislation and pharmacology categories, decreased in medication calculations as well as in the patient vignettes category and stayed the same in the medication administration category (Table 2). When considering the change in the medication competence subcategory scores for all the Baltic students, there was a statistically significant change in the legislation category according to the linear mixed model test. The changes in other categories were not statistically significant.

Factors associated with the medication competence scores were evaluated with correlation coefficients when comparing the scores with continuous factors and with statistical tests when comparing independent backgound variable groups. Associated factors were analysed from the pre-survey data

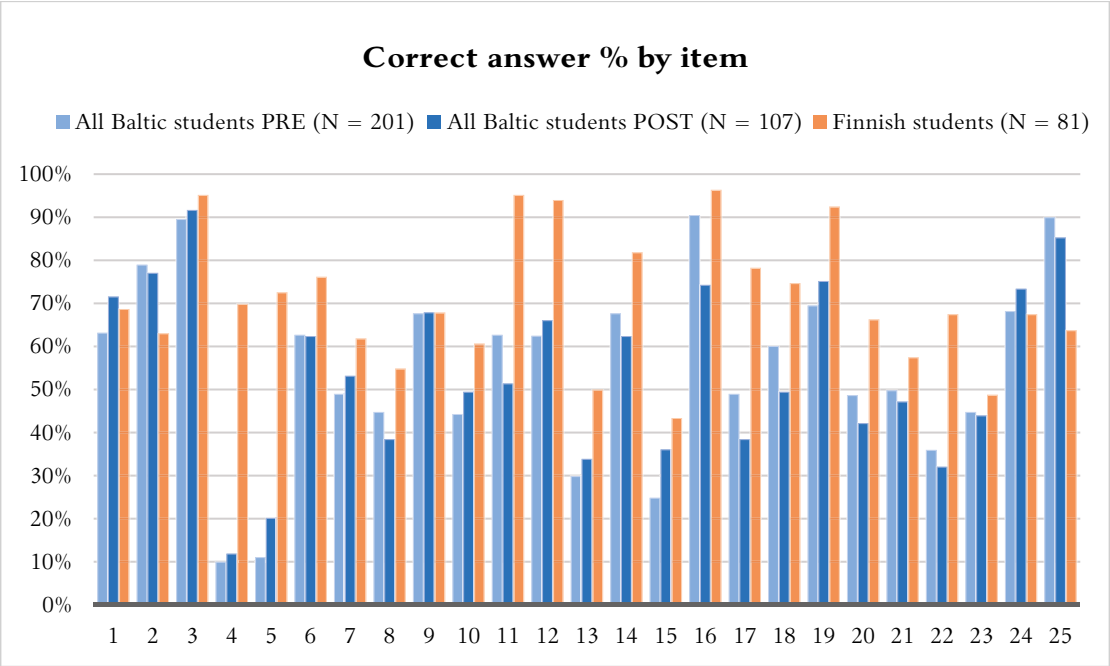

Fig. 2. The percentage of the correct answers by item

Table 2. Medication competence evaluation mean scores by category in Baltic countries and Finland

	Estonia mean ± SD		Latvia mean ± SD		Lithuania mean ± SD		Finland mean ± SD
Medication competence category	PRE (N = 75)	POST (N = 44)	PRE (N = 58)	POST (N = 16)	PRE (N = 68)	POST (N = 47)	PRE (N = 84)
Legislation & abbreviation	2.37 ± 0.90	2.55 ± 0.88	2.74 ± 0.69	2.38 ± 0.50	2.50 ± 0.91	3.06 ± 1.05	3.67 ± 1.10
Pharmacology	3.12 ± 1.32	3.32 ± 1.16	2.98 ± 1.33	2.81 ± 1.28	1.94 ± 1.06	2.19 ± 1.23	3.20 ± 1.21
Medication administration	2.35 ± 1.02	2.93 ± 0.97	3.19 ± 0.81	3.00 ± 0.89	2.00 ± 1.02	1.98 ± 1.13	3.62 ± 0.97
Medication calculations	3.67 ± 1.08	3.89 ± 0.97	3.48 ± 1.30	2.94 ± 1.24	2.32 ± 1.19	1.77 ± 1.59	3.99 ± 1.24
Patient vignettes	2.49 ± 0.99	2.86 ± 1.05	3.90 ± 1.29	4.19 ± 0.75	2.44 ± 1.06	2.30 ± 1.41	3.01 ± 1.40
Total sum (max 25 p)	14.00 ± 3.43	15.55 ± 2.96	16.29 ± 3.33	15.31 ± 2.68	11.21 ± 3.05	11.30 ± 4.67	17.33 ± 3.67

