Nurse Education Today 106 (2021) 105060

Contents lists available at ScienceDirect

Nurse Education Today

journal homepage: www.elsevier.com/locate/nedt

Nursing informatics competences of Finnish registered nurses after national educational initiatives: A cross-sectional study

Anu-Marja Kaihlanen [a,*], Kia Gluschkoff [a], Ulla-Mari Kinnunen [b], Kaija Saranto [b], Outi Ahonen [c], Tarja Heponiemi [a]

[a] Finnish Institute for Health and Welfare, P.O. Box 30, FI-00271 Helsinki, Finland
[b] Department of Health and Social Management, University of Eastern Finland, Kuopio, Finland
[c] Laurea University of Applied Sciences, Vantaa, Finland

ARTICLE INFO

Keywords:
Nursing informatics
Competence
Newly graduated nurse
Education
Nursing
eHealth

ABSTRACT

Background: Nursing informatics competences (ie. knowledge and skills in electronic and structured documentation) have become a necessary prerequisite for nurses to carry out their professional roles. Therefore, there is a global need to integrate nursing informatics into nursing curricula. In Finland, the requirements to increase nursing informatics education were noted in eHealth strategies in 2015. However, it is not known whether these educational initiatives have succeeded in increasing nursing informatics competences of recent nursing graduates.

Objectives: To examine whether nurses who graduated after the Finnish educational initiatives have higher nursing informatics competences than nurses who graduated before the initiatives. Additionally, the associations of age, gender, work setting and geographical area with the nurses' informatics competences were examined.

Design: Cross-sectional study.

Settings: The study was carried out between October–December 2018 in Finland.

Participants: Registered nurses who graduated before (n = 931) and after (n = 712) the 2015 educational initiatives.

Methods: Nursing informatics competences were measured by four items: (1) terminology-based documentation, (2) patient-related digital work, (3) general IT competency and (4) electronic documentation according to structured national headings. The associations of the year of the graduation and demographic background variables with nurses' overall nursing informatics competence and also separately with four specific competence items were examined with analysis of covariance.

Results: Nurses' graduation year was associated with their overall nursing informatics competence and the specific competence related to terminology-based documentation. Nurses who had graduated after the initiatives had higher competence than nurses with earlier graduation years. Associations were also found between age and work setting with the nursing informatics competences. Younger nurses and nurses working in specialised healthcare and elderly care had the highest competence.

Conclusions: The national eHealth strategies with educational initiatives seem to have affected favorably on nursing informatics education in Finnish nursing programs and have potentially led to increased nursing informatics competences of recent nursing graduates. The results of this study highlight the importance of educational policies stating the directions and objectives of education programs.

1. Introduction

Due to the rapid and ongoing increase of Information and Communication Technology (ICT) in society, there has been a growing demand for the competences needed to adapt to digitalisation(Ferrari, 2013; Gallardo-Echenique et al., 2015). Integrating digitalisation successfully in policies and practices has become essential in the healthcare context where professionals require new knowledge, skills and attitudes towards

* Corresponding author at: Finnish Institute of Health and Welfare, P.O. Box 30, FI-00271 Helsinki, Finland.
E-mail addresses: anu.kaihlanen@thl.fi (A.-M. Kaihlanen), kia.gluschkoff@thl.fi (K. Gluschkoff), ulla-mari.kinnunen@uef.fi (U.-M. Kinnunen), kaija.saranto@uef.fi (K. Saranto), outi.ahonen@laurea.fi (O. Ahonen), tarja.heponiemi@thl.fi (T. Heponiemi).

https://doi.org/10.1016/j.nedt.2021.105060
Received 29 January 2020; Received in revised form 21 June 2021; Accepted 11 July 2021
Available online 20 July 2021

digital technology and technology-based services (Konttila et al., 2019). The state of health care digitalisation and the use of health information systems vary considerably between different countries (Thiel et al., 2019). However, there is a globally shared concern about the health workforces' ill-preparedness for the digital transformation and how they should be equipped for the digitalisation through better incentives and adequate training (European Health Parliament, 2016; OECD, 2019).

Staying up to date with novel technologies and changing health information systems creates new educational needs for health care professionals (Ashrafi et al., 2014; Vehko et al., 2018). Concerns have been expressed, for example, regarding the use of online services in patient care and how competent health professionals are to guide and support people through and in the use of new online services (Kujala et al., 2018; Öberg et al., 2018). Increased educational needs have also been reported in regard to client records systems, structured documentation, basic IT skills (Tolonen and Värri, 2017) and skills that are required in adopting new digital services in client care (Kinnunen et al., 2019; Öberg et al., 2018). All of the above-mentioned education needs are seen as the priority competence areas for professionals providing care (Carrasqueiro, 2018). This study focuses on the nursing informatics competences of registered nurses and examines the potential impact of national educational initiatives on nursing informatics competences.

