Pre-service teachers as partners in climate change and health education

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University-based teacher preparation programs in Kosovo still lack climate and health education, leaving preservice teachers (PSTs) unprepared for addressing climate challenges. Considering that the climate crisis is one of the biggest global health challenges of the century, awareness among PSTs as future change agents regarding this issue is crucial. This study investigates how PSTs can be both learners and active contributors in the fields of climate change and health education as future change agents. A cross-sectional survey was conducted to assess the PSTs' perceptions regarding climate change and health education, among a sample of 137 PSTs at the University of Prishtina - Kosovo. To gain deeper insights, 5 focus groups and 3 interviews with a total of 21 participants were conducted. Descriptive statistics were used for the surveys, and qualitative data from focus groups and interviews were analyzed through thematic analysis. There is a strong commitment among future educators to teach climate change and health topics, with most participants eager to include them in classrooms and willing to learn more. Focus groups emphasized the crucial role of teachers in shaping knowledge and behavior, highlighting preservice teachers' motivation to integrate these vital topics into their future teaching. Gaps in teacher curricula highlighted the need for greater focus on these topics and more practical, experiential learning. The findings indicate a readiness and eagerness among future educators in Kosovo to learn and teach more about climate change and health, underscoring their potential role as partners in curriculum development. Through co-creation and student partnership initiatives, universities can harness the enthusiasm of future educators to integrate climate and health education into their teaching.

KEYWORDS

climate change education, health education, pre-service teachers, teacher training, sustainability

1 Introduction

The climate crisis stands as the foremost global health challenge of the 21st century, profoundly affecting public health. It not only intensifies current health threats but also leads to new ones, such as injuries from extreme weather events, malnutrition, and a range of diseases (IPCC, 2021; Romanello et al., 2024). Considering the global nature

of climate change (CC) and its far-reaching consequences, particularly on public health, the education sector emerges as a critical player in fostering awareness and sustainable practices among future generations (Limaye et al., 2020). In this context, the concept of climate health literacy is gaining traction among researchers as a crucial means to enhance both individual and planetary health. Limaye et al. (2020) define climate health literacy as the comprehensive understanding of the complex interactions between climate change and human health, enabling individuals to make informed decisions and advocate for broader health-protective policies. This literacy involves recognizing direct and indirect linkages, communicating risks, assessing data, and navigating uncertainty. Reismann et al. (2021) view of climate specific health literacy extends beyond factual knowledge to include the emotional integration of information and feelings about climate change and health. This recipient-centered approach incites interest and motivation among recipients, thereby fostering climate-friendly education. Both perspectives underscore the critical role of education and communication in developing the necessary skills and awareness to effectively tackle the health impacts of climate change.

Climate change education (CCE) emerged as a key focus within Education for Sustainable Development (ESD) to address global challenges and to be integrated into the broader framework of sustainable development. This emphasis was particularly highlighted by the 2009 UNESCO World Conference on ESD in Bonn (UNESCO, 2009), which laid the groundwork for the launch of a flagship initiative specifically focusing on CCE for Sustainable Development within the ESD framework (UNESCO, 2010). In this context, schools and universities are key to driving climate action by spreading knowledge and mobilizing resources (Leal Filho et al., 2023). They are essential for developing core competencies and promoting continuous knowledge exchange in the fight against climate change (Rousell and Cutter-Mackenzie-Knowles, 2020; Pimpalkhute, 2021). Central to these efforts are students and teachers, who serve as pivotal "change agents" in environmental and climate education, acting as key multipliers of knowledge and action (Winter et al., 2022). Given their future role as educators, pre-service teachers (PSTs) are particularly important to target, as they will soon be responsible for shaping students' understanding of climate change and health, fostering intergenerational learning, and driving sustainable action within classrooms and communities.