only because the number of the respondents was significantly lower in the post-survey, making it harder to get statistically significant correlations. The student's gender, age, phase of the studies, previous working experience in health care and the grade in the examination on the theoretical basis of pharmacotherapy had a correlation with the medication competence. Male students, older students, senior nursing students, students with longer work experience in health care and students with better grade in the pharmacotherapy examination had a higher score in MCAF test all together or at least in some categories of the test (Table 3).

Male students had higher scores in the medication competence test than female students (mean score 16.52 vs 14.59; $P = 0.009$). They performed better in the legislation competence (mean 3.12 vs 2.82; $P = 0.020$) and in medical calculations (mean 4.15 vs 3.31; $P = 0.000$). Age had a positive correlation with the total test scores as well as all the subcategories except of the medicaton calculation performance. The study year had a positive correlation with the total test scores as well as all the subcategories except of the pharmacology knowledge. These mean that the knowledge increases as the students' age rises and the studies progress. The grades in the examination on the theoretical basis of pharmacotherapy had a positive correlation with the legislation competence and patient vignettes competence (Table 3). Previous working experience correlated positively with the medication competence. Students with longer working experience in health care had higher scores in MCAF test, especially in legislation & abbreviation and medication administration categories. The students with prior nurse assistant experience had higher scores in pharmacology (mean 3.35 vs 2.78; $P = 0.008$) and medical administration competence (mean 3.23 vs 2.77; $P = 0.019$). The students with practical nurse experience had higher scores in legislation and abbreviation (mean 3.39 vs 2.78; $P = 0.002$) and in medical administration competence (mean 3.21 vs 2.77; $P = 0.018$) (Table 3).

The students were asked to give a self-evaluation on their activeness and self-confidence in the studies related to medication management. The internal consistency of the sum variables in these subjects were good in both surveys (Table 4). The students' activeness and self-confidence in studies related to

Table 3. Connections between background variables and the medication competence evaluation score

	Medication competence evaluation score (total sum & subcategories)					
Categorical background variables Means (significance)	Total score (max 25)	Legislation & abbreviation (max 5)	Pharmacology (max 5)	Medication administration (max 5)	Medication calculations (max 5)	Patient vignettes (max 5)
Gender: male vs. female	16.52 vs 14.59 ($P = 0.009$)	3.12 vs 2.82 ($P = 0.020$)	3.12 vs 2.80 (ns)	3.06 vs 2.79 (ns)	4.15 vs 3.31 ($P < 0.001$)	3.06 vs 2.91 (ns)
Previous working experience: a) Nurse assistant experience vs. none b) Practical nurse experience vs. none		b) 3.39 vs 2.78 ($P = 0.002$)	a) 3.35 vs 2.78 ($P = 0.008$)	a) 3.23 vs 2.77 ($P = 0.019$) b) 3.21 vs 2.77 ($P = 0.018$)		
Continuous background variables Pearson correlation (significance)	Total score	Legislation & abbreviation	Pharmacology	Medication administration	Medication calculations	Patient vignettes
Age	r = 0.189 ($P = 0.001$)	r =0.137 ($P = 0.020$)	r = 0.131 ($P = 0.026$)	r = 0.176 ($P = 0.003$)	r = 0.050 (ns)	r = 0.142 ($P = 0.017$)
Study year	r = 0.270 ($P < 0.001$)	r = 0.282 ($P < 0.001$)	r = 0.114 (ns)	r = 0.220 ($P < 0.001$)	r = 0.134 ($P = 0.023$)	r = 0.146 ($P = 0.014$)
Working experience in health care (years)	r = 0.170 ($P = 0.004$)	r = 0.198 ($P = 0.001$)	r = 0.061 (ns)	r = 0.220 ($P < 0.001$)	r = 0.085 (ns)	r = 0.084 (ns)
Grade in the examination on the theoretical basis of pharmacotherapy	r = 0.083 (ns)	r = 0.122 ($P = 0.039$)	r = 0.034 (ns)	r = 0.095 (ns)	r = –0.047 (ns)	r = 0.122 ($P = 0.040$)