2. Background

The use of digital services has become an essential part of nurse's work and consequently, competences related to informatics have become a necessary prerequisite for nurses to carry out their professional roles (Khezri and Abdekhoda, 2019; Kinnunen et al., 2019; T.I.G.E.R., 2011). Nursing informatics has been defined as the processing of information (collection, processing, storing and sharing of data) and integration of ICT for promoting patients or clients' health (Staggers et al., 2002; Staggers and Thompson, 2002). Nurses' informatics competence affects the quality of healthcare (Darvish et al., 2014; Lin et al., 2014) and nurses need sufficient informatics literacy for providing safe care for the clients and the management of services (De Gagne et al., 2012).

The discussion about the lack of sufficient competence in nursing informatics and how informatics should be integrated into nurse education has been ongoing for decades (Saranto and Leino-Kilpi, 1997; Saranto et al., 2015; Staggers et al., 2002), yet it is still relevant today (O'Connor et al., 2017). According to the Technology Informatics Guiding Education Reform (T.I.G.E.R) initiative, which has focused on defining the minimum informatics competencies required from the nursing workforce, every nurse should have competencies related to basic computer skills, information literacy and clinical information management, including the use of electronic health records (T.I.G.E.R, 2011).

It is crucial for new nursing graduates to have sufficient preparation levels in nursing informatics when they enter the work-life (Choi and De Martinis, 2013; Cummings et al., 2015). The urgent need to integrate nursing informatics to the nursing curriculum in a way that it meets the needs of changing health care settings is acknowledged worldwide (Button et al., 2014; De Gagne et al., 2012; Foster and Sethares, 2017). This has proved to be a challenge to nurse educators who should be leaders of the integration of nursing informatics in curricula (Cummings et al., 2015; Foster and Sethares, 2017; Rajalahti et al., 2014). Formally, this integration has been conducted, for example, in Australia, Canada and Denmark (Cummings et al., 2015), but in many countries, national policies or strategies have not succeeded in sufficiently increasing resources in nursing informatics and competency development (Peltonen et al., 2019). In 2015, three considerable initiatives were launched in Finland highlighting the need for increasing the informatics education in health care. The Finnish Ministry of Social Affairs and Health (2015) published an eHealth and eSocial strategy "Information to support well-being and service renewal 2020", which stated that training in information management, data protection, information security and information systems should be provided to professionals in all education levels. The requirement for nursing students to acquire health informatics knowledge and skills during their education was stated in the eHealth strategy of the Finnish Nurses Association 2015–2020 (Ahonen et al., 2015; Ahonen et al., 2016). In 2015, national guidelines for minimum requirements for nurse education (nurse responsible for general care) were defined, where nursing informatics and eHealth services were linked to most of the defined competences in nursing education (Eriksson et al., 2015).

Despite educational initiatives, the Universities of Applied Sciences (UAS) that provide nursing education in Finland (leading to a qualification of Bachelor of Healthcare, 210 credits) hold autonomy in making independent decisions on how the new competence requirements are eventually implemented in curricula and teaching. A review that was conducted in 2017 concluded that UASs have not yet included all the recommended informatics education in nursing curricula. However, this conclusion was based on a review of only nine (out of 21) UASs that provide nursing education in Finland (Tolonen and Värri, 2017.) Similar deficiencies in adherence to existing strategies and criteria in teaching nursing informatics have been reported internationally (Forman et al., 2020). The topic requires further investigation since several studies have shown that the education level, the quality of the received informatics education, and the amount of practical experience in using technology and information systems are associated with nurses' informatics competence (Hwang and Park, 2011; Khezri and Abdekhoda, 2019; Kinnunen et al., 2019). Not much is known about the current state of nursing informatics education in nursing programs and whether the developed strategies and educational initiatives have resulted in an increase in nurses informatics competences.

The present study was conducted to evaluate the potential impact of national educational initiatives launched in 2015 on the nursing informatics competences of Finnish registered nurses. This was done by examining the nursing informatics competences of newly graduated nurses who graduated after the establishment of the educational initiatives in comparison to nurses who graduated before these initiatives. The main research question was whether nurses who graduated after the educational initiatives have higher nursing informatics competence than nurses who graduated before the initiatives. Because the level of nursing informatics competences are shown to vary significantly in relation to demographic characteristics and other background variables (e.g. Hwang and Park, 2011; Kinnunen et al., 2019), we also examined whether age, gender, work setting and geographical area are associated with nursing informatics competences of nurses.

3. Methods

3.1. Participants and data collection

This study included two groups of participants. The first group consisted of newly graduated nurses who had completed their studies after the year 2015 educational initiatives. This total sample consisted of all the nurses who had graduated within the past 2 years (between 9/2016 and 6/2018) at the time of data collection ($n = 6979$). The second group consisted of a random sample of nurses ($n = 10{,}000$) who graduated on or before 2015. The sample size of the second group was determined at approximately the same level as the number of newly graduated nurses, also taking into account possible non-response. Both samples were picked from the Finnish Central Register of Valvira (National Supervisory Authority for Welfare and Health). E-mail addresses were obtained for 3942 nurses in the first group (newly graduated nurses), and for 7000 nurses in the second group from the register of the Union of Health and Social Care Professionals in Finland (Tehy).