While the inclusion of CCE in curricula is crucial, its effectiveness heavily relies on teachers, which ultimately enables or hinders students' understanding and action (Tibola da Rocha et al., 2020). Evaluations of CCE reveal that both students and teachers at different levels often lack knowledge and hold misconceptions about climate change (Nyarko and Petcovic, 2021; Milovanovic et al., 2022; Tolppanen and Kärkkäinen, 2022; Beach, 2023). Misconceptions, such as confusing ozone depletion with the greenhouse effect, are common due to overcrowded curricula, lack of interdisciplinary training, teacher misconceptions, concept conflation and complex concepts (Hung, 2022). In addition, many educational institutions struggle to integrate CCE, particularly its health-related aspects, into their curricula, leaving significant gaps in student preparedness. While the integration of climate change into medical curricula has been gaining traction (Ogunseitan, 2022; Sullivan et al., 2022; Albrecht et al., 2023; Rybol et al., 2023), its inclusion beyond medical curricula in pre-university

or undergraduate settings remains scarce and under researched (Limaye et al., 2020; Ramadani et al., 2023). Similarly, many higher education institutions often lack courses covering climate-related health effects, leaving graduates underprepared (Lavey, 2018). A survey of teaching staff and researchers from 42 countries highlighted the pressing need for better education and training on the connection between climate change and health in higher education (Leal Filho et al., 2024), especially as higher education is crucial for CCE as it builds knowledge, enhances leadership skills, and raises awareness to support adaptive change (Leal Filho et al., 2023).

For Kosovo, a landlocked country in the Western Balkans, increasing knowledge on climate change and health is critical due to its susceptibility to significant climate impacts and low environmental awareness among youth. The region faces rising temperatures, changed precipitation patterns leading to more frequent and severe heatwaves, wildfires, floods, and landslides (IPCC, 2021; The World Bank Group, 2024). In Kosovo, recent research highlights growing concerns about how these changes affect people's health. Heat-related illnesses, stress and trauma from extreme weather, outbreaks of disease, economic struggles, increased conflict, displacement, and disruptions to vital services are all expected to become more common as climate impacts intensify (UNICEF, 2024). Despite these challenges and growing adverse health impacts, environmental knowledge among Kosovo's youth remains low (Ymeri et al., 2023).

Kosovo has adopted its first Law on Climate Change in 2024, determining the country's mitigation and adaptation measures and responsibilities, which also included the development of capacity building, education, training and awareness-raising programs on environment and climate change (Article 32) (Official Gazette of the Republic of Kosovo, 2024). Recent research shows that Kosovo's pre-university curricula and textbooks are insufficient in developing climate health literacy among school children (Ramadani et al., 2025a). In addition, the findings of a study that surveyed PSTs reveal misconceptions regarding climate science and a lack of understanding of the comprehensive health impacts of climate change (Ramadani et al., 2025b). Curricula changes at all educational levels are even more urgent in the light of the recent efforts to integrate environmental education in the upcoming PISA (Programme for International Student Assessment) tests (Eames et al., 2024). Engaging students as co-researchers or co-creators in curriculum development not only enhances their learning but also amplifies their voices, political agency, and creativity in addressing climate challenges (Cutter-Mackenzie and Rousell, 2018; Harrington et al., 2021). Mercer-Mapstone et al. (2017) describe "Students as Partners" as students and staff collaborating on teaching and learning in higher education. Co-creation is seen as a type of student-staff partnerships where these collaborations take place in developing the curriculum (Lubicz-Nawrocka, 2018). The core idea is that involving diverse viewpoints in curriculum development enhances educational outcomes (Lubicz-Nawrocka and Bovill, 2023). Different approaches are used to foster this inclusion of students, with faculty-student liaison committees, focus groups, and feedback questionnaires being the most used methods (Bovill et al., 2009).

Considering the significant role of PSTs as knowledge multipliers and change agents, this study aims to explore their perspectives on climate change and health education,

assessing their readiness to drive change in these areas. By discussing the importance of informing students about climate change and health, challenges in teaching the subject, the role of educational institutions, and the preparation provided by teacher education programs, the study aims to identify both strengths and weaknesses in current approaches. Ultimately, it seeks to inform improvements that can better equip future educators to integrate climate change topics into their teaching effectively and inspire proactive engagement among students.