ns = statistically non-significant difference or connection

medication management increased from pre-survey to post-survey in the Baltic countries (activeness mean from 3.64 to 3.86 and self-confidence mean from 3.51 to 3.70). The change in both was statistically significant according to the linear mixed model (Table 4). The Estonian students' average in activeness and self-confidence grew the most.

Students' activeness and self-confidence in studies related to medication management correlated positively with the medication competence scores (Table 5). In the pre-survey, students' activeness had a positive connection only to the patient vignettes scores. However, after the eMedication Passport learning activity implementation, the students' activeness had a mediocre and statistically significant correlation with the medication competence total score as well as all the subcategories except pharmacology. Likewise, the positive effect of students' self-confidence on medication competence scores grew significantly after implementation. Students' self-confidence correlated positively with the medication competence total score as well as the subcategories

Table 4. The students' activeness and self-confidence at the medication management related studies

	Pre-survey mean ± SD (α)		Post-survey mean ± SD (α)	*P* value
Sum variable	Finland (N = 79–82)	Baltic countries (N = 193–196)	Baltic countries (N = 101)	Baltic countries Pre- vs post-survey
Active participation in studying topics of medication care (4 items)[1]	3.99 ± 0.69 (0.664)	3.64 ± 0.75 (0.680)	3.86 ± 0.67 (0.717)	0.005
Self-confidence in medication management (5 items)[1]	3.50 ± 0.89 (0.902)	3.51 ± 0.73 (0.879)	3.70 ± 0.69 (0.903)	0.007

[1] Sum-score on a scale of 1–5, strongly disagree–strongly agree

Table 5. Correlation coefficients between medication competence and the studies related to medication management in Baltic countries (pre- and post-evaluation). Statistically significant correlations bolded

	Correlations in Baltic countries pre-evaluation (N = 201) Pearson correlation (*P* value)					
	Total test score	Legislation & abbreviation	Pharmacology	Medication administration	Medication calculations	Patient vignettes
Active participation in studying topics of medication care [1]	0.068 (ns)	0.118 (ns)	–0.043 (ns)	0.072 (ns)	–0.034 (ns)	0.145 (0.040)
Self-confidence in medication management [1]	0.202 (0.004)	0.160 (0.023)	0.072 (ns)	0.143 (0.042)	0.179 (0.011)	0.118 (ns)

	Correlations in Baltic countries post-evaluation (N = 109) Pearson correlation (*P* value)					
	Total test score	Legislation & abbreviation	Pharmacology	Medication administration	Medication calculations	Patient vignettes
Active participation in studying topics of medication care[1]	0.370 (< 0.001)	0.209 (0.029)	0.165 (ns)	0.268 (0.005)	0.256 (0.007)	0.341 (< 0.001)
Self-confidence in medication management[1]	0.373 (< 0.001)	0.008 (ns)	0.291 (0.002)	0.383 (< 0.001)	0.372 (< 0.001)	0.130 (ns)

[1] Sum-score on a scale of 1–5, strongly disagree–strongly agree
ns = statistically non-significant connection

of pharmacology, medication administration and medication calculations. This means that the more active or self-confident the student is in studies related to medication management, the better medication competence he/she has.

