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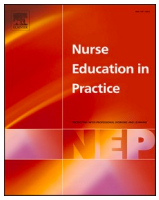

Perceptions and concerns about sustainable healthcare of nursing students trained in sustainability and health: A cohort study☆

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ABSTRACT

Aim: To describe nursing students' perceptions of sustainable health education in the nursing curriculum and their concerns about sustainable healthcare and the impact of climate change on nursing.
Background: Sustainable health education involves education on the impact of climate change on health and the impact of healthcare on the environment. The effectiveness of sustainable health education in improving attitudes, knowledge and skills in sustainable healthcare has been demonstrated. However, there is a need to study students' perceptions of this and their concerns about achieving sustainable healthcare from the use and disposal of healthcare resources.
Design: A cohort study with an inductive content analysis of open-ended questions included in a survey.
Methods: The study was carried out with undergraduate nursing students throughout their four-year undergraduate academic program using scenario-based learning and augmented reality related to sustainability, climate change and health. As students were exposed to three educational interventions, they completed a survey of open-ended questions about their perceptions of their environmental sustainability training in the nursing curriculum, their concerns about the resources' used in healthcare and their perceptions of the impact of climate change on the nursing profession.
Results: Students identified content in the nursing degree program on climate change and health and hospital waste segregation. They also demanded more content on 'low environmental impact nursing care' when their clinical practice training increased. Students were concerned about the excessive and unnecessary use of materials in healthcare, especially in the post-pandemic period, the lack of environmental awareness of healthcare professionals and the lack of power to change the situation. They recognised the lack of proper waste segregation in healthcare settings, no recycling bins and little reuse of materials. They were also concerned about the polluting disposal of material. They perceived important impacts of climate change on nursing, such as patient care due to increased pollution-related diseases, including foetal malformations and new health care needs arising from weather conditions. Finally, students were concerned about the impact this will have on nursing care work and require 'nursing leadership in environmental awareness'.
Conclusions: Students demand more training in low environmental impact healthcare and innovative educational practices are effective in this regard. Appropriate Sustainable Healthcare Education can make future health professionals more environmentally aware and enable them to lead the shift towards climate-smart care.
Tweetable abstract: Students demand more training in low environmental impact healthcare and perceive significant impacts of climate change on nursing.

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1. Introduction

Climate change and degradation of ecosystems present the 'greatest threat' to public health in this century. Nurses will be called on to care for patients who bear the burden of disease resulting from the impact of climate change and ecologically irresponsible practices that harm ecosystems and contribute to climate change (Anåker et al., 2021; Teherani et al., 2017). According to Minogue and Wells (2016), waste includes clinical waste, waste arising out of clinical practice, service delivery and care, infrastructure and carbon emissions. The categories of waste have been defined as overuse, administration, care, research, fraud and prevention (Minogue and Wells, 2016). Overuse includes overprescribing and overuse of medications, diagnostics, interventions, procedures and treatments; administration includes functions such as organisational processes, patient-related processes and financial procedures; care relates to variations, lack of coordination, or unnecessary interventions; while prevention involves preventable conditions or avoidable complications.

2. Background

Medical waste management can be achieved with the cooperation of all workers and patients; however, nursing professionals play a significant role in the whole process. Therefore, nurses need to be well equipped with skills and practices in managing medical waste (Anåker et al., 2021; Musa et al., 2020). Furthermore, nurse managers can contribute to the development of an evidence base and drive towards high-value care by identifying low-value activities, reducing waste (Minogue and Wells, 2016) and implementing improvements in the waste management that will result in the reduction of risks and hazards to health (Musa et al., 2020).

To attempt to reduce waste requires an understanding of the causes and addressing the causes requires a change in attitudes, knowledge and skills and the creation of a culture that supports a shift in individual and organisational practice. Reducing waste needs to be seen as an integral part of service delivery that leads to better, more targeted use of resources and not simply a cost exercise (Minogue and Wells, 2016). Therefore, it is necessary to recognise the connection between the climate, ecosystems, sustainability and health and the responsibility and capacity to change the status quo. Sustainable healthcare education (SHE), defined as education about the impact of climate change and alterations of the ecosystem on health and the impact of the healthcare industry on these, is vital for the prevention of adverse health outcomes due to the changing climate and environment (Teherani et al., 2017).

SHE aims to improve the healthcare system by: (1) enhancing population health through proactive anticipation of society's healthcare needs and attention to prevention; and (2) through reducing healthcare costs by focusing on sustainability and resource efficiency (including containment of waste and cost).