The data were collected with an electronic questionnaire. Nurses received invitations to participate in the study and a link to the questionnaire via e-mail. The data collection, including three e-mail

reminders, was carried out between November and December 2018. Altogether, 712 nurses in the first group (18% response rate) and 1226 nurses in the second group (15% response rate) participated in the study. From these nurses, only those who currently work with patients/clients were included. This selection was done because nurses working for example in research or in administrative positions were thought to have different competency requirements and information systems in use compared to nurses who practiced directly with patients/clients. The final numbers of participants were 669 (89% women) for the first group and 970 (92% women) for the second group. (Fig. 1) Ethical approval for the study was provided by the ethics committee of the Finnish institute for health and welfare (THL/253/6.02.01/2018). Submission of the completed questionnaire was considered as consent to participate in the study. To maintain data integrity and security, only members of the research team had access to the data and the ability to store and process the data.

3.2. Measures

Nursing informatics competences were measured with four items, each representing one of the four nursing informatics competences previously identified by Kinnunen et al. (2019): (1) terminology-based documentation (Finnish Care Classification, FinCC), (2) patient-related digital work, (3) general IT competency and (4) electronic documentation according to structured national headings. Participants were asked to evaluate "*How well do you master*: *documentation by using Finnish Care Classification (FinCC)* (competency 1)*; supporting the patient to take advantage of the potential of electronic services* (competency 2); *basic IT skills (eg, word processing, information retrieval, data security)* (competency 3); *electronic documentation of the patient care according to the nursing process* (competency 4). Items were rated on a 5-point scale varying from 1= "very poorly" to 5 = "very well". The four items were summed together to provide an overall score for informatics competence (α = 0,73).

3.3. Statistical analysis

The associations between the independent variables (graduation year group, age, gender, work setting, geographical area) and nurses' informatics competences were examined with analysis of covariance. This was done in three steps: First, the effect of the graduation year group (1 = graduated in or before 2015 and 2 = graduated between 2016 and 2018) on informatics competences were examined (Model 1). Second, age (continuous variable) and gender were added to the model (Model 2). Third, work setting (divided into 6 categories: 1 = Emergency care; 2 = Psychiatric and substance abuse services; 3 = Specialised health care; 4 = Elderly care; 5 = Outpatients department; 6 = Other) and geographical area (the five University Hospital areas) were additionally included (Model 3). The associations were first examined for the overall informatics competence and then separately for each individual informatics competence.

To get more detailed information about the potential effects of graduation year on nurses' informatics competence, we repeated the variance analysis but categorized nurses into eight groups based on their graduation year (1 < 1989, 2 = 1990–1999, 3 = 2000–2007, 4 = 2008–2012, 5 = 2013–2015, 6 = 2016, 7 = 2017, 8 = 2018). These categories were chosen to ensure rather equal distribution of participants in each group.

All the analyses were conducted with IBM SPSS Statistics 25.

4. Results

4.1. Descriptive results

The characteristics of the participants and descriptive statistics are presented in Table 1. Most of the participants were female (90,7%). The age distribution of the first group (newly graduated nurses) ranged from 21 to 61 years (mean 31.1 SD 8.7) and of the second group from 23 to 66 years (mean 44.9 SD 11.2). The majority of participants worked in specialised health care or in elderly care. Most commonly participants worked in the Helsinki University Hospital area, and the rest represented rather evenly the other university hospital areas. Nurses evaluated their competence to be the highest in 'general IT competency' and lowest in 'terminology-based documentation'.

4.2. Associations between the graduation year group and informatics competences

In the fully adjusted models, the graduation year group (when used as binary: before/in 2015 and 2016–2018) was significantly associated with nurses' overall informatics competence and the individual competence related to 'terminology-based documentation' (Table 2). In