2 Materials and methods

This study used a mixed-methods, explanatory sequential design. Initially, a cross-sectional survey was conducted to assess perceptions and willingness to engage in climate change and health education among a sample of PSTs at the University of Prishtina "Hasan Prishtina" in Prishtina, Kosovo (hereinafter referred to as the University of Prishtina), during the period of March to April 2024. After analyzing the survey findings, focus groups and interviews were conducted to gain deeper insights into the PSTs' perspectives and explore their potential as change agents in climate change and health education. By triangulating the data from surveys, focus groups, and interviews, we were able to provide a more comprehensive understanding of their views. The focus groups offered richer, more nuanced perspectives on students' opinions and suggestions. Through focus groups, researchers are "looking for the range of opinions, perceptions, ideas or feelings that people have about something like an issue, behavior, practice, policy, program, or idea" (Krueger and Casey, 2014) (p.21).

2.1 Survey

2.1.1 Participants

The survey targeted PSTs in Bachelor's and Master's programs at the Faculty of Education from the University of Prishtina. The PSTs' study concentrations include Early Childhood, Primary Education, Pedagogy, and Subject Teaching. While there are no specific programs on environment and climate change, PSTs in Kosovo can integrate climate change into lessons through the cross-curricular approach of Education for Sustainable Development (ESD), throughout primary and secondary education (Veselaj and Krasniqi, 2014; University of Prishtina, 2024). Through convenience sampling, the first author accessed various classes and administered surveys via a QR code and an online questionnaire on LimeSurvey to gather data. Based on enrollment data of the 2024/25 academic year, 90.3% of the student body are women (University of Prishtina, 2025), and the broader population of Kosovo is predominantly Albanian (91.8%) (Kosovo Agency of Statistics, 2024). As such, a disproportionate representation of gender and ethnicity in the sample was anticipated and reflects the composition of the student population. The original data was in Albanian language and the whole dataset was translated from Albanian into English language before analysis.

2.1.2 Design and validation

The survey questions in this study were drawn from a larger survey (Ramadani et al., 2025b) examining PSTs' knowledge, attitudes, and practices related to climate change and health. While Ramadani et al. (2025b) presented findings from several sections of the survey, this study focuses specifically on a previously unreported subset of questions related to Climate Change Education. These include questions about sources of information, levels of concern, willingness to teach or learn more about climate change and health, and perceptions of how effectively these topics are addressed at the university. This subset formed an ad hoc instrument tailored for the purposes of this study. It was informed by a review of existing surveys on climate change and health, with slight modifications and adaptations (Wachholz et al., 2014; Kotcher et al., 2021; Nam and Lee, 2021; UNICEF, 2021; Salem et al., 2022; Wang et al., 2022; Breakey et al., 2023). To ensure clarity and internal consistency, instrument was reviewed by the research team and their networks. A pilot study was also conducted with 10 students, to confirm the understandability and coherence of the questions. For the subset of questions used in the survey questionnaire, see Supplementary File 1.

2.1.3 Data analysis

Descriptive statistics in MS Office Excel 2019 were employed to quantify and analyze survey responses. Frequency distributions, percentages, arithmetic means, and standard deviations are used for the quantitative analysis of data.

2.2 Focus groups and interviews

2.2.1 Participants

This study employed a combination of convenience sampling and purposive sampling (Etikan et al., 2016) with PSTs of different study concentrations at the Faculty of Education within the University of Prishtina. Participants for the focus groups and interviews were recruited through email outreach, social media calls, and direct in-person interactions at the university buildings. While convenience sampling was used for easier access to respondents, purposive sampling was specifically employed to ensure a more balanced participant composition by intentionally recruiting students from underrepresented categories, such as male students or those enrolled in the Master's programs. The Consolidated Criteria for Reporting Qualitative Research (COREQ) is provided in the Supplementary material (Supplementary File 2). COREQ is a 32-item checklist for comprehensive reporting of qualitative studies using interviews and focus groups (Tong et al., 2007).