The eMedication Passport learning tool was piloted in the Baltic countries for the first time during the project. The use of eMedication Passport was however minor. Although 70% of the students reported using the eMedication Passport, only 19% of the students confirmed using it actively and 40% of the students felt that the use of eMedication Passport did not support their learning of medication care in clinical practice very well (Fig. 3).

Discussion

Registered nurses compose the largest workforce of health care professionals involved in medication management (28). Globally, approximately 5 of 100 hospitalised patients experience medication errors, and medication errors are the most common errors in nursing care (29). Medication competence is one of the essentials areas of professional nursing competences and therefore an important part of nursing education (c.f. 7). Further, medication competence plays an important role in medication safety which is moreover an integral part of patient safety entity (5). On that count, it is extremely important in nursing education to develop nursing curricula, teaching methods and clinical learning activities to enhance learning in medication competence both in theory as well in practice. It is important to make medication care and medication competence visible in nursing education immediately from the beginning of the education. Learning activities, such as eMedication Passport learning tool, are needed.

The Baltic students average score in MCAF test was 13.7 out of 25 before the implementation of the eMedication Passport learning tool and 13.6 after. Therefore, no significant change in the medication competence was observed when considering the test scores alone. The highest score in individual subcategories was for the Baltic students in pre-survey in medication calculations where the students achieved 3.2 out of 5. Medication competence of the nursing students varied somewhat between the Baltic countries. Even though there was no significant change in the medication competence test score, students' activeness and self-confidence related to medication management were increased via the use of the eMedication Passport. It was also observed that both had a positive correlation with the medication competence MCAF scores. Therefore, it could be argued that eventually the use of the eMedication Passport learning tool could have an influence on the medication competence shown in MCAF test scores.

According to previous competence literature also in this study, the student's age, phase of the studies and previous working experience in health care had a positive correlation with the medication competence. This is good news for the nurse educators, while it is known that the students are working actively during the school semesters in clinical practice. Using the eMedication Passport