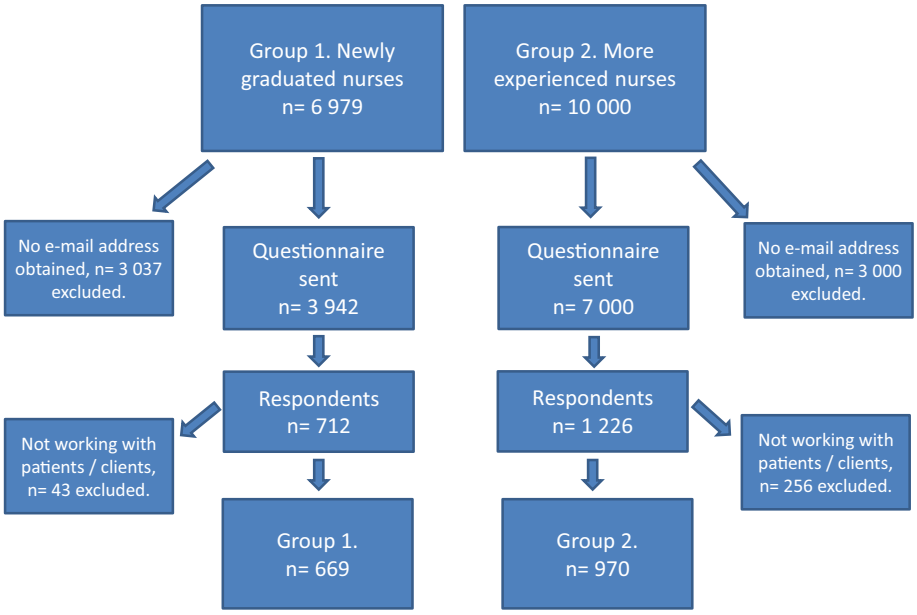

Fig. 1. Flowchart of the study participants.

Table 1
Characteristics of the participants and descriptive statistics.

	n	%
Female	1481	90.7
Male	148	9.1
Other	3	0.2
Work setting		
Emergency care	199	12.1
Psychiatric and substance abuse services	200	12.2
Specialised health care	602	37.6
Elderly care	350	21.9
Outpatients department	133	8.3
Other	115	7.2
Geographical area		
Helsinki University Hospital	599	37.1
Kuopio University Hospital	286	17.7
Oulu University Hospital	325	20.1
Tampere University Hospital	228	14.1
Turku University Hospital	176	10.9

	Mean	SD
Overall IC	3.92	0.65
FinCC	3.38	1.13
Patient	3.66	0.91
General IT	4.31	0.71
e-Document.	4.29	0.70

Overall IC = Overall nursing informatics competence; FinCC = Terminology based documentation; Patient = Patient related digital work; General IT = General IT competency; e-Document. = Electronic documentation according to structured national headings).

both cases, nurses graduated between 2016 and 2018 had higher competence compared to nurses who had graduated in or before 2015.

We additionally analysed the effect of graduation year by categorizing nurses into eight graduation year groups. Graduation year group was associated with nurses' overall informatics competence ($F = 4.91$ $p < 0.001$) and with the individual competences related to 'terminology-based documentation' ($F = 5.27$ $p < 0.001$), 'patient-related digital work' ($F = 3.63$ $p < 0.001$) and 'general IT competency' ($F = 3.63$ $p = 0.001$) (Supplementary Table 1). Newly graduated nurses (graduated in 2016, 2017 and 2018) and nurses graduated between 2013 and 2015 had higher overall informatics competence than nurses who had a longer time from their graduation (Fig. 2). The results were similar for each individual competence. Newly graduated nurses, and particularly the 2017 graduates, evaluated their informatics competences as the highest (Fig. 2).

4.3. Associations between demographic and other background variables and informatics competences

Nurses' age was associated with their overall nursing informatics competence and each individual nursing informatics competences except with the 'electronic documentation according to structured national headings'. Nurses with lower age had higher competence than older nurses. However, after categorizing nurses into eight graduation year groups, age was no longer associated with any of the nursing informatics competences.

Nurses' work setting was associated with the overall nursing informatics competence and the individual competences related to 'terminology-based documentation' and 'patient-related digital work' (Table 2). Nurses working in specialised healthcare and in elderly care had the highest overall nursing informatics competence, whereas nurses working in emergency care the lowest scores. Descriptive statistics about the nurses' informatics competences by the work setting are presented in Table 3.

5. Discussion

This study aimed to evaluate the potential impact of national educational initiatives launched in 2015 on the nursing informatics competences of Finnish registered nurses. We examined the nursing informatics competences of nurses who graduated before and after these initiatives and found that nurses who graduated after the initiatives had higher overall nursing informatics competence than nurses with earlier graduation. Similar results were seen in individual nursing informatics competence that concerned the use of terminology in documentation. When the level of nurses' overall informatics competence was examined using more detailed information on their year of graduation (eight graduation year groups), the results showed that the more recent the year of graduation, the higher the overall nursing informatics competence. A similar finding was also observed with regard to the individual competences of terminology- based documentation and patient-related digital work.

This study shows an increasing trend in nurses' informatics competences when viewed from the perspective of nurses' graduation years from the 1990s to recent. Based on the timing of the national educational initiatives (Ahonen et al., 2015; Eriksson et al., 2015; Finnish Ministry of Social Affairs and Health, 2015), and the detected associations between nurses' graduation years and measured informatics competences, it seems that Finnish UASs may have embedded more informatics in their curricula after the initiatives. These findings reinforce the view that along with many other important functions, eHealth strategies have essential value in expressing the educational needs of healthcare professionals' and providing evidence-based guidance and justification to target resources (Scott and Mars, 2013). For example, in the USA, knowledge of nursing information technology has become more widely known with the TIGER qualification reform (T.I.G.E.R., 2011).