2.2.2 Design and validation

Focus group questions were designed based on analyzing findings of the conducted survey as well as referring to the relevant literature (Wachholz et al., 2014; UNICEF, 2021; Winter et al., 2022). We structured and sequenced the questions following the recommendations of Krueger and Casey (2014) to ensure a clear and logical flow. The discussion included an opening question to create a comfortable atmosphere, followed by an introductory question that sets the context. Transitions were

included to guide participants toward the core themes. The key questions were divided into two categories: "The Role of Teachers and Educational Institutions in Relation to Climate Change and Health," which explored educators' responsibilities, curriculum gaps, and institutional support, and "The Potentials and Challenges of Change Agents," which examined PSTs' views on the importance of climate and health topics, and their readiness to integrate them into their future teaching as well as the anticipated barriers. Finally, we ended the focus group with summarizing key insights, gathering final reflections, and concluding the discussion.

2.2.3 Data analysis

Focus group sessions and interviews were audio-recorded, fully transcribed, anonymized, and translated from Albanian to English. The data were analyzed using thematic analysis (Clarke and Braun, 2017) with ATLAS.ti 9 by two researchers (LR and PR). Abductive coding blends deductive and inductive approaches, starting with a theory-based codebook and refining it as new patterns emerge. This iterative process integrates theory and data-driven insights into a final abductive codebook (Vila-Henninger et al., 2024). The process involved LR creating an initial coding guide, which was then tested by both LR and PR, while also allowing for open coding to identify emergent themes. Both researchers independently coded the same data segments and discussed any discrepancies to refine the guide. This form of double coding helped ensure consistency and reliability. The finalized guide was then used by LR to complete the coding and record frequencies. Final codebook is shared as Supplementary File 3.

3 Results

There were a total of 200 surveys registered, out of which 137 were completed in full. The remaining 63 incomplete surveys were excluded from the analysis. In addition, throughout September-November of 2024, five focus groups were organized with a total of 19 pre-service teachers from the University of Prishtina. The average duration of the focus groups was around 45 min. Three focus groups were conducted online and two were in person. Focus groups had varying participants due to their availability, ranging from two to five participants. The focus group sessions were moderated by LR in Albanian, with documentation responsibilities and moderation support handled by FC. In addition to the five focus groups, we also conducted three individual interviews, due to logistical and availability reasons of the participants.

3.1 Participant characteristics

The median age of the survey respondents was 20 years, and the majority were of Albanian ethnicity (98.5%) and were female (92.7%). A little above half of respondents reported living in urban areas, 54.0%, while 46.0% reported living in rural areas. We defined urban areas as cities, suburbs or towns, while rural areas as villages

(Mela, 2014). Most participants were Bachelor students (80.3%), with 19.7% Master students.

For the focus groups the median age was slightly higher, 23 years. Like survey respondents, the majority were of Albanian ethnicity (95.2%) and female (90.5%). There was an almost equal distribution of participants living in urban areas (47.6%) and rural areas (52.4%). Bachelor students made up 47.6% of participants and Master students 52.4%. The demographic information of the participants is given in Table 1.

3.2 Survey responses

3.2.1 Perceptions and willingness to engage in climate change education

Most respondents disagreed with the notion that climate change education is unnecessary, with 82.5% disagreeing or strongly disagreeing, underscoring its perceived importance. Respondents largely supported making climate change a compulsory subject in schools, with 68.7% agreeing or strongly agreeing. The belief that schools are the best place to develop children's climate change awareness is also strongly held, with 90.5% agreeing or strongly agreeing. Additionally, the majority recognized the crucial role of understanding climate change impacts as future educators (96.3% agree or strongly agree). Moreover, there was significant readiness to learn about climate change causes, and mitigations (97.1% agree or strongly agree), it's health impacts and preventive measures (94.9% agree or strongly agree), as well as a willingness to change behavior to prevent adverse health impacts (94.2% agree or strongly agree). Finally, a strong majority, 95.6% of respondents, agreed or strongly agreed with the statement, "I am willing to teach children and impart knowledge about the health impact of climate change

TABLE 1 Participants' demographic data.