Opportunities and hopes for including sustainability in higher education across Europe are anticipated with the consolidation of the Bologna Process. There are some examples of SHE. Grose et al. (2015) carried out a scenery-based intervention with undergraduate nursing students to teach sustainable healthcare and waste management. It comprised four skills stations where students generated a range of ideas to innovate product and packaging concepts at a local and industry-wide level. Also, an evidence-based sustainability skill teaching session was delivered to 293 nursing students from child and adult health disciplines as a realistic way of motivating learners to consider current and best practices (Grose and Richardson, 2016). Richardson et al. (2017) found that a scenario-based learning approach with nursing and midwifery students can change attitudes and knowledge towards sustainability and climate change. Embedding this approach in clinical skills provides a novel and engaging approach that is both educationally sound and clinically relevant. Another skill session carried out by Richardson et al. (2014) resulted in 70% of the nursing students reporting that they were more aware of peak oil and 100% were more aware of both the risks to the patient experience and service delivery if resources become unavailable and the waste management in healthcare. In spite of these experiences, it is still not stipulated the number of credits or hours of teaching on sustainability and health across Europe and only some universities in Spain, United Kingdom, Germany, Netherland, Sweden and Belgium have embedded as a transversal curricular theme some contents about this topic as pilot experience (Huss et al., 2020; Shaw et al., 2021).

Previous studies show the effectiveness of SHE in improving attitudes, knowledge and skills in sustainable healthcare; however, it is also important to study students' perceptions of climate change and sustainability. Given the lack of knowledge of students' perceptions of this, there is a need for exploratory and qualitative studies. To date, there is only one qualitative study that revealed that students see themselves living in a mismatched discourse (Anåker et al., 2021): nursing students thought that sustainability is society's joint obligation to achieve the right to a good life for all people equally. They also perceive themselves as important actors in the work of climate change and sustainability. Therefore, this study wanted to explore this area and aimed to: i) describe nursing students' perceptions of SHE in the nursing curriculum, ii) identify nursing students' concerns about the use and disposal of resources for health care delivery and iii) determine nursing students' perception of the impact of climate change and its relevance to Nursing.

3. Methods

3.1. Design

A cohort study was carried out with undergraduate nursing students during their four-year undergraduate academic program using scenario-based learning and augmented reality on sustainability, climate change and health issues introduced into three nursing clinical skills sessions (Álvarez-Nieto et al., 2022). This report provides an inductive content analysis of the open-ended questions included in a survey.

3.2. Procedure and context

The study population was all students who started the nursing degree program in the 2019–2020 academic year. During the 2nd and 3rd years, this purposive sample participated in the evidence-informed sustainability and health scenario-based sessions specifically adapted and designed to raise environmental awareness and develop competencies in sustainability, climate change and health. The sessions' objectives were to show the impact of environmental risk factors on the health of vulnerable population groups (children and the elderly) and proper waste management. The educational intervention consisted of three learning sessions using learning materials available at: http://nursus.eu (Erasmus + KA2 Project, 2014–2017):

- Session 1, in the second year: scenario-based session on an asthmatic child exposed to pollutants at home, at school and in the city, whose health is exacerbated by housing and environmental conditions. The case was based on a real context of over-industrialisation. (Based on topic J3_A1 NurSus).
- Session 2, in the third year: scenario-based session about bladder catheterisation with low environmental impact. A nurse does not make appropriate use of infection prevention materials, discards unused open material and does not recycle the large amount of waste generated. (Based on Topic P2_B1, NurSus).
- Session 3, in the third year: scenario-based session about an older adult suffering from heatstroke. During a summer with high temperatures and a 3-day heat wave, a multi-pathological, mobility impaired and dependent older person shows signs and symptoms of dehydration. (Based on Topic E3_B2, NurSus).

Additionally, the scenario-based learning was complemented with augmented reality to increase the students' deep "immersion" in the clinical situation by a more realistic visualisation. 3D images and videos from the MOZAIK education®, Sketchfab®, Biodigital® and MERGE® applications, accessed with QR code-type markers and MERGE cubes to activate the digital information, were used. Students could access the augmented reality using tablets or mobile phones.

Information was obtained at three points: 1) in the 4th semester after session 1 (in second year); 2) in the 5th semester after completion of sessions 2 and 3 and 6 weeks of clinical practice (clinical placement I) (in third year); 3) and in the 6th semester after completion of another 12 weeks of clinical practice (clinical placement II and III) (in third year). (Fig. 1).

The students self-completed a questionnaire with open-ended questions: i) Are you aware of any content on climate change and/or environmental sustainability in the degree program you have chosen to study at this University and if they responded 'yes' they were asked for further details; ii) Is there a specific topic on environmental sustainability and/or climate change that you would like to study as part of your degree program at the University?; iii) Are you concerned about the overuse of devices or materials in the provision of health care or healthcare (provide some details)?; iv) Are you concerned about the disposal of devices or materials in healthcare (provide some details)? Additionally, they were asked to indicate one major impact of climate change that they consider relevant for Nursing.