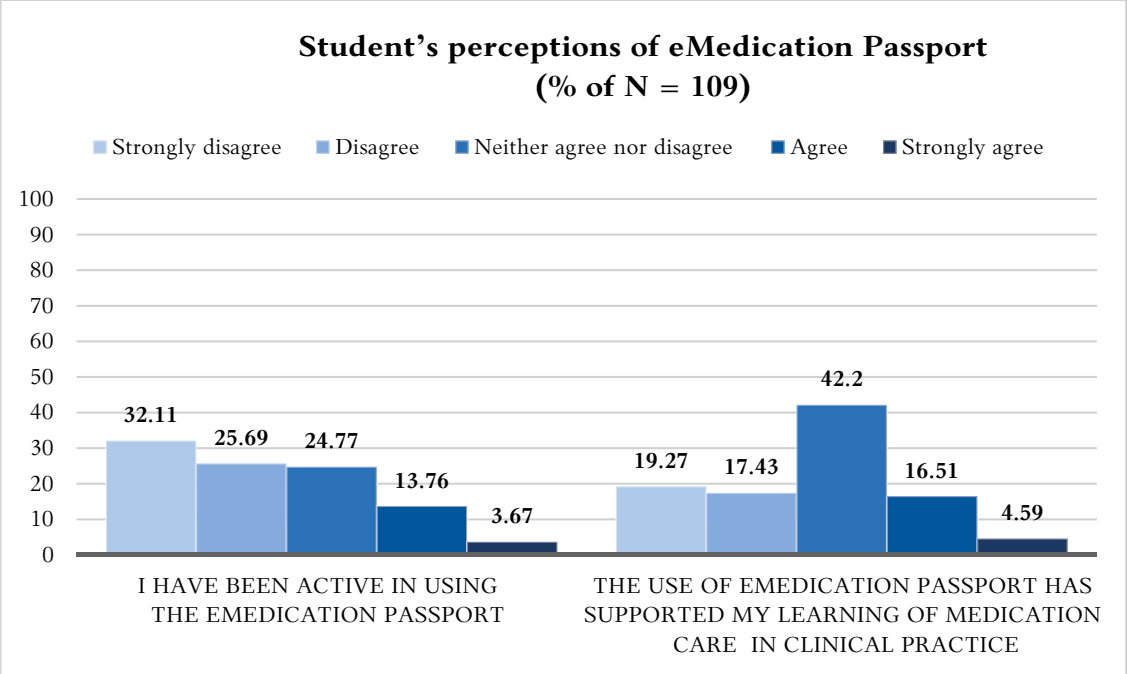

Fig. 3. Students' perception in using and support of the learning of eMedication Passport

tool had no effect on the medication competence scores in this study. Musafiri & Daniels (15) found in their study that most respondents perceived themselves as competent in some respects related to the administration of oral medication. However, few perceived themselves as generally competent in this competency. Further, Cleary-Holdforth and Leufer (1) also found that students do not feel adequately prepared for medication management and confident to undertake this responsibility. In addition, Ghamari-Zare and Adib-Hajbaghery (13) outline in their study that the students' satisfaction regarding their own knowledge and skill of pharmacology and medication management was at medium level. According to all these studies, something must be done, and medication competence and learning activities must be researched more effectively.

It must be taken into consideration, that the eMedication Passport was a new learning tool to the students of the Baltic countries, the time of the tool use was very short in this pilot study and the students did not use the learning tool actively. However, students' activeness and self-confidence in studies related to medication management increased during this study in the Baltic countries. As these factors are associated to the medication competence scores based on this study, significant effects on the medication competence could be expected when implementing the tool as part of the studies in a longer period. Use of the eMedication Passport increased students' awareness and practices related to medication competence teaching and practice, which is crucial. There is a place for further studies and learning activity testing. For example, in Finland, special attention has been paid to medication competence for several decades, and therefore, the Finnish nursing students may have better medication competence. Nursing students' use of the eMedication Passport in clinical practice was not active. In future, there is an obvious need to develop interventions on how to commit students, supervisors in clinical practice and teachers to use eMedication Passport as a learning activity in nursing education, and how to discuss medication competence with the help of the eMedication Passport and consider the career pathway in point of the medication competence.

There are some limitations to this study. The sampling was purposive, and the sample was quite small. There were no control groups in this study. Therefore, in future a more detailed quasi-experimental study design should be used when testing the eMedication Passport. One limitation is also the orientation of the use of the eMedication Passport in theory and practice. The students and mentor nurses should have been more effectively prepared for working with the learning activity. Therefore, in future, the learning activity must be more visible and emphasised by educators for students and mentor nurses, e.g., with posters, flyers, and pop-ups, telling about the magnificence of the innovative learning activity. There are also strengths in this study. The cultural adaptation aspects related to the use of eMedication Passport were examined and considered. The eMedication Passport was tested internationally between three countries. Further, the strength in this study is that MCAF is a tested, reliable, and valid tool to assess medication competence. Still, it is obvious that some other tools or scales or methods to evaluate the medication competence could have been used alongside as criterion measurement. The analysis was limited to Baltic students only, for they provided data for the analysis both in pre- and post-survey.

Conclusions

There were differences in medication competence between the Baltic countries and compared with Finland. Baltic students and Finnish students achieved the highest scores in medication calculations. The students' age, phase of the studies, and previous working experience in health care had a positive correlation with the medication competence. The student's activeness and self-confidence in studies related to medication management increased from pre-survey to post-survey in the Baltic countries. In future, medication competence learning activities should be developed and implemented for nursing students during their whole education effectively, together in collaboration with supervisors and nurse educators. Learning activities are helpful, but students need support and control as well as help in the use of them. It is topical in Baltic countries as well as in Finland to develop and continuously improve nursing students' medication competence and pay attention to students' supervision in clinical practice, competence of clinical nurses and supervisors. Equally essential is to evaluate the amount and visibility of medication competence in nursing Curricula.