Demographic data	Survey	Focus groups and interviews
Sample size	N = 137	N = 21
Median age (years)	20	23
Ethnicity		
Albanian	135	20
Other	2	1
Gender		
Female	127	19
Male	8	2
Prefer not to say/diverse	2	0
Place of residence		
Urban	74	10
Rural	63	11
Current level of education		
Bachelor	110	10
Master	27	11

TABLE 2 Survey responses on statements related to climate change education, role of education and willingness to engage in climate change and health education.

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Climate change education is not necessary.*	5.1%	2.9%	9.5%	33.6%	48.9%
Climate change should be a compulsory subject in school.	28.5%	40.2%	27.7%	3.7%	0.0%
School is the best place to develop children's climate change awareness.	37.2%	53.3%	9.5%	0.0%	0.0%
It is important for future teachers/educators to understand the impacts of pollution and climate change on health, as they play an important role in educating future generations.	51.8%	44.5%	2.9%	0.7%	0.0%
I am willing to know the causes and mitigations of climate change.	51.8%	45.3%	2.9%	0.0%	0.0%
I am willing to know the health impacts and preventive measures of climate change.	59.1%	35.8%	3.7%	1.5%	0.0%
I am willing to change my behavior to prevent adverse health effects.	57.7%	36.5%	5.1%	0.7%	0.0%
I am willing to teach children and impart knowledge about the health impact of climate change in the future.	64.2%	31.4%	3.7%	0.7%	0.0%

*Reverse coded.

in the future." These findings suggest a robust support for integrating comprehensive climate change education into school curricula and emphasize the readiness of future educators to lead this initiative (Table 2).

Given the responses to the question "How worried are you about climate change?" where 55.5% are "somewhat worried" and 16.8% are "very worried," there is an alignment with the respondents' proactive attitudes toward climate change education. Their significant concern about climate change is reflected in their strong willingness to educate future generations about its health impacts and their readiness to learn about its causes and mitigations. Most respondents reported that they receive their climate change information via internet and social media (91.2%) and the least respondents (24.1%) reported they get such information from governmental or official institutions' websites (Figure 1).

The survey highlights a clear enthusiasm among future educators for teaching climate change and health topics, with 89.1% eager to include them in their classrooms. Only 0.7% opposed and 10.2% were uncertain about teaching these topics. Furthermore, 92.0% are keen to learn more about climate change and health. On a scale from 1 to 5, the participants rated the effectiveness of their university's teaching about climate change and health issues as follows: 44.5% rated it as "good" or "excellent," the rest rated it poor (6.6%), fair (17.5) and the most reported response was neutral (3) at 31.4% (Figures available in Supplementary File).

3.3 Focus groups

3.3.1 The role of teachers in combating climate change

Teachers play a key and significant role in shaping and preparing younger generations to deal with new realities, including climate change and its impact on public health. This and other findings in this study present an acknowledgment of

teachers as knowledge bearers and multipliers (informing/passing knowledge to school students), as well as change agents and role models. Besides sharing factual information, participants emphasized the role of teachers in fostering critical thinking skills, enabling students to question, analyze, and evaluate climate-related information (Figure 2).

> "I think that children tend to mirror what they see in others, especially in people they admire. Even when I was young, I saw my teacher as a role model and always followed what she did. So, I think that the aspect of environmental protection has a big impact when they see their teacher trying to save water, and then the students start saving water too. This means that when teachers practice it themselves and students observe it, along with various activities like planting trees or similar things, I believe it has a huge impact." (P.5, Bachelor Student, Female)

Teachers also play a crucial role in influencing awareness and understanding, hence affecting students' attitudes, behaviors, and engagement in climate action by modeling sustainable practices. Several participants believe that teachers should be encouraging action and engagement among school students, thus becoming proactive citizens in combating climate change. In addition, some of the participants also acknowledge the role of teachers in influencing critical thinking, supporting climate change initiatives and community-wide change and warning about the consequences.