Information was collected during mandatory 150-minute training classes with a maximum of 15 students per session. The questionnaires were self-administered via an online tool (Survey Monkey) in computer classrooms or using their own laptops or mobile phones.

3.3. Information analysis

The information obtained from the open-ended questions were subjected to an inductive content analysis following the methodology proposed by Elo and Kyngas (2007). It includes three main phases: preparation, organisation and reporting. The preparation phase involves the familiarisation and repeated in-depth reading of the qualitative information collected; it was performed by two researcher members independently (IMLM and SSM). The second phase of the analysis involved open coding, category creation and abstraction. Codes were generated from the units of analysis and through interpretation, sub-categories and their respective categories were formulated, moving on to abstraction with the generation of the main categories for a general description of the study phenomenon; this process was carried out by IMLM and SSM with cross-checks by CAN to increase confirmability. Fig. 2 shows an example of the process of categorisation and abstraction. The prominence of the main categories at each stage of the training process studied was analysed by dividing their occurrence by the total number of categories to indicate the relative importance of student responses for each main category. The prominences are reported as percentages.

In the reporting phase, a conceptual map was drawn up with the main categories for the conceptual explanation of the findings obtained, which respond to the research objectives.

3.4. Ethical approval

Ethical approval was granted by the Research Ethics Committee of the University of Jaen (JUL.19/3. PRY). All students received information about the study and signed their consent voluntarily. They had the right to withdraw without affecting their academic standing. The surveys were coded for comparison with those completed in the following academic years.

4. Results

4.1. Knowledge of the contents of climate change and sustainability in the nursing degree program

All students answered this question in both the 2nd and 3rd year. 62/100 in the 2nd year and 57/100 in the 3rd year indicated that they were unaware of the existence of content on this topic in the Nursing Degree program (Table 1).

The 2nd year students who did identify them indicated that the degree program includes contents on "environmental pollution and health" and "children's environmental health". The 3rd year students, after sessions 2 and 3 and clinical placement I, indicated the existence of content related to the "appropriate use of sanitary materials", "segregation of hospital waste" and "care with low environmental impact".

They pointed out that the contents on climate change and sustainability included in the degree program are mainly dealt with in "practical seminars in several subjects", specifically Children's Nursing, Clinical Nursing, Pharmacology and Sexual Health.

They specify that NurSus resources are used in teaching. They consider that their inclusion is useful to raise awareness of this topic among future nursing professionals. Table 1 shows the main categories that emerged from this question and their weighting by student group.

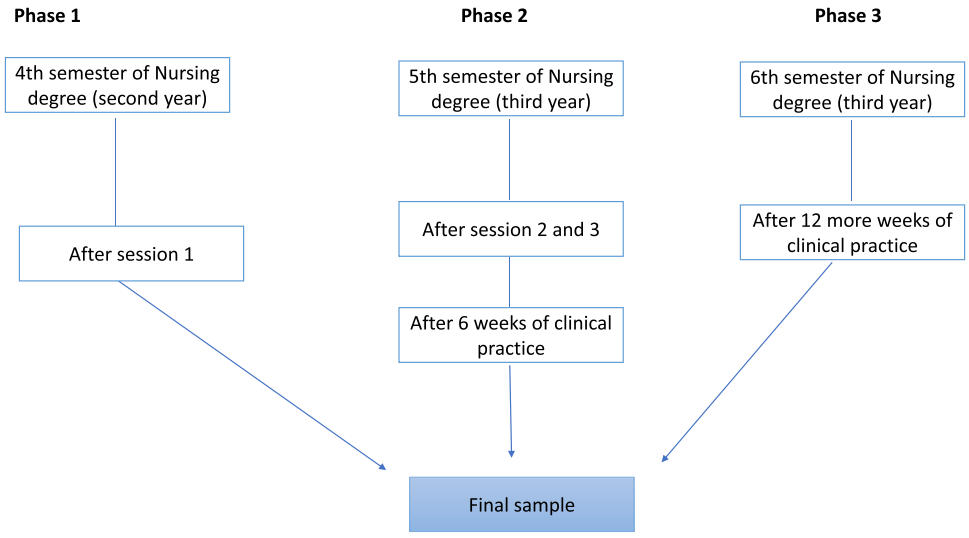

Fig. 1. Phases of the data collection.

