Received 27 January 2024
Revised 22 April 2024
5 June 2024
Accepted 2 July 2024

Sustainability education in nursing degree for climate-smart healthcare: a quasi-experimental study

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Abstract

Purpose – In light of the world's accelerating march towards a sustainable future, the education for sustainable healthcare must be sufficiently acknowledged in health professions curricula. Early integration of these competences into nursing degree programme emphasizes its importance and applicability. This paper aims to investigate the effectiveness of an educational sustainability intervention in higher education to change nursing students' attitudes towards sustainability and climate change, and environmental awareness.

Design/methodology/approach – A quasi-experimental study was performed with repeated measures between September 2019 and May 2023. Undergraduate students were introduced to sustainability and climate change in the context of healthcare using scenario-based learning and augmented reality over the courses in nursing degree. Participants' attitudes and awareness were collected by online questionnaires.

Findings – The educational intervention showed effectiveness in significantly improving attitudes towards climate change and sustainability, and the environmental awareness for changing their clinical practice ($p < 0.01$). However, students struggled to apply sustainability and address unsustainable practices in healthcare settings.

Originality/value – This study shows an effective model of curricular sustainability that can be implemented in other universities and health disciplines. The findings highlighting the importance of sustainability education in nursing and its potential to drive positive change in healthcare practice and society at large. Embedding key topics aligned with sustainable development goals in the curriculum prepares nursing or health workforce to address planetary health and implement sustainable practices that provide climate-smart care.

Keywords Sustainability education, Nursing degree, Attitudes, Awareness

Paper type Research paper

Introduction

The environment is a determining factor in the well-being and health of the population. When the environment is toxic or unbalanced it causes a negative impact on health (Kiang and Behne, 2021). Additionally, the provision of health care contributes to environmental

International Journal of Sustainability in Higher Education
Vol. 25 No. 9, 2024
pp. 278-292
Emerald Publishing Limited
1467-6370
DOI 10.1108/IJSHE-01-2024-0061

changes, for example, through considerable greenhouse gas emissions, the use of harmful products, and the production of enormous waste volumes (Aronsson *et al.*, 2020). Health professionals are becoming increasingly concerned about the health impacts of climate change and the challenges they will face when delivering healthcare. It might be possible to create a health service workforce cognizant of the evidence with clinical care strategies that enable resilience in the face of extreme weather events or decreased resource availability. Establish greater ambitious leadership in healthcare sector for delivering sustainable climate smart health care offers opportunities for financial, environmental, and social gains – a "triple win" (Kiang and Behne, 2021). The International Council of Nurses (ICN, 2021) stated that:

> [. . .] nurses collaborate and practice to conserve, support and protect the natural environment and are aware of the health consequences of environmental degradation. They advocate for initiatives that reduce environmentally harmful practices promoting health and wellness.

Thus, ICN has called for nurses to act as leaders in building climate-resilient health systems. Education is essential to building an adaptative nursing workforce that achieves environmental sustainability. To advance in that, nursing students' attitudes should be investigated, as they are associated with their environmentally sustainable behaviours (Verplanken and Orbell, 2022). On the other hand, students require awareness of the health impacts of climate change and an understanding of the environmental impacts of healthcare delivery (Goodman and East, 2014). Integrating sustainability education into nursing curricula promote proactive changes in clinical practice especially if is supported by managers and clinical mentors (Aronsson *et al.*, 2020). The present study aims to investigate the effectiveness of a sustainability educational intervention for improving nursing students' attitudes towards sustainability and climate change, and their awareness to implement sustainable practices in clinical work. This educational intervention is carried out through scenario-based learning and augmented reality as an innovative and effective teaching methodology. Measurements were taken before and after the educational intervention to assess its effectiveness.

Literature review

The 2030 Sustainable Development Goals clearly state the need for education on sustainable development to maintain planetary health (Shaw *et al.*, 2021), but the educational directives that dictate health professional training are notoriously slow to change. Clinical educators at the faculty and dean level have generally resisted the inclusion of planetary health in their undergraduate and postgraduate curricula, either because they are not aware of how important the topic is or because they tend to focus on illness treatment over presentation. In all settings, there is a dearth of curricular space and faculty expertise (Walpole *et al.*, 2019).