Acknowledgements

We would like to thank all the nursing students in Estonia, Finland, Latvia, and Lithuania who participated in this study.

Statement of Conflict of Interest

The authors have no conflict of interest.

Funding Source

This work was supported by EU, Erasmus+, Cooperation for innovation and the exchange of good practices, Strategic Partnerships for higher education 2017-1-EE01-KA203-034884.

References

1. Cleary-Holdforth J, Leufer T. Senior Nursing Students' Perceptions of Their Readiness for Oral Medication Administration Prior to Final Year Internship: A Quantitative Descriptive Pilot Study. Dimens Crit Care Nurs 2020;39(1):23-32. doi: 10.1097/DCC.0000000000000401.
2. Gill M, Andersen E, Hilsmann N. Best practices for teaching pharmacology to undergraduate nursing students: A systematic review of the literature. Nurse Educ Today 2019;74:15-24. doi: 10.1016/j.nedt.2018.11.017.
3. Green C. Contemporary issues: The pre-licensure nursing student and medication errors. Nurse Educ Today 2018;68:23-25. doi: 10.1016/j.nedt.2018.05.016.
4. Asensi-Vicente J, Jiménez-Ruiz I, Vizcaya-Moreno MF. Medication Errors Involving Nursing Students: A Systematic Review. Nurse Educ 2018;43(5):E1-E5. doi: 10.1097/NNE.0000000000000481.
5. WHO [Internet]. Patient Safety Curriculum Guide, Multi-professional edition. 2011 [cited 2023 Jul 27]. Available from: URL: https://www.who.int/publications/i/item/9789241501958
6. Gaard M, Orbæk J. Supervising nursing students in a technology-driven medication administration process in a hospital setting: a systematic review protocol. JBI Database System Rev Implement Rep 2016;14(8):52-7. doi: 10.11124/JBISRIR-2016-003051.
7. Sulosaari V. Medication competence of nursing students in Finland. PhD Thesis. University of Turku, Finland, 2016. In: Annales Universitatis Turkuensis [Internet], ser D, tom 1232 [cited 2021 Jul 23]. Available from: URL: https://www.utupub.fi/handle/10024/124032
8. Sulosaari V, Kajander S, Hupli M, Huupponen R, Leino-Kilpi H. Nurse students' medication competence – an integrative review of the associated factors. Nurse Educ Today 2012;32(4):399-405. doi: 10.1016/j.nedt.2011.05.016.
9. Lee SE, Quinn BL. Incorporating medication administration safety in undergraduate nursing education: A literature review. Nurse Educ Today 2019;72:77-83. doi: 10.1016/j.nedt.2018.11.004.
10. Treiber LA, Jones JH. After the Medication Error: Recent Nursing Graduates' Reflections on Adequacy of Education. J Nurs Educ 2018;57:275-280.
11. Farley D, Zheng H, Rousi E, Leotsakos A. Field Test of the World Health Organization Multi-Professional Patient Safety Curriculum Guide. PLoS One 2015;10(9):e0138510. doi: 10.1371/journal.pone.0138510.
12. Bagnasco A, Galaverna L, Aleo G, Grugnetti AM, Rosa F, Sasso L. Mathematical calculation skills required for drug administration in undergraduate nursing students to ensure patient safety: A descriptive study: Drug calculation skills in nursing students. Nurse Educ Pract 2016;16(1):33-9. doi: 10.1016/j.nepr.2015.06.006.
13. Ghamari Zare Z, Adib-Hajbaghery M. Performance of Clinical Nurse Educators in Teaching Pharmacology and Medication Management: Nursing Students' Perceptions. Nurs Midwifery Stud 2016;5(1):e29913. doi: 10.17795/nmsjournal29913.