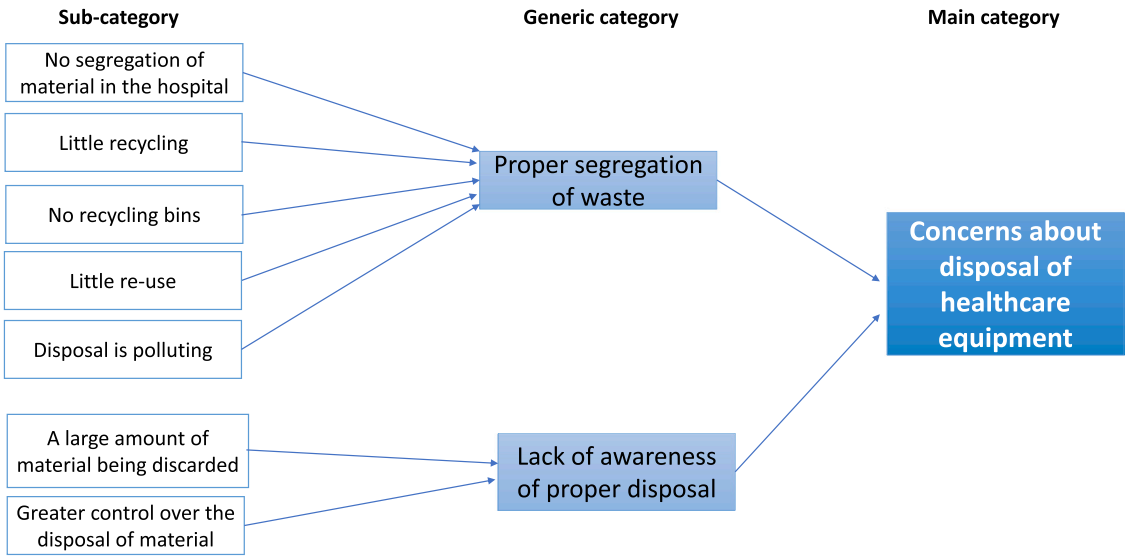

Fig. 2. Example of categorization.

Table 1
Knowledge of climate change and sustainability content in the nursing degree program.

Generic categories	Year 2 after session 1	Year 3 after session 2 and clinical placement I
Lack of knowledge if there are contents	**Category weight: 62.0%**	**Category weight: 57.0%**
Identification of contents in Nursing Degree	**Category weight: 38.0%**	**Category weight: 43.0%**
1. Environmental pollution and health 2. Children's environmental health 3. Proper use of healthcare materials 4. Segregation of hospital waste 5. Low environmental impact care	*Yes, in the case of environmental and surrounding factors and the influence on the child population (Year 2 student, 19 years old).* *Yes, in relation to sustainability through reusing and recycling health care materials and reducing waste generated unnecessarily (Year 3 student, 20 years old).* *Nursing studies teach and raise awareness of the need to improve care practice by reducing environmental impact (Year 3 student, 20 years old).*	
Integration of contents	**Category weight: 28.57%**	**Category weight: 71.43%**
1. Contents in practical seminars of various courses	*In our nursing degree since we started, in certain subjects, they talk to us and make us aware of climate change and environmental sustainability (Year 3 student, age 20).* *There are contents within the internships in different courses from the first year of nursing (Year 3 student, 20 years old).*	

(*)

4.2. Contents to be included on climate change and sustainability in the nursing degree program

Regarding the contents considered necessary to include on the topic in the degree program, 99/100 students in the 2nd year and 99/100 students in the 3rd year responded, with two main categories emerging: 'Influence of the environment on health' and 'Environmental impact of health care'.

The 2nd year students emphasised more the contents on the 'influence of the environment on health' and specifically those related to 'environmental health in children, pregnant women and adults', 'effects on cancer, respiratory diseases and hypersensitivities' and 'external pollutants and polluted environments as triggers of diseases' (Table 2).

However, the 3rd year students, after sessions 2 and 3 and clinical placement, emphasised more the contents on the 'environmental impact of health care'. For all the students, 'low environmental impact nursing care' was one of the most important contents, demanding training on how they can reduce their carbon footprint from their nursing practice (Table 2).

The 'environmental impact of healthcare centres' was mainly indicated by students after having completed a clinical training period, especially the 'management of healthcare waste' and the 'use of resources and new materials'. In addition, they refer to the importance of addressing 'environmental awareness of healthcare professionals' and learning more about the 'green hospital plan'.

Table 2
Contents to be included on climate change and sustainability in the nursing degree program.