Environmental knowledge, attitudes and values (Paço and Lavrador, 2017; Liobikienė and Poškus, 2019; Maurer and Bogner, 2020) are key to fostering impactful pro-environmental behaviours (Whitmarsh *et al.*, 2021). Importantly, all are core elements of the Value-Belief-Norm (VBN) model of environmental action (Stern *et al.*, 1999), which posits that pro-environmental behaviour is driven by one's environmental values and awareness of environmental problems. Environmental sustainability and stewardship need to be taught so that nurses and students not only understand, but also have the ability to initiate change (Butterfield *et al.*, 2021), become confident climate and health advocates, and be leaders in resilient and sustainable healthcare. Different investigations describe and analyse the implementation of education programs on environmental sustainability and climate change in the training of nursing students in different contexts (Cruz *et al.*, 2018; Richardson *et al.*, 2019;

Linton *et al.*, 2020; Moustafa Saleh and Elsabahy, 2022; La Torre *et al.*, 2023; Tang, 2023). Through this, nursing students are helped to develop critical thinking and skills in the adaptive delivery of health care (Cruz *et al.*, 2018). Training on climate change and/or sustainability significantly increases the level of knowledge (Linton *et al.*, 2020; Moustafa Saleh and Elsabahy, 2022), beliefs (about the anthropogenic causes of climate change and vulnerability to its impacts) (Tang, 2023), awareness (Richardson *et al.*, 2019) and attitudes (Cruz *et al.*, 2018; Richardson *et al.*, 2019; Linton *et al.*, 2020; Moustafa Saleh and Elsabahy, 2022), although attitudinal changes was not significant in all cases (Tang, 2023). It is essential empowering the role that students and healthcare professionals can play in disseminating information about climate change and even encouraging the creation of policies to prevent the rapid progression of climate change and its consequences. This allows building resilient communities (raising awareness among the public), and promoting sustainable practices within healthcare settings (La Torre *et al.*, 2023).

On the other hand, providing training and education to healthcare staff on sustainable practices and the importance of reducing emissions can foster a culture of environmental responsibility within the institutions. Climate change mitigation in general is important, but the literature finds that hospital professionals feel little responsibility for climate change mitigation. Besides there are conflicting perceptions between reducing emissions and providing high-quality healthcare. This conflict could be reduced if emission reductions were not only justified as a contribution to mitigation, but also as a contribution to disease prevention (Quitmann *et al.*, 2023).

A student-centred learning approach emphasizes the development of self-awareness and environmental responsibility. Humanistic education is very effective in enabling students to develop rationality, autonomy, creativity, and concern for humanity, as well as teamwork, critical thinking, and problem-solving skills, and will help empower students to become agents of change (Veugelers, 2011; Chen and Schmidtke, 2017; Colonna, 2020). Therefore, these principles are best suited to help students not only reflect on and understand their activities concerning sustainability but also to enable them to contribute to mitigating problems arising from unsustainable human activities and to provide environmentally low-impact health care. Integrating planetary health education in curricula is a key action necessary to raise awareness of how the many activities of health care provision, e.g. procurement, high energy and water demands, and large volumes of generated waste, lead to greenhouse gas emissions. Practical advice exists in terms of how and when integration can happen (Lopez-Medina *et al.*, 2019; Tun, 2019; Walpole *et al.*, 2019; Schwerdtle *et al.*, 2020). Still, some barriers have been described (Maurer and Bogner, 2020): the perception that sustainability is not relevant to health care (Richardson *et al.*, 2014), the lack of educator expertise (Richardson *et al.*, 2016; Tun, 2019; Amerson *et al.*, 2022), the challenge of including yet another topic within what are currently crowded curricula and the lack of existing assessment approaches (Tun, 2019).