Previous studies have found that younger nurses have higher informatics competence (Khezri and Abdekhoda, 2019) and are more satisfied with the informatics competence training received than older nurses (Kinnunen et al., 2019). In this study, lower age was similarly associated with higher informatics competences among nurses, but only when those who graduated before and after 2015 were compared. When

Table 2
Results from the analysis of covariance.

Independent variables	Overall IC		FinCC		Patient		General IT		e-Document.	
	F	p	F	p	F	p	F	p	F	p
Year of graduation (binary)	4.83	**0.028**	9.22	**0.002**	2.90	0.089	0.89	0.347	0.33	0.566
Age	12.91	**<0.001**	5.32	**0.021**	8.30	**0.004**	17.81	**<0.001**	2.78	0.095
Gender	3.00	**0.050**	2.36	0.094	1.54	0.214	1.30	0.274	3.08	0.063
Work environment	3.82	**0.002**	5.47	**<0.001**	6.36	**<0.001**	0.83	0.527	1.76	0.119
University hospital area	1.20	0.310	1.10	0.356	1.90	0.116	1.39	0.234	2.38	0.051
Adjusted R Squared		0.031		0.034		0.029		0.019		0.012

Overall IC = Overall nursing informatics competence; FinCC = Terminology based documentation; Patient = Patient related digital work; General IT = General IT competency; e-Document. = Electronic documentation according to structured national headings.
Bold text shows statistically significant associations.

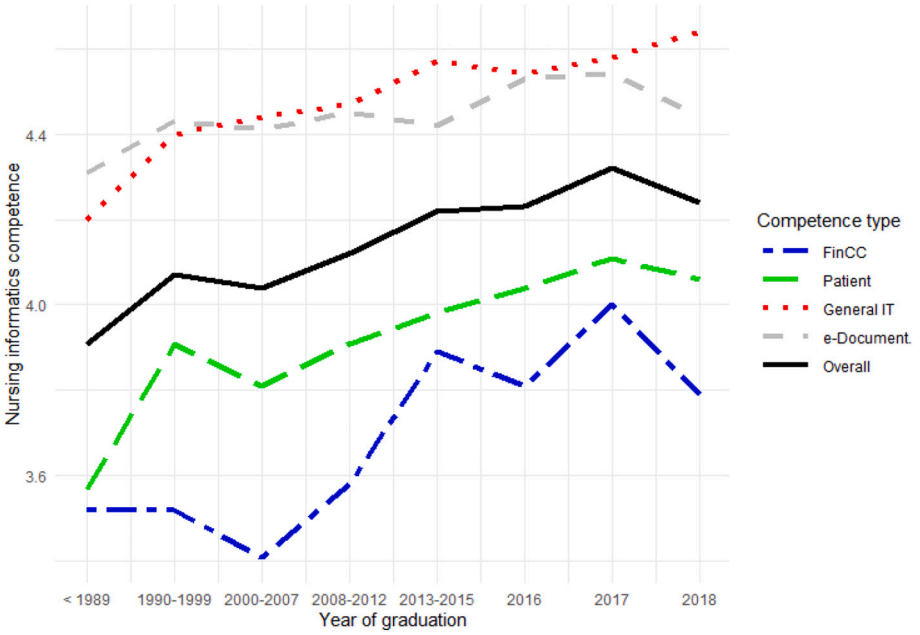

Fig. 2. Nurses' informatics competences by the year of graduation.
Overall IC = Overall nursing informatics competence; FinCC = Terminology based documentation; Patient = Patient related digital work; General IT = General IT competency; e-document. = Electronic documentation according to structured national headings.

Table 3
Nurses' informatics competences by the work setting.

Work setting	Overall IC		FinCC		Patient		General IT		e-Document.	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Emergency care	3.78	0.74	3.17	1.22	3.46	1.03	4.29	0.76	4.22	0.89
Psychiatric and substance abuse services	3.92	0.64	3.27	1.08	3.81	0.90	4.34	0.69	4.25	0.70
Specialised health care	3.96	0.64	3.53	1.11	3.59	0.93	4.35	0.67	4.36	0.65
Elderly care	3.94	0.63	3.46	1.10	3.71	0.86	4.29	0.71	4.30	0.64
Outpatients department	3.89	0.58	3.27	1.09	3.73	0.76	4.25	0.67	4.24	0.68
Other	3.90	0.65	3.24	1.15	3.78	0.86	4.29	0.76	4.22	0.68

Overall IC = Overall nursing informatics competence; FinCC = Terminology based documentation; Patient = Patient related digital work; General IT = General IT competency; e-Document. = Electronic documentation according to structured national headings.

nurses were categorized into eight groups based on their graduation year, age no longer predicted any of the nursing informatics competences. This suggests that the effect of age on competence may be partly explained by differences in graduation year supporting the assumption that differences in nurses' competence may be explained by the changes in undergraduate curricula. It is also notable that the age range in the newly graduated nurses' sample was between 21 and 61 years which shows the variability in today's nursing students and that they are not all "millennials" who grew up alongside the digitalisation. It is possible that due to the increased use of technology in nurse education in general, the students and graduates of today, regardless of their age, are more used to utilising multiple technologies than earlier graduates (Montenery et al., 2013). They may also have been a higher motivation to learn to use ICT because of the increased awareness of the relevance of information and communication technology to their future careers (Levett-Jones et al., 2009) and its positive value to care and work efficiency (Warshawski et al., 2019).