Generic categories	Year 2 after session 1	Year 3 after session 2 y 3 and clinical placement I
Influence of the environment on health	**Category weight: 96.66%**	**Category weight: 0.03%**
1. Environmental health in children, pregnant women and adults 2. Effects on cancer, respiratory diseases and hypersensitivities 3. External pollutants and polluted environments as triggers of disease	*I think it would be interesting to focus on pregnant and breastfeeding women, because they are a vulnerable group and therefore their level of exposure is higher (Year 2 student, 20 years old).* *How pollution and other environmental factors induce the appearance of cancer (Year 2 student, 20 years old).*	
Environmental impact of health care	**Category weight: 25.35%**	**Category weight: 74.64%**
1. Low environmental impact nursing care	*How could the degree of contamination generated by a nursing professional in their day-to-day work be reduced, both in the materials used and in the general hospital environment (Year 2 student, 19 years old).*	
1. Environmental impact of healthcare centers • Management of healthcare waste • Use of resources and new materials • Environmental awareness of healthcare professionals • Green hospital plan	*I would like to learn more about the recycling of waste generated during clinical practice (Year 3 student, 23 years old).* *On how to make clinical objects with organic material as close to plastic as possible and how to dispose of them without producing any pollution and even contributing to the environment (Year 2 student, 21 years old).* *Development of a plan to make hospitals green (Year 3 student, 20 years old).*	

4.3. Concerns about excessive use of healthcare equipment

All students in all three groups answered this question. There was widespread concern about excessive use of healthcare equipment among students, although students in Year 2 were the least concerned (21/100).

From this question, 8 main categories emerged as to what concerned them about the overuse of medical devices: 'medical devices contaminate', 'inappropriate disposal of waste', 'inappropriate use of devices', 'balance between overuse and patient health', 'lack of awareness of waste', 'variety of overused devices', 'too much post-pandemic waste' and 'no power to change the situation' (Fig. 3).

One of the main concerns, mainly among 2nd year students, was that 'healthcare materials pollute', especially if, in addition to overuse, there is 'inadequate disposal of the waste' they generate:

> I am concerned about the pollution caused by these materials and the places where they end up (which unfortunately are not always in recycling centres). (Year 2 student, 22 years old).

In addition, there was great concern that in clinical practice there is 'inappropriate use of material', characterised by 'squandering of material' with 'lack of control of use' and 'unnecessary use':

> There is a lot of squandering and massive use of materials and devices (Year 2 student, 19 years old).

> There should be greater control in the use of material, using what is necessary, but without inappropriate use (Year 3 student, 49 years old).

All groups of students expressed the importance of maintaining a 'balance between excessive use and patient health', justifying that the use of material is to achieve the patient's health. Therefore, a 'sterilisation-decrease of use balance' is sought to limit the use of sterile materials to procedures that are strictly necessary for infection prevention. They propose as a solution the use of less polluting materials by 'investigating alternative materials' for medical devices and other sterilisation procedures:

> The main concern I have is how to minimise the use of materials while maintaining maximum health and safety for the patient. I think I try to do that, but there is also a need for research into materials that are less polluting and apply them to the hospital environment (Year 3 student, 21 years).

At the beginning of their clinical placement, they perceive a 'lack of awareness of waste' in healthcare contexts, associated with inappropriate and excessive use of materials:

> There is a lack of awareness on the part of healthcare staff of the impact that inappropriate use of equipment can have (Year 3 student, 22 years old).

As their training in clinical settings increases, students' references to the wide 'variety of overused equipment' increase: 'too many plastics', 'excessive use of gloves', 'too many wraps', 'excessive IV sets', 'excessive cotton gauze', 'excessive use of masks', 'excessive use of toxic chemicals', 'excessive single-use equipment':

> Excessive use of materials and plastics in which all materials are wrapped (Year 3 student, 20 years old).

> Excessive use of gloves could be greatly reduced. Hand washing is often enough. You don't need to wear gloves for everything (Year 3 student, 21 years old).

Especially with the Covid-19 pandemic, the students detected an increase in the use of gloves and masks and considered that there is 'a lot of post-pandemic waste':

> Especially after Covid, we used gloves for absolutely everything, even if we didn't touch the patient, so a lot of gloves were thrown away unnecessarily (Year 3 student, 20 years old).

Some students reported being 'powerless to change the situation' on their own and view the excessive use of materials as difficult to solved:

> There is an excessive and abusive use of materials and I care about it, but I can't have a big concern because it depends not only on myself but on everybody and that is more complicated (Year 3 student, 23 years old).

4.4. Concern about the disposal of healthcare equipment

This question was answered by 100/100 students in year 2, 99/100 students in phase II and 100/100 students in phase III. There was a general concern about the disposal of healthcare equipment, with more than 80% of the students in each group expressing this concern. However, there is a discourse, mainly among 2nd year students, that 'disposal of material is not a concern', considering that 'disposal of material will be correct', that 'it needs to be single-use' and that 'it is not a concern because they recycle' in health care contexts:

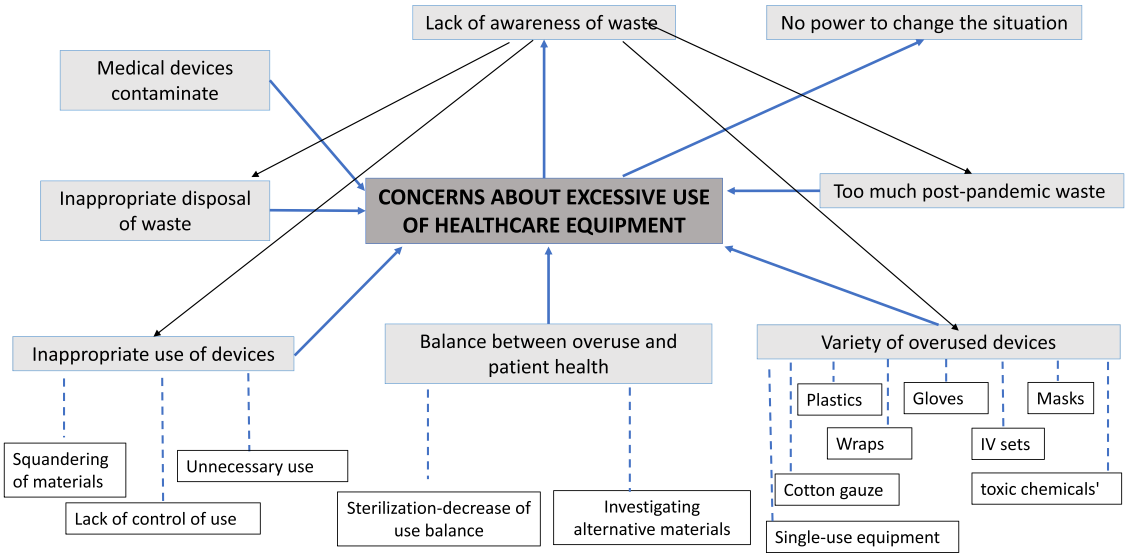

Fig. 3. Concerns use of material.

I am not concerned. Disposal in the in-hospital context, I think, is done correctly (Year 2 student, 21 years old).

Even after some periods of practical training, there are students in all groups who say that they 'don't know how medical equipment is disposed of' or that they 'haven't thought about disposal until now':

I am not aware of how exactly the disposal of medical devices in health care is done (Year 2 student, 19 years old).

I never stopped to think about it (Year 3 student, 21 years old).

The students' main concerns about the disposal of medical devices resulted in 2 main categories: 'proper segregation of waste' and 'lack of awareness of proper disposal'.

The category 'proper waste segregation' was created by grouping the emerging categories: 'no segregation of material in the hospital', 'little recycling', 'no recycling bins', 'little reuse' and 'disposal is polluting'. The lack of proper segregation of disposed materials is the students' main concern, which became more prominent as they increased their clinical practice training, clearly showing that materials are not properly segregated in the hospital:

In hospitals, not all devices or materials are disposed of as they should be (Year 3 student, 22 years old).

Everything is disposed of in the same container with the exception of needles (Year 3 student, 24 years old).

They mainly refer to the segregation of waste similar to urban waste and specify that little recycling takes place in healthcare contexts, basically due to the fact that there are no recycling containers available:

I think that paper, glass and plastic should be recycled (Year 2 student, 21 years old).

In hospital wards there are no recycling bins, everything is disposed of in the same bin (Year 2 student, 21 years old).

They are also concerned that material is 'little reused' and that research should be carried out on how to reuse materials during clinical practice and the use of reusable materials instead of single-use materials:

Material is discarded that can be reused for other non-sterile activities, e.g. gauze (Year 3 student, 22 years old).

We should go back to reusable materials, which can be sterilised by autoclaving (Year 3 student, 22 years old).

Another concern about healthcare materials was that 'their disposal is polluting' because they are not biodegradable and can produce toxic gases when disposed of:

I am concerned that when they are disposed of they produce toxic gases (Year 2 student, 23 years old).

Materials that are not biodegradable make pollution worse (Year 2 student, 21 years old).

They perceive a 'lack of awareness of proper disposal' in healthcare settings, both at the level of the healthcare professionals during their healthcare activity and the level of the healthcare institution at the organisational level. However, the most aware students considered that proper disposal of materials 'is just another responsibility' of healthcare professionals in their daily activity:

I am concerned about the lack of awareness among professionals (Year 3 student, 22 years old).

I consider that proper waste disposal is just another responsibility within the healthcare environment, like caring, curing or treating (Year 2 student, 20 years old).

This lack of awareness leads to 'a large amount of material being discarded' both used and unused. For this reason, they suggest the need for 'greater control over the disposal of material' in health centres:

We prepare the material in the interventions and what is left over is discarded and not used (Year 3 student, 20 years old).

Disposal of devices and materials should be more controlled to reduce contamination (Year 2 student, 26 years old).

4.4.1. Impact of climate change on the nursing profession

This question was answered by 97/100 students in year 2 and 95/100 students in year 3 in phase II.