Scenario-based learning is founded on situated learning theory and valuing contextual knowledge, encouraging opportunities for active learning and bringing students closer to the issues they will need to address in their intended profession (Grose *et al.*, 2015). Given the potential for universities to act as transient agencies for sustainability (Grose *et al.*, 2015), the teaching of this in higher education can benefit from using real-world practice-based scenarios introducing the students to sustainability issues relevant to their discipline. Interactive scenarios have enabled students to improve their awareness, attitudes, and behaviours on the health effects of climate change beyond knowledge acquisition in some European universities. They have used the free, online evidence-based sustainability literacy and competency resources in nursing education: NurSusTOOLKIT (www.nursus.eu/). These

pedagogies encompass the real-life challenges of climate change and place students at the centre of identifying and evaluating solutions, which can help facilitate interdisciplinary learning (Thew *et al.*, 2021). On the other hand, augmented reality (AR) helps enrich educational scenarios with visual, audio, and virtual information, enabling active and participatory learning by enriching real scenarios and increasing student motivation, which is very effective for acquiring nursing competencies (Mendez *et al.*, 2020). Based on the NurSus framework for Sustaining Literacy and Competency (NurSus Project), can cross-disciplinary training throughout the degree using scenario-based learning and augmented reality improve undergraduate nursing students' attitudes towards climate change and sustainability and their environmental awareness? The authors hypothesize that an approach to education for sustainability in healthcare will raise their attitudes and environmental awareness, and consequently, they will apply their competencies in clinical practice.

Method

Study design

A quasi-experimental study was designed using a pre-and post-educational intervention evaluation to assess attitudes and awareness in nursing degree students through repeated measures during the four-year academic university program using scenario-based learning and augmented reality related to sustainability, climate change, and health. It follows the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) (von Elm *et al.*, 2008) and TIDieR (Template for Intervention Description and Replication) guidelines (Hoffmann *et al.*, 2014).

Participants

The target population was all enrolled undergraduate first-year nursing students in a Spanish university in 2019. All students who expressed their desire to participate were included. Later, in years 2 and 3, this purposive sample participated in three teaching sessions specially designed to create environmental awareness and develop competencies in sustainability, climate change and health.

The sample size was established to be a minimum of 65 pairs to achieve 80% power, a confidence level of 95%, and detect a difference of 1.5 points with a standard deviation of 2.5 points based on the previous pre-post study to measure the impact of a sustainability-focused, scenario-based learning educational intervention on the attitudes and knowledge of student nurses (Richardson *et al.*, 2017).

Educational intervention

The educational intervention scenario-based sessions were integrated within healthcare education, where the aim is to focus on student¨*s* ability to assimilate knowledge and build practical skills that they can transfer to clinical practice. The intervention consisted of three health and sustainability and climate change evidence-based scenarios delivered to over 120 nursing students during the degree in mandatory training sessions (there were a maximum of 15 students per session, and the duration of each one was 150 min). The sessions were designed to represent clinically relevant scenarios that engage students in discussion, fact-finding, and practical work about the impact of healthcare on the environment and issues regarding sustainability and climate change (Richardson *et al.*, 2019). Augmented reality facilitated the students' deep "immersion" in the clinical situation with more realistic visualization. The linked digital content (3D images and videos) was obtained from the applications MOZAIK education®, Sketchfab®, Biodigital® and MERGE®. As markers to

activate digital information, QR codes and MERGE cubes were used to increase the learning potential in the scenarios. Students accessed the augmented reality integrated into the learning scenarios using tablets or mobile phones.

In Year 2, the first evidence-based scenario was about an asthmatic child exposed to pollutants at home, school, and city, whose health and care were compromised by the housing conditions and environment in which he lives (extracted from NurSus topic J3_A1, subject session 1: Children and Adolescence Nursing). The case study was based on real circumstances of the effects of climate change and problems arising from excessive industrialization in an Andalusian city. High levels of air pollution exacerbate asthma and increase greenhouse gas emissions. In groups of four to five, students discussed issues arising from the assessment, case analysis, and evidence collection, and suggested solutions or care formulation. The teacher guided students to critically think about the problems and identify solutions. Further information seeking and critique of proposed care regimens from each group were encouraged to promote learning.

In Year 3, two sessions were developed:

(1) An evidence-based scenario about waste management related to bladder catheterization, which reflected a healthcare treatment with high environmental impact; a nurse performing this procedure does not correctly use infection prevention materials, discards unused open material, and does not recycle the large amount of waste generated (extracted from NurSus topic P2_B1, subject session 2: Clinical Nursing). Excessive use of resources and inadequate waste management is an unsustainable practice that aggravates climate change without increasing procedural safety. Students should analyse the relationship between preventing urinary tract infection and the rational use of material, proper waste separation, and environmental, and economic costs of healthcare waste management.