Based on our result, it seems that current nursing programs in Finnish UASs provide nursing students with particularly good preparation to use classifications in electronic documentation. The result is promising because inadequate opportunities for students to engage in documentation with real or at least realistic electronic health records during their education have been identified as a primary educational need among nursing graduates (Forman et al., 2020). A previous study shows that nurses' attitudes towards informatics and the use of computers correlate with their informatics competences (Hwang and Park, 2011). It is possible that nurses who have experienced the shift from paper to electronic patient records – in Finland during the past 20 years (Saranto et al., 2015)—may still have more negative attitudes towards electronic documentation and about learning to document by using classification systems than more recent nursing graduates. Use of classifications and standardized nursing language is known to have a positive impact on the quality of documentation, continuity of care and patient safety (Häyrinen et al., 2010; Saranto et al., 2014). Thus, providing sufficient support and training especially for those nurses who have not had formal education about terminology-based documentation in their undergraduate studies would be of importance.

We also detected differences in nurses' informatics competences between different work settings. Nurses working in specialised healthcare and in elderly care evaluated themselves more competent than nurses working in emergency care environments. This difference may be explained by the fact that the intensity of the use of electronic patient records is slightly lower in the emergency setting than in other health care settings in Finland (Reponen et al., 2019). Nurses' workload, availability of informatics related training, opportunity to attend training, demands related to documentation, or how much technology is used in daily work may also vary between different health care settings.

6. Limitations

We used self-assessment of nursing informatics competences in this study, which must be considered when interpreting the findings because it may have led to an inflation of the strengths of associations. By using, for example, tests or simulations we could have obtained objective data related to competence and thus perhaps different results. The four items that were used to measure the nursing informatics competences provide only a limited picture of all the knowledge and skills required from nurses who work in continuously digitalising health care. The limitations of cross-sectional design need to be taken into account, as it does not allow conclusions to be drawn about causality or the effect of educational initiatives on the nurses' informatics competences. Digitalisation and the use of technology in everyday life have increased in recent years, which may play a significant role in the development of informatics competences. The increasing trend in competences may be a result of many factors and we cannot confirm whether some, if any, of the educational initiatives have been more influential than others. The detailed guidelines about the minimum requirements for nursing education by Eriksson et al. (2015) may have had greater influence on the curriculum work of UASs than the eHealth strategies of the Ministry of Health and Social Affairs (2015) and the Finnish Nurses Association (Ahonen et al., 2015), which deal with the subject more generally. Finally, although we controlled for age, gender, and work setting, we cannot rule out the possibility of residual confounding. We acknowledge that newly graduated nurses were younger on average than nurses who had graduated earlier. Even though response rates in this study were quite low, respondents represented fairly evenly the different graduation years, work environments and geographical areas, which increases the chances that results are generalisable. By conducting the analyses with different graduation year groups, we also aimed to ensure the credibility of the findings.

7. Conclusions

In this study, we found differences in nurses' informatics competences between different graduation years. Nurses graduated most recently evaluated themselves more competent than nurses with earlier graduation years, which suggests that the educational initiatives in 2015 may have pushed Finnish UASs to integrate more nursing informatics education in their nursing curricula. The results of this study highlight the importance of having educational policies stating the directions and objectives of education programs. Nursing informatics is an increasingly central part of nurses' everyday work and competence requirements related to informatics are likely to expand in the midst of digitalisation. Besides the education sector, also health care organisations should invest in providing continuing education and sufficient support especially for those nurses who have not had formal informatics education in their undergraduate studies. They may not necessarily be as receptive to the changes in work that digitalisation brings, thus, the creation of a positive image of the benefits of digitalisation should also be better highlighted and addressed.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.nedt.2021.105060.

Funding

This work was funded by the Strategic Research Council (SRC) at the Academy of Finland (project 327145).

CRediT authorship contribution statement

Anu-Marja Kaihlanen: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization. **Kia Gluschkoff:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – review & editing, Visualization. **Ulla-Mari Kinnunen:** Conceptualization, Methodology, Writing – review & editing. **Kaija Saranto:** Conceptualization, Methodology, Writing – review & editing. **Outi Ahonen:** Conceptualization, Writing – review & editing. **Tarja Heponiemi:** Conceptualization, Methodology, Writing – review & editing, Visualization, Supervision.

Declaration of competing interest

None declared.

References

Ahonen, O., Kouri, P., Liljamo, P., Granqvist, H., Junttila, K., Kinnunen, U.-M., Kuurne, S., Numminen, J., Salanterä, S., Saranto, K., 2015. eHealth strategy of the Finnish Nurses Association 2015–2020. Report of the Finnish Nurses Association 10.