> "I believe every teacher should be academically prepared about the importance and impacts of climate change so that they can pass this knowledge on to younger generations, encouraging them to be open to climate change initiatives. By clearly explaining the impact of climate change on health and lifestyle, teachers can influence students' understanding and actions on this issue. Additionally, teachers can support climate change initiatives by participating in them or even initiating their own." (P.3, Bachelor Student, Female)
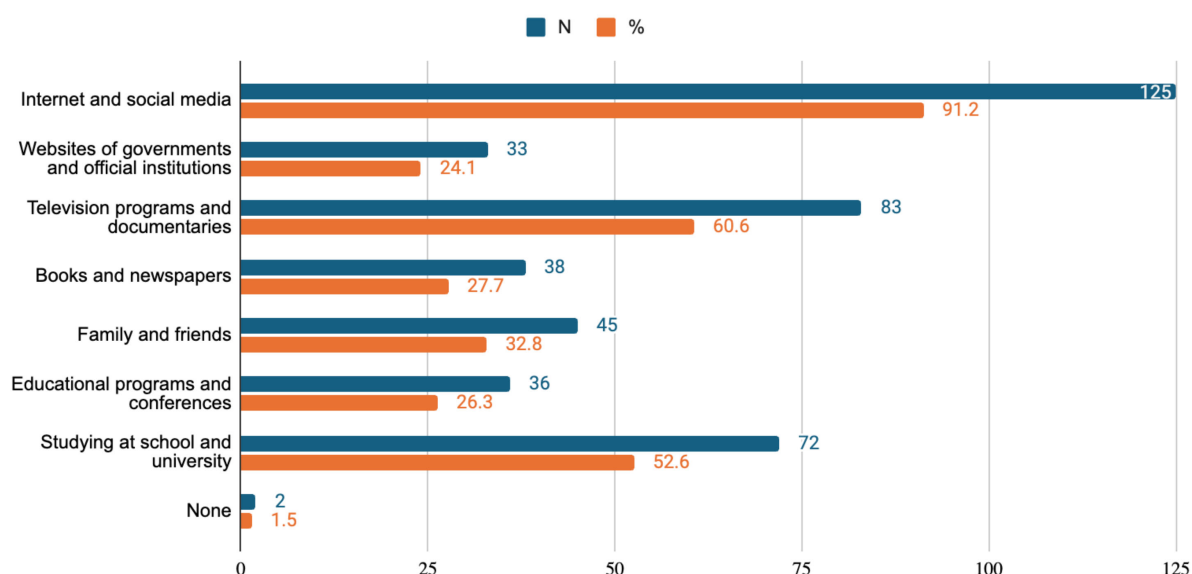
FIGURE 1
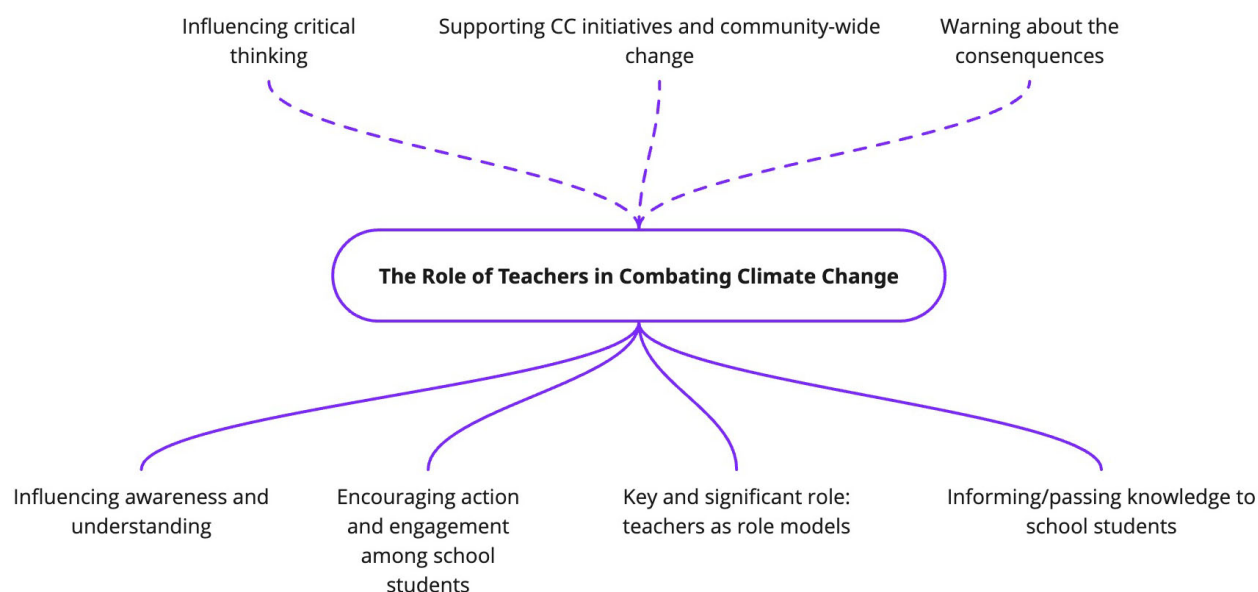Sources of information about climate change according to survey respondents (N = 137).