(2) An evidence-based scenario about an older person who is poly-medicated, multi-pathological, mobility impaired and dependent in need of a caregiver. Episodes of extreme heat are becoming more frequent and intense and heatwaves add a negative factor to climate change, which is posing a serious global health problem. Due to high summer temperatures and a 3-day heatwave, the older person shows signs and symptoms of dehydration (extracted from NurSus topic E3_B2, subject session 3: Ageing Nursing). In this simulation, the students should analyse the consequences of climate change on the health of this population group, which is vulnerable to temperature changes.

All scenarios were as realistic as possible to reflect the care situation that students might experience in their future placements. The aim was to provide the exposure to a reliable environment for a correct handling of clinical procedures, which in turn will increase the level of attitudes and develop awareness in future exposures, together with a sustainable way of delivering quality care.

Data collection and instruments

The questionnaire used included the *Sustainability Attitudes in Nursing Survey* (SANS_2) (Box 1) that evaluates nursing students' attitudes towards climate change and sustainability and comprises five items whose response options range from 1 (strongly disagree) to 7 (strongly agree) on a Likert-type scale, with a maximum score of 35 points. Reliability analysis showed a Cronbach's alpha of 0.82, and the five items loaded on a single factor explained 58% of the total variance (Richardson *et al.*, 2016). Level of attitudes was categorized as *Excellent* (score >90%), *Very good* (score 70–89%), *Good* (score 50–69%), *Not*

enough (score 30–49%) and *Poor* (score <29%) (Álvarez-Nieto *et al.*, 2022b). In addition, items 6–9 were included in the survey for this study for students in years 2, 3, and 4 to investigate sustainability awareness in nursing practice (Box 1) (Richardson *et al.*, 2019). Also, response options range from 1 (strongly disagree) to 7 (strongly agree) on a Likert-type scale, with a maximum score of 28 points. No previous reliability data exists.

Box 1. Sustainability attitudes and awareness items

Sustainability attitudes in Nursing survey (SANS_2) items

(1) Climate change is an important issue for nursing.
(2) Issues about climate change should be included in the nursing curriculum.
(3) Sustainability is an important issue for nursing.
(4) Sustainability should be included in the nursing curriculum.
(5) I apply sustainability principles at home.

Awareness in nursing practice survey items

(6) I apply sustainability principles in my nursing practice.
(7) I am aware of unsustainable practice in my work environment.
(8) I challenge unsustainable practice in my work environment.

Source: Authors' own creation/work

Students starting the Nursing degree in September 2019 were asked to complete the SANS-2 questionnaire (Box 1) in academic year 1 before students had any exposure to sustainability teaching (to avoid reporting bias). Later, the same students participated in three educational sessions (one in year 2 of the degree and two in year 3). All the learning materials used are available at: www.nursus.eu/ (Erasmus + KA2 Project, 2014–2017). Attitudes (Box 1, items 1–5) were measured after the three educational sessions (in year 3) and upon completion of the degree. Further items (items 6–9, Box 1) were included in the survey for this current study to investigate sustainability awareness in nursing practice (Richardson *et al.*, 2019), being measured as follows: in the year 2 after the first sustainability educational session and completing the clinical placement I (336 h that equivale to 12 ECTS); in the year 3 after the second and third sustainability educational sessions and completing the clinical placements II and III (24 ECTS); and at the end of the degree after the last clinical internship period (in total 2352 h that equivale to 84 ECTS). The data collection procedure and instruments used are shown in Figure 1.

Self-administered questionnaires were completed through an online tool (Survey Monkey) in computer classrooms or using their own laptops or mobile phones.