Ahonen, O., Kouri, P., Kinnunen, U.M., Junttila, K., Liljamo, P., Arifulla, D., Saranto, K., 2016. The development process of eHealth strategy for nurses in Finland. Studies in health technology and informatics 225, 203–207.

Ashrafi, N., Kuilboer, J.P., Joshi, C., Ran, I., Pande, P., 2014. Health informatics in the classroom: an empirical study to investigate higher education's response to healthcare transformation. J. Inf. Syst. Educ. 25 (4), 5.

Button, D., Harrington, A., Belan, I., 2014. E-learning & information communication technology (ICT) in nursing education: a review of the literature. Nurse Educ. Today 34 (10), 1311–1323.

Carrasqueiro, S., 2018. Recommendations on a Common Framework for Mapping Health Professionals' eHealth Competencies. Assessed 29.10.2019 from: https://jasehn.eu/wordpress/wp-content/uploads/2018/07/JAseHN_D7.1.3_RECOMMENDATIONS_common_Framework_mapping_health_profession…pdf.

Choi, J., De Martinis, J.E., 2013. Nursing informatics competencies: assessment of undergraduate and graduate nursing students. J. Clin. Nurs. 22 (13–14), 1970–1976.

Cummings, E., Borycki, E., Madsen, I., 2015. Teaching Nursing Informatics in Australia, Canada and Denmark. In: Studies in Health Technology and Informatics, 218, pp. 39–44.

Darvish, A., Bahramnezhad, F., Keyhanian, S., Navidhamidi, M., 2014. The role of nursing informatics on promoting quality of health care and the need for appropriate education. Global J. Health Sci. 6 (6), 11.

De Gagne, J.C., Bisanar, W.A., Makowski, J.T., Neumann, J.L., 2012. Integrating informatics into the BSN curriculum: a review of the literature. Nurse Educ. Today 32 (6), 675–682.

Eriksson, E., Korhonen, T., Merasto, M., Moisio, E., 2015. Sairaanhoitajan ammatillinen osaaminen - Sairaanhoitajakoulutuksen tulevaisuus hanke. Ammattikorkeakoulujen terveysalan verkosto ja Suomen sairaanhoitaja liitto (in Finnish). The professional competence of a nurse repsonsible for general care. Assessed 20.10.2019 from: https://www.epressi.com/media/userfiles/15014/1442254031/loppuraportti-sairaanhoitajan-ammatillinen-osaaminen.pdf.

European Health Parliament, 2016. Digital Skills for Health Professionals. Assessed 20.10.2019 from. https://www.healthparliament.eu/digital-skills-health-professionals/.

Ferrari, A., 2013. DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe. Publications Office of the European Union, Luxembourg.

Forman, T.M., Armor, D.A., Miller, A.S., 2020. A review of clinical informatics competencies in nursing to inform best practices in education and nurse faculty development. Nurs. Educ. Perspect. 41 (1), E3–E7.

Foster, M., Sethares, K., 2017. Current strategies to implement informatics into the nursing curriculum: an integrative review. Online Journal of Nursing Informatics (OJNI) 21 (3).

Gallardo-Echenique, E.E., de Oliveira, J.M., Marqués-Molias, L., Esteve-Mon, F., Wang, Y., Baker, R., 2015. Digital competence in the knowledge society. MERLOT J. Online Learn. Teach. 11 (1).

Häyrinen, K., Lammintakanen, J., Saranto, K., 2010. Evaluation of electronic nursing documentation—nursing process model and standardized terminologies as keys to visible and transparent nursing. Int. J. Med. Inform. 79 (8), 554–564.

Hwang, J.I., Park, H.A., 2011. Factors associated with nurses' informatics competency. CIN: Computers, Informatics, Nursing 29 (4), 256–262.

Khezri, H., Abdekhoda, M., 2019. Assessing nurses' informatics competency and identifying its related factors. J. Res. Nurs. 24 (7), 529–538, 1744987119839453.

Kinnunen, U.M., Heponiemi, T., Rajalahti, E., Ahonen, O., Korhonen, T., Hyppönen, H., 2019. Factors related to health informatics competencies for nurses—results of a National Electronic Health Record Survey. CIN: Computers, Informatics, Nursing 37 (8), 420–429.

Konttila, J., Siira, H., Kyngäs, H., Lahtinen, M., Elo, S., Kääriäinen, M., Mikkonen, K., 2019. Healthcare professionals' competence in digitalisation: A systematic review. Journal of Clinical Nursing 28 (5-6), 745–761.

Kujala, S., Rajalahti, E., Heponiemi, T., Hilama, P., 2018. Health Professionals' Expanding eHealth Competences for Supporting Patients' Self-Management. In: Studies in Health Technology and Informatics, 247, p. 181.