FIGURE 2
The role of teachers in combating climate change. Higher frequency codes (five or more mentions) are shown with solid lines, lower frequency codes (up to four) with dashed lines.

3.3.2 Teacher education program preparation on climate change and health

The thematic analysis of focus group responses regarding the teacher education program preparation revealed several themes, which were separated into four main categories: Program's Current Approach, Strengths, Weaknesses and Suggestions for Improvement. The categories and respective subcategories are depicted in Figures 3 and 4.

3.3.2.1 Teacher education program strengths and weaknesses

Participants reported that there is a lack of strengths in terms of climate change and health preparation at their current program. When asked about the strengths of the program, a commonly reported response was *no strengths*. Other reported responses included the presence of one sustainability and environmental issues course, positive changes in students'
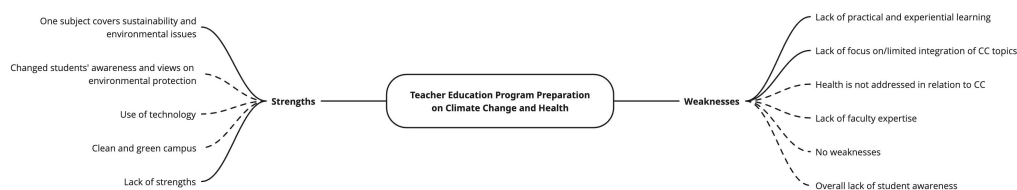
FIGURE 3
Strengths and weaknesses of teacher education program preparation on climate change and health. Higher frequency codes (five or more mentions) are shown with solid lines, lower frequency codes (up to four) with dashed lines.
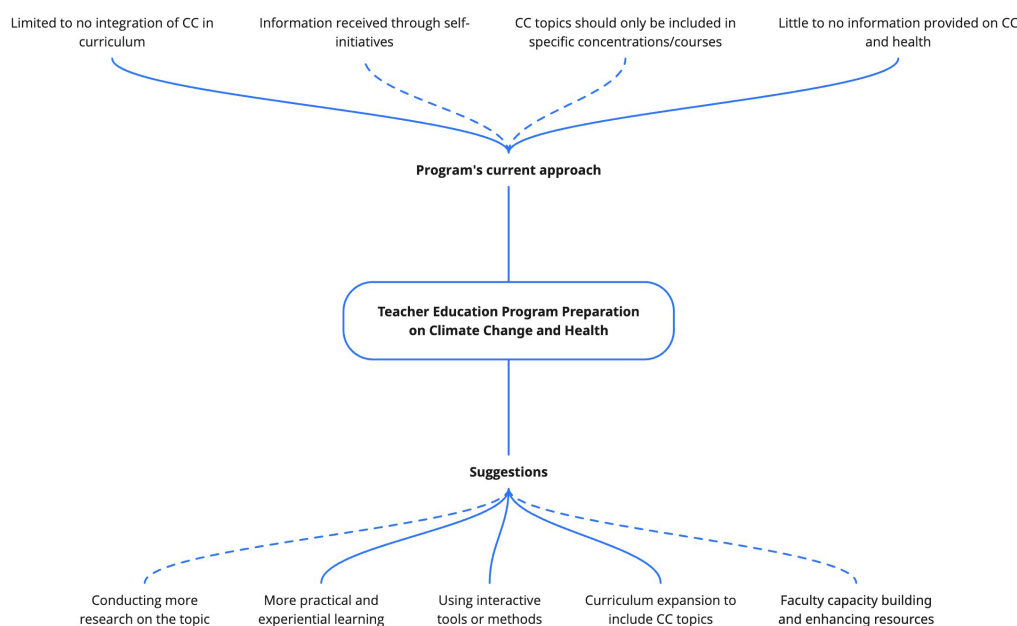