Data analysis

Questionnaire data are presented as mean and standard deviation: SANS_2 mean value (items 1 to 5), Awareness mean (items 6 to 9) and mean individual items (1–9), and as total survey scores (SANS_2 and Awareness). Reverse scoring was undertaken for item 9 because it is worded negatively. Reliability was calculated by Cronbach's alpha. The normal data distribution was tested by the Kolmogorov-Smirnov test, analysis of skewness and kurtosis, and visual analysis of the Q-Q plot and histogram for both pre-intervention and post-intervention distributions. SANS_2 mean and total score and items 1–9 were compared for

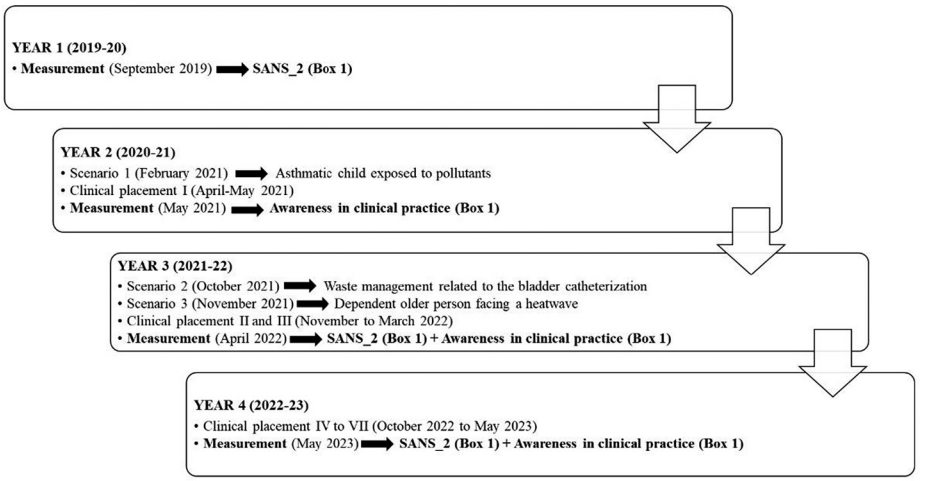

Figure 1.
Summary of the sessions and data collection

Source: Authors' own creation/work

surveys completed in year 1 or 2 and 4 using a paired Wilcoxon test procedure. Effect sizes, and rank biserial correlation, were calculated for variables with statistically significant differences. The level of significance was established at 0.05. Data were entered into JASP 0.17 version for analysis.

Ethical considerations

This study was approved by the Research Ethic Committee of the University of Jaen (JUL.19 / 3.PRY) and was performed following the ethical standards laid down in the Declaration of Helsinki. All students were informed and gave consent to participate in the study. The confidentiality and anonymity of personal data were guaranteed by coding students' identities. No risks were foreseen in participating in this study, but any participant could leave the study at any time without affecting their academic situation.

Results

The sample in the first year included 119 nursing students (of 120 enrolled); however, only 76 completed the questionnaires at all four collection points (36.13% lost). Demographic data are reported in Table 1.

SANS_2 and awareness surveys followed a non-normal distribution. The SANS_2 scale (items 1–5) showed good reliability (0.79 for the first measure, 0.81 for the second measure and 0.8 for the final score).

Attitudes towards climate change and sustainability

Questionnaires were matched to ensure that the same participants were compared across the three times. No statistically significant differences were found in the evaluation before and after the intervention according to the gender of the participants, method of access to university education, or having received any training on environmental sustainability before the nursing degree ($p > 0.05$). Table 2 shows the values of attitudes towards climate change and sustainability before the intervention.

Demographic data	
Age (M/SD)	23.61 (4.29)
Gender	*n* (%)
Male	20 (26.3)
Female	56 (73.7)
Pathway to university	
Baccalaureate	43 (56.6)
Professional training	30 (39.5)
Other university degree	1 (1.3)
Over 45 years old	2 (2.6)
Attended a sustainability session	
Yes, within the prior three months	6 (7.9)
No	67 (88.2)
Yes, more than 3 months prior	3 (3.9)

Source: Authors' own creation/work

Table 1. Demographic data of the sample ($n = 76$)

Demographic variable	Mean (SD)	*p*-value
Gender		
Male	26.45 (6.08)	0.362
Female	27.77 (4.63)	
Pathway to university		
Baccalaureate	27.33 (4.94)	0.831
Professional training	27.37 (5.44)	
Other university degree	31 (0)	
Over 45 years old	28.8 (0.78)	
Attended a sustainability session		
Yes, within the prior three months	25.77 (6.09)	0.552
No	27.61 (5.02)	
Yes, more than 3 months prior	26.67 (3.51)	

Note: $n = 76$
Source: Authors' own creation/work

Table 2. Attitudes towards climate change and sustainability (SANS_2)

Significant differences were found between the pre-and post-intervention measures (in both years 3 and 4) for the SANS_2 mean and total score, and for each item mean except item 5 (*I apply sustainability principles at home*), which showed lower values after the complete educational intervention (between year 1 and 4). Neither found significant differences for item 2 (between year 1 and 3). Table 3.