Levett-Jones, T., Kenny, R., Van der Riet, P., Hazelton, M., Kable, A., Bourgeois, S., Luxford, Y., 2009. Exploring the information and communication technology competence and confidence of nursing students and their perception of its relevance to clinical practice. Nurse Educ. Today 29 (6), 612–616.

Lin, H.C., Hsu, M.H., Yang, C.W., 2014. The influences of computer system success and informatics competencies on organizational impact in nursing environments. CIN: Computers, Informatics, Nursing 32 (2), 90–99.
Ministry of Social Affairs and Health, 2015. Information to support well-being and service renewal. eHealth and eSocial Strategy 2020. Assessed 20.10.2019 from: https://stm.fi/en/social-and-health-services/information-management.
Montenery, S.M., Walker, M., Sorensen, E., Thompson, R., Kirklin, D., White, R., Ross, C., 2013. Millennial generation student nurses' perceptions of the impact of multiple technologies on learning. Nurs. Educ. Perspect. 34 (6), 405–409.
Öberg, U., Orre, C.J., Isaksson, U., Schimmer, R., Larsson, H., Hörnsten, Å., 2018. Swedish primary healthcare nurses' perceptions of using digital eH ealth services in support of patient self-management. Scand. J. Caring Sci. 32 (2), 961–970.
O'Connor, S., Hubner, U., Shaw, T., Blake, R., 2017. Contemporary issues time for TIGER to ROAR! Technology informatics guiding education reform. Nurse Educ. Today 58, 78–81.
OECD, 2019. Health in the 21st Century. Putting data to work for stronger health system. In: OECD Health Policy Studies. OECD Publishing, Paris. https://doi.org/10.1787/e3b23f8e-en.
Peltonen, L.M., Pruinelli, L., Ronquillo, C., Nibber, R., Perezmitre, E.L., Block, L., Topaz, M., 2019. The current state of Nursing Informatics–An international cross-sectional survey. Finnish Journal of eHealth and eWelfare 11 (3), 220–231.
Rajalahti, E., Heinonen, J., Saranto, K., 2014. Developing nurse educators' computer skills towards proficiency in nursing informatics. Informatics for Health and Social Care 39 (1), 47–66.
Reponen, J., Kangas, M., Hämäläinen, P., Haverinen, J., Keränen, N., 2019. Availability and use of e-health in Finland. In: Vehko, T., Ruotsalainen, S., Hyppönen, H. (Eds.), E-health and E-welfare of Finland. Check Point 2018, 2019. National Institute for Health and Welfare Report 7/2019.
Saranto, K., Leino-Kilpi, H., 1997. Computer literacy in nursing; developing the information technology syllabus in nursing education. J. Adv. Nurs. 25 (2), 377–385.
Saranto, K., Kinnunen, U.M., Kivekäs, E., Lappalainen, A.M., Liljamo, P., Rajalahti, E., Hyppönen, H., 2014. Impacts of structuring nursing records: a systematic review. Scand. J. Caring Sci. 28 (4), 629–647.
Saranto, K., Jylhä, V., Kinnunen, U.-M., Kivekäs, E., 2015. Nursing informatics in Europe. In: Saba, Virginia K., McCormick, Kathleen A. (Eds.), Essentials of Nursing Informatics, 6th edition, pp. 751–776.
Scott, R.E., Mars, M., 2013. Principles and framework for eHealth strategy development. J. Med. Internet Res. 15 (7), e155.
Staggers, N., Thompson, C.B., 2002. The evolution of definitions for nursing informatics: a critical analysis and revised definition. J. Am. Med. Inform. Assoc. 9 (3), 255–261.
Staggers, N., Gassert, C.A., Curran, C., 2002. A Delphi study to determine informatics competencies for nurses at four levels of practice. Nurs. Res. 51 (6), 383–390.
T.I.G.E.R, 2011. Competencies for every Practicing Nurse: Recommendations from the TIGER Collaborative. Assessed from. http://s3.amazonaws.com/rdcms-himss/files/production/public/FileDownloads/tiger-report-informatics-competencies.pdf.
Thiel, R., Deimel, L., Schmidtmann, D., Piesche, K., Hüsing, T., Rennoch, J., Stroetmann, V., Stroetmann, K., 2019. #SmartHealthSystems. In: International Comparison of Digital Strategies, Bertelsmann Stiftung.
Tolonen, J., Värri, A., 2017. Survey of health informatics education in Finland in 2017. Finnish Journal of eHealth and eWelfare 9 (2–3), 217–231.
Vehko, T., Hyppönen, H., Ryhänen, M., Tuukkanen, J., Ketola, E., Heponiemi, T., 2018. Tietojärjestelmät ja työhyvinvointi–terveydenhuollon ammattilaisten näkemyksiä. Finnish Journal of eHealth and eWelfare 10 (1), 143–163.
Warshawski, S., Itzhaki, M., Barnoy, S., 2019. Nurse and nurse student attitudes and perceived self-efficacy in use of information and communication technologies: professional and cultural differences. CIN: Computers, Informatics, Nursing 37 (1), 20–28.