The students' beliefs about the impact of climate change on the nursing profession could be grouped into 5 main categories: 'environmental pollution as a factor associated with disease', 'nursing care for foetal development and child health problems', 'weather conditions cause new health care needs', 'overload of the health care system', 'impact on nursing care work' and 'nursing leadership in environmental awareness'.

As a factor associated with diseases, environmental pollution was considered an important impact, mainly for 2nd year students. Respiratory diseases', 'cardiovascular diseases' and 'cancer' were the main pathologies considered. However, they also indicated, mainly 3rd year students, that the appearance of 'new diseases and infections' that may arise because of climate change will have a great impact on the nursing profession:

Climate change is relevant for nursing, as because of this problem, there are more diseases that nursing will have to deal with (Year 2 student, 20 years old).

Climate change goes hand in hand with newly emerging diseases caused by pollution and is therefore a priority in the knowledge of nursing staff (Year 3 student, 20 years old).

Year 2 students also identified 'nursing care for foetal development and child health problems' as another impact on nursing. They highlighted increases in premature babies and foetal malformations, as well as decreases in children's life expectancy and development of chronic childhood diseases as the main effects, which will have to be addressed by nursing professionals:

The increase in premature newborns due to climate change (Year 2 student, 21 years old).

An increased incidence of chronic diseases throughout children's lives (Year 2 student, 20 years old).

Another impact on the nursing profession identified was that 'extreme weather conditions cause new health care needs', especially related to 'heat waves', 'temperature changes', 'cold waves', 'drought', or 'contaminated water' that nurses will have to deal with:

Increased temperatures lead to the transmission of diseases that are not common in our country, such as mosquitoes coming from Africa (Year 3 students, 20 years old).

Natural disasters that we as professionals will have to attend to the victims, the appearance of diseases related to the increase in temperature, etc. (Year 3 student, 20 years old).

They consider that all this will also lead to an 'overload of the health system', especially due to an increase in patient-load due to all the problems associated with climate change:

The different environmental pollutants mean an increase in health problems that can overload health systems (Year 2 student, 19 years old).

Third year students in particular expressed an 'impact on nursing care work' more directly related to the use of resources during nursing practice due to 'plastic in medical supplies', 'single-use supplies', 'use of devices' and 'transport of health care staff', which should be

reconsidered in health care as it could lead to a 'decrease in health care resources':

> The use of materials, laundry, anaesthetics,. that contaminate and that Nursing plays a fundamental role in their good management (Year 2 student, 19 years old).

> Preventing the use of unnecessary materials and the excessive use of materials that are covered in plastic and paper for their packaging (Year 3 student, 20 years old).

> Change of IV bags to biodegradable material (Year 3 student, 22 years old).

A new category emerged when considering the impact of climate change in Nursing—nursing leadership in environmental awareness—, which involves raising awareness among other health professionals and among politicians and the general population:

> Raise awareness of both health professionals and politicians to change attitudes towards overuse and non-recycling in our health care system (Year 3 student, 20 years old).

> Carrying out campaigns and talks for health and non-health staff to raise awareness (Year 3 student, 22 years old).

5. Discussion

This study investigated, among other aspects, students' knowledge of the contents of the Nursing degree program on climate change and sustainability. More than half of the students reported their lack of knowledge about this content. This indicates either that this topic is addressed little or in an unattractive way, as they do not remember it, despite having been taught in practical seminars in various subjects and with attractive teaching methodologies such as augmented reality or scenario-based learning. Among those who identified these contents, they recognised that they have dealt content on environmental pollution and health and on the management of hospital waste. Students considered it useful to include in nursing curricula content on the influence of the environment on health, similarly to students from Arab countries (Cruz et al., 2018) and on the environmental impact of health care. The latter aspect is not as highly valued in settings where the concept of environmental sustainability in health care is not as widespread (Cruz et al., 2018). Awareness of environmental health issues should not only be provided as post-training, but should be integrated into nursing curricula to improve students' knowledge, skills, critical thinking and attitude towards resource scarcity, complex diseases and other environmental changes (Cruz et al., 2018; Schwerdtle et al., 2020). In a survey of nursing school leaders in the United States, it was found that 81% of respondents did not include health implications of climate change in their teaching content and 67% did not include health implications of sustainability (Amerson et al., 2022). Many recommendations could be taken to train healthcare professionals to practice healthcare in an environmentally sustainable way. Twelve tips were developed to address what content should cover, how it should be covered and why it should be covered (Schwerdtle et al., 2020); this aimed to help teachers because teachers themselves have to learn a new subject and teach it to their students (Tun et al., 2020). Universities are the right environment to raise awareness and educate about planetary health (Walpole et al., 2019) and for these students to become health professionals and change-makers.