The *Excellent* level of attitudes increased in post-intervention statement (39.48%) with respect to pre-intervention (18.42%). The *Good* category of attitudes decreased slightly after the intervention (18.42% before to 14.47% after), and the *Not enough* level disappeared (3.95% to 0%), obtaining the highest percentage in the *Very good* category in the post-intervention group (46.05%). Nobody at any time had *Poor* attitudes. Statistically significant differences were found in the categories between the two measurements ($\chi^2 = 17.010, p = 0.009$).

Awareness in clinical practice

Mean and total awareness scores showed significant differences between years 2 and 3, and after completing the degree clinical placements and the educational intervention. Nursing students scored the lowest for item 9: *I feel unable to challenge unsustainable practice in the work environment* (3.57 for the first measure, 4.5 for the second and 4.03 for the final). After completing the educational intervention, an increase was found in all items of the environmental awareness survey but only reached statistical significance in items 6 (*I apply sustainability principles in my nursing practice*) and 7 (*I am aware of unsustainable practice in my work environment*) (Table 4).

Discussion

This study aimed to explore the effectiveness of an educational sustainability intervention in higher education using scenario-based learning and augmented reality to improve nursing students' attitudes towards sustainability and climate change and awareness that has allowed changes in clinical practice to enhance sustainability. As in previous studies (Richardson *et al.*, 2019; Linton *et al.*, 2020; Moustafa Saleh and Elsabahy, 2022), the results showed a significant improvement in environmental attitudes and awareness after the training sessions and those maintained over time or lightly decreased, even though there were no further education sessions. Specifically, both the attitude about the importance of climate change and sustainability for nursing, as sustainability inclusion in the nursing curriculum, improved notably after completing the educational intervention, similarly to another researches (Cruz *et al.*, 2018; Richardson *et al.*, 2019; Linton *et al.*, 2020). However,

Table 3. Comparisons of SANS_2 score among pre and post intervention

Statement	Year 1	Year 3	RBC	Year 4	RBC
1. Climate change is an important issue for nursing	6.16 (1.18)	6.45 (1.19)*	0.415	6.44 (1.08)*	0.465
2. Issues about climate change should be included in the nursing curriculum	5.12 (1.47)	5.51 (1.56)	0.260	5.61 (1.37)*	0.386
3. Sustainability is an important issue for nursing	5.68 (1.31)	6.25 (1.16)*	0.493	6.11 (1.22)*	0.386
4. Sustainability should be included in the nursing curriculum	5.04 (1.34)	5.61 (1.54)**	0.387	5.61 (1.30)**	0.400
5. I apply sustainability principles at home	5.42 (1.45)	5.46 (1.21)	0.006	5.34 (1.21)	−0.096
Mean	5.48 (1.01)	5.86 (0.92)**	0.348	5.82 (0.92)**	0.397
Total	27.42 (5.03)	29.28 (4.59)**	0.349	29.11 (4.59)**	0.358

Notes: *$p < 0.05$; **$p < 0.01$; RBC = Rank biserial correlation
Source: Authors' own creation/work

Table 4. Comparisons of awareness statements among pre and post intervention

Statement	Year 2	Year 3	RBC	Year 4	RBC
6. I apply sustainability principles in my nursing practice	4.49 (1.51)	5.01 (1.54)*	0.335	5.11 (1.57)*	0.341
7. I am aware of unsustainable practice in my work environment	5.96 (1.32)	6.08 (1.30)	0.075	6.36 (0.88)*	0.379
8. I challenge unsustainable practice in my work environment	4.55 (1.51)	4.97 (1.50)	0.307	4.63 (1.58)	0.026
9. I feel unable to challenge unsustainable practice in my work environment	3.57 (1.87)	4.05 (1.97)	0.229	4.03 (1.95)	0.237
Mean	4.64 (0.87)	5.03 (1.44)**	0.382	5.03 (0.88)**	0.369
Total	18.57 (3.48)	20.12 (4.18)**	0.382	20.12 (3.51)**	0.369