14. López-Entrambasaguas OM, Martínez-Yebenes R, Calero-García MJ, Granero-Molina J, Martínez-Linares JM. Newly Qualified Nurses' Perception of Their Competency Achievement on Leaving University: A Qualitative Study. Int J Environ Res Public Health 20194;16(21):4284. doi: 10.3390/ijerph16214284.
15. Musafiri JJ, Daniels F. Nursing students' perceptions of clinical learning opportunities and competence in administration of oral medication in the Western Cape. Curationis 2020;43(1):e1-e9. doi: 10.4102/curationis.v43i1.2044.
16. Preston P, Leone-Sheehan D, Keys B. Nursing student perceptions of pharmacology education and safe medication administration: A qualitative research study. Nurse Educ Today 2019;74:76-81. doi: 10.1016/j.nedt.2018.12.006.
17. Mackie JE, Bruce CD. Increasing nursing students' understanding and accuracy with medical dose calculations: A collaborative approach. Nurse Educ Today 2016;40:146-53. doi: 10.1016/j.nedt.2016.02.018.
18. Cancino KD, Arias M, Caballero E, Escudero E. Development of a safe drug administration assessment instrument for nursing students. Rev Lat Am Enfermagem 2020;28:e3246. doi: 10.1590/1518-8345.2989.3246.
19. Mariani B, Ross JG, Paparella S, Allen LR. Medication safety simulation to assess student knowledge and competence. Clinl Simul Nurs 2017;13:210-216.
20. Morales KA. Active Learning Strategies to Enhance Nursing Students' Knowledge of Pharmacology. Nurs Educ Perspect 2017;38(2):100-102. doi: 10.1097/01.NEP.0000000000000085.
21. Hanson J, Andersen P, Dunn PK. Effectiveness of three-dimensional visualisation on undergraduate nursing and midwifery students' knowledge and achievement in pharmacology: A mixed methods study. Nurse Educ Today 2019;81:19-25. doi: 10.1016/j.nedt.2019.06.008.
22. Sulosaari V, Suhonen R, Leino-Kilpi H. An integrative review of the literature on registered nurses' medication competence. J Clin Nurs 2011;20(3-4):464-78. doi: 10.1111/j.1365-2702.2010.03228.x.
23. Leufer T, Cleary-Holdforth J. Senior Nursing Students' Perceptions of Their Readiness for Practice Prior to Final Year Internship: Part 2-A Qualitative Perspective. Dimens Crit Care Nurs 2020;39(2):81-90. doi: 10.1097/DCC.0000000000000407.
24. Thelen M. Medication competence: a concept analysis. Nurse Educ Today 2022;111:105292. doi: 10.1016/j.nedt.2022.105292.
25. Kiljako M, Sulosaari V, Grauduma A, et al. Nursing Students' Medication Competence in Finland, Estonia, Latvia and Lithuania – Overview of National Study Results. 2017 [Internet] [cited 2023 Jul 27]. Available from: URL: https://emedpassport.wordpress.com/
26. Medication passport [Internet] [cited 2023 Jul 27]. Available from: URL: https://laakehoitopassi.fi/
27. Kiljako M, Lenk-Adusoo M, Teuri R, Kuusisto H, Bruus I. Undergraduate Nursing Students' Evaluations of Learning Medication Management in Clinical Practice. NERP 2021;11(2):15-22.
28. Eisenhauer LA, Hurley AC, Dolan N. Nurses' reported thinking during medication administration. J Nurs Scholarsh 2007;39(1):82-7. doi: 10.1111/j.1547-5069.2007.00148.x.
29. Latimer S, Hewitt J, Stanbrough R, McAndrew R. Reducing medication errors: Teaching strategies that increase nursing students' awareness of medication errors and their prevention. Nurse Educ Today 2017;52:7-9. doi: 10.1016/j.nedt.2017.02.004.

Received July 2022
Accepted December 2022