Among the aspects that raised the most concern, we found that the third year students expressed more the need for training on the environmental impact of healthcare as they have completed more periods of clinical practice and therefore have carried out on more occasion waste management (segregation, disposal, rational use of material...). This aspect coincides with the results of studies indicating that one of the factors that most influences the proper management of healthcare waste is professional experience and its duration (Akkajit et al. 2020).

Our students express two important aspects that concerned them about the environmental impact of their professional activity: the excessive use of material necessary to maintain patients' health and the proper disposal of healthcare material. Nurses do not consider these same aspects as potential barriers to the proper management of health care waste when this professional group is well trained and aware of sustainability (Musa et al., 2020). As a more positive attitude and knowledge of health professionals on proper waste management promotes higher performance of good waste management practices (Akkajit et al., 2020). Previous literature indicates that the role of nurses is critical in waste reduction. Through critical thinking, nurses can identify the three areas of greatest waste (overuse, management and care) and act accordingly (Minogue and Wells, 2016). Also, nurses and paramedical staff are more knowledgeable about good practices in healthcare waste management. This may be because nurses are involved in direct patient care activities such as blood sampling, cleaning of body fluids, disposal of syringes or sharps, intravenous therapy and blood transfusion equipment and therefore have to carry out waste management practices more regularly than doctors (Kumar et al., 2016).

Finally, another of the topics explored in this research was the students' perception of the impact of climate change on the nursing profession. Of note, students in the lower year considered that an increase in diseases such as cancer, respiratory diseases, cardiovascular diseases, foetal malformations, or premature births has an impact on nursing care. The third year students perceived that healthcare needs and therefore the profession itself, were changing as a consequence of changing weather conditions (heat and cold waves, droughts…). Consequently, increasing the workload and the use of necessary resources such as gloves, masks, plastics and single-use materials. This, in turn, leads to an excessive use of healthcare materials, which, as we have already mentioned, is one of the concerns expressed by them and which motivates the need for adequate waste management.

The students who had carried out a higher number of clinical placements emphasised the role of nursing in raising environmental awareness among colleagues and other healthcare and non-healthcare professions and even politicians. This is in line with existing recommendations that authorities should provide adequate training to professionals who are involved in healthcare waste management (Akkajit et al., 2020). On the other hand, it is important to highlight according to the results of this study, the impact of the clinical practices on the awareness of the theory gathered in the learning sessions. The awareness gained in this learning space was substantial and also contributed to a better integration and translation of sustainability education into practice. The international Council of Nurses (ICN, 2018) called for nurses to act as leaders in building climate resilient health systems. Thus, Nursing must lead this awareness by sharing knowledge on effective and proper waste management, assisting in the dissemination of good practices and partnering with other healthcare professionals. Although to do so, they have to face some challenges such as: identifying the categories of expenditure that most affect care and treatment; deciding on the most appropriate approach; convincing that appropriate resource management is related to quality care and not cost reduction; and the lack of specific successful interventions in waste reduction (Minogue and Wells, 2016).

5.1. Limitations

A limitation of the study is the reliance on self-reported measures that do not allow for a deeper exploration of students' perceptions and concerns. In addition, as the study required self-reporting, it did not measure actual events. Further studies are needed to support this, using, for example, in-depth interviews or focus groups; this could also provide validation and development of open-ended questions.

6. Conclusions

Nursing professionals are one of the main agents of change in the face of climate change. The inclusion of content in the undergraduate nursing curriculum has improved the competencies of nursing students on the effects of environmental risk factors on the most vulnerable sectors of the population and increased their awareness of climate-smart care. Nursing students consider content on environmental health and the impact that health practices have on health to be important for the nursing degree and a high proportion of students consider the existing content to be insufficient. They are concerned about the lack of environmental awareness and proper segregation of waste in healthcare contexts, especially regarding the inappropriate use of equipment and excessive post-pandemic waste. An adaptation in degree Nursing curriculum is essential to enable students to gain the enough knowledge to become sustainable and to empower students to take leadership for change in clinical practice. Thus, it is necessary to include education for sustainable development through innovative educational practices from the first year of the degree to develop healthcare professionals who will be able to deal with the mitigation and adaptation challenges that climate change presents.

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CRediT authorship contribution statement

Isabel M López-Medina: Conceptualization, Methodology, Validation, Investigation, Resources, writing, Visualization, Supervision, Project administration and Funding acquisition. **Cristina Álvarez-García:** Conceptualization, Investigation, writing, and Visualization. **Laura Parra-Anguita:** Methodology, Investigation, writing, and Visualization. **Sebastián Sanz-Martos:** Methodology, Software, Validation, Formal analysis, Investigation, Data curation, writing and Visualization. **Carmen Álvarez-Nieto:** Conceptualization, Investigation, writing, and Visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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