Notes: *$p < 0.05$; **$p < 0.01$; RBC = Rank biserial correlation
Source: Authors' own creation/work

this was not transformed into the application of these sustainable principles at home. Perhaps that is because the training focused on what should be done in the workplace without extrapolating this attitude to being responsible citizens or because of the idea that health professionals are examples for the population. Nevertheless, the mean score obtained for applying sustainable practices at home was higher in the students who had just started nursing training than that obtained by Richardson *et al.* (2019), leaving fewer improvement opportunities.

Given that attitude is an antecedent for behaviours (Verplanken and Orbell, 2022), measuring students' attitudes is very helpful in promoting environmentally sustainable practices in nursing. Globally, the improvement in attitudes was greater in a previous study (Álvarez-Nieto *et al.*, 2022a) but in the present study, the baseline values were high with an initial percentage of excellent attitudes of 18,42% and reaching almost 40% in the final of the study. Congruently with this quantitative data, qualitative research on students states that nurses' work can contribute to a sustainable healthcare system through research, leadership and education (Anåker *et al.*, 2021).

Learners are more likely to challenge unsustainable practices in the work environment after participating in all scenario-based learning sessions. In general, students applied more sustainability principles when their clinical practice training increased, and most importantly they are increasingly aware of the importance of nursing practices aligned with sustainability and of unsustainable practices. However, perhaps because they are students, they feel unable to challenge institutional policies to bring about a general change in unsustainable practices. These results are in line with previous research (Aronsson *et al.*, 2020; Ergin *et al.*, 2021; Tuna *et al.*, 2022; Álvarez-Nieto *et al.*, 2022b) where nursing students felt they did not have sufficient authority and confidence to challenge unsustainable practices and the resistance to change. (Aronsson *et al.*, 2020) reported that only some students felt able to change their own practice (in terms of waste disposal/recycling or by ensuring sustainable use of equipment) and even influence others (by challenging their behaviour or educating them on sustainable practice) after being exposed to all sustainability scenario sessions.

Educating nursing students about these topics is required to empower nurses to take leadership for change as future health professionals. There is evidence of varying attitudes towards the inclusion of sustainability and climate change in nursing curricula in different countries (Richardson *et al.*, 2019; Aronsson *et al.*, 2020; Linton *et al.*, 2020). Teaching materials and approaches need to be culturally and contextually specific as adapting information to the local and real-world context will provide relevance. Our study developed three sessions on key sustainability topics, adapted to the Spanish context, that should be included in the nursing curriculum, concerning vulnerable populations, such as children and the elderly, and the responsible use and recycling of medical devices. Early introduction and integration of competencies in the curriculum emphasize its importance and its relationship with professional identity (Shaw *et al.*, 2021).

Nursing students demand more training in low environmental impact healthcare (López-Medina *et al.*, 2022) 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 healthcare (sustainable care based on collective efforts to reduce gas emissions that support development and enable people to anticipate, absorb and adapt to climate shocks) (López-Medina *et al.*, 2022). There are limited studies that determine the extent to which universities have incorporated planetary health, although there have already been some higher education institutions that have included education on sustainable development in their

curricula, not just as a one-off activity (Shaw *et al.*, 2021). Notably, this is the first time a cohort of students has received comprehensive, cross-curricular training in sustainability and health throughout their degree in a Spanish university. Using scenario-based learning in the context of clinical skills creates a unique and interesting approach that is both instructional and clinically relevant (Richardson *et al.*, 2017). The combination of augmented reality and scenario-based approach to learning used in this research made students more receptive to the training and the acquisition of nursing competencies is more effective (Mendez *et al.*, 2020). Previous research has demonstrated that the use of augmented reality stands out to more faithfully stage the cases and also add a more playful part to the training (Álvarez-Nieto *et al.*, 2022b). That, along with supporting intrinsic motivation and student engagement through humanistic principles, leads to student initiatives and empowerment (Huss *et al.*, 2020) and facilitates the development of self-knowledge including an awareness of their natural environment and how they relate to that environment (Colonna, 2020).

Implications for clinical practice

Early introduction and integration of content on sustainable healthcare into the nursing curriculum emphasizes its importance and its relationship with professional identity. Given the current situation, where care for the environment is key, it is necessary to expand this experience to other universities to train health professionals in these sustainable competencies and work towards planetary health. The applicability of the results in other university contexts requires the use of a consistent methodology, adequate teacher training and the creation of inter-university collaboration networks to promote a homogeneous and sustained implementation. However, this process may encounter obstacles such as resource availability and institutional resistance to change, among others. The use of case-based learning and augmented reality are innovative learning strategies that add gamification, making them attractive and suitable for teaching environmental health with a background of gaining attitudes and environmental awareness. Nevertheless, more emphasis should be placed on extrapolating these sustainable practices to homes and personal lives, making health professionals examples of sustainability in the community.

It is also necessary to promote during the training the idea that nurses, and health professionals in general, are agents of change in health policy and have the power to lead the healthcare workforce in efforts to mitigate negative outcomes through sustainable practices, both in the workplace and home environment. Nurses, as frontline healthcare providers, can contribute to reducing the environmental footprint of healthcare delivery, promoting public health, influencing public attitudes and advocating for policies that support sustainability and climate resilience. Training nursing students in low environmental impact healthcare practices enables them to develop sustainable behaviours during their clinical training in healthcare facilities and can also be advocates for climate-smart healthcare.

Promoting sustainable healthcare practices can enhance the reputation of healthcare organizations, attracting environmentally conscious patients and investors. Therefore, the findings of this and future research can inform policymakers about the importance of incorporating sustainability education into healthcare professional training programs. Future research can build upon these findings by exploring long-term outcomes and evaluating the scalability and sustainability of similar interventions in diverse educational settings.

The implications derived from this research demonstrate the potential for educational interventions to foster sustainability awareness and action among nursing students, ultimately benefiting healthcare practice, education, policy, research and societal well-being.

Conclusions

A sustainability educational intervention in higher education using scenario-based learning and augmented reality improved nursing students' attitudes towards sustainability and climate change, and awareness to implement sustainable practices in clinical placements. Students involved in the intervention are more aware of the importance of sustainability training for environmentally sound work, however, they show difficulty in applying sustainable principles at home or challenging unsustainable behaviours in clinical practice.

In future studies, in addition to expanding the sample to include other universities internationally and other disciplines, it would be recommendable to add greater emphasis in training on the importance of health professionals as examples of sustainable practices and agents of change. The sustainability educational sessions could have contents more focused on the realization of sustainable behaviours at home and the ability to challenge unsustainable practices with specific communication strategies and examples. The cases designed to be worked on during the educational sessions must be extracted from real data of local patients so that the students feel more identified with them and are culturally congruent, as in this study by showing cases of specific cities in Spain (with a lot of pollution due to factories that are exacerbating childhood asthma). This training, more focused on personal attitudes, should be added to the last training course during the last clinical placements as it requires greater technical ability and critical thinking. This would also help to maintain positive attitudes towards sustainability and to continue improving in this critical period as it is the final phase of academic training. The environmentally aware nursing students will become professionals able to provide sustainable healthcare that focuses on improved health and better healthcare delivery, rather than only late intervention in disease, with consequent benefits for patients and for the environment on which human health depends. In this way, they can provide high-quality healthcare now without compromising the ability to meet the health needs of the future.

Despite the strengths of this study, some limitations can be noted. First, the study did not include a control group for comparison, which limits the ability to attribute the observed changes in attitudes and awareness solely to the educational intervention. Moreover, the study was restricted to a single university and there was a loss of sample during the study in part due to transfers and mobility grants to other universities, and because new students who could not be surveyed at the beginning of the study in 2019. However, the sample loss was less than a third of the participants and this fact is implicit in longitudinal studies. Utilization of a purposive sample of only one university limits the generalizability of the results to other undergraduate students. Finally, item 9 is worded negatively and may be confusing to the respondents.

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Further reading

NurSus Project, available at: www.nursus.eu/uk/(accessed 03 January 2024).

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