FIGURE 4
Current approach of the teacher education program preparation on climate change and health and suggestions for improvement. Higher frequency codes (five or more mentions) are shown with solid lines, lower frequency codes (up to four) with dashed lines.

awareness and views, a clean and green campus, and the use of technology. Conversely, the more pronounced weaknesses included an insufficient focus on and integration of climate change topics:

> "The weaknesses of the program on climate change are, in my opinion, the lack of subjects that more thoroughly cover this topic, and the lack of emphasis placed on these issues." (P.3, Bachelor Student, Female)

Another commonly reported weakness was the limited practical and experiential learning:

> "I think it needs to be demonstrated in a concrete way, rather than just through words, so that students can truly grasp the concepts themselves. For example, using practical, hands-on methods can help make the material more tangible and ensure they understand what is being discussed. It shouldn't be a matter of simply learning from a textbook and then forgetting the information after a few days." (P.16, Bachelor Student, Male)

Whereas less frequently mentioned weaknesses include: the absence of health considerations related to climate change, an overall lack of student awareness, lack of professors or expert staff along with resources such as laboratories, literature, data and research tools available, with a few participants noting no weaknesses.

3.3.2.2 Teacher education program current approach and suggestions for improvement

The participants frequently reported that the current teacher education program integrates the topics of general climate change marginally or not at all, with little to no information provided regarding climate change impacts on health. A few participants stressed that information regarding climate change and health is retrieved through internet or self-initiative as the university fails to provide such information.

Although generally there was a consensus that climate change topics should be integrated within the Teacher Education Program, it was also reported by one participant that not all concentrations should include these topics, only relevant ones such as STEM concentration.
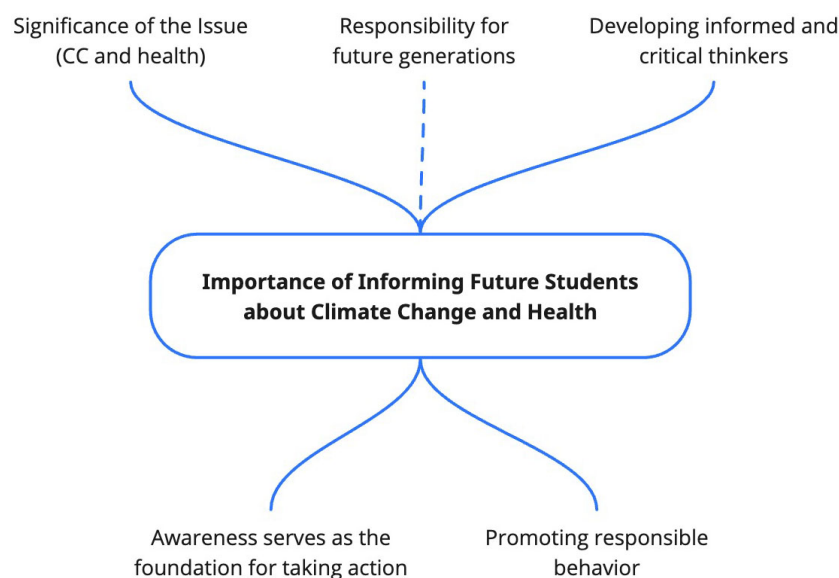
FIGURE 5
The potentials of PSTs as Change Agents. Higher frequency codes (five or more mentions) are shown with solid lines, lower frequency codes (up to four) with dashed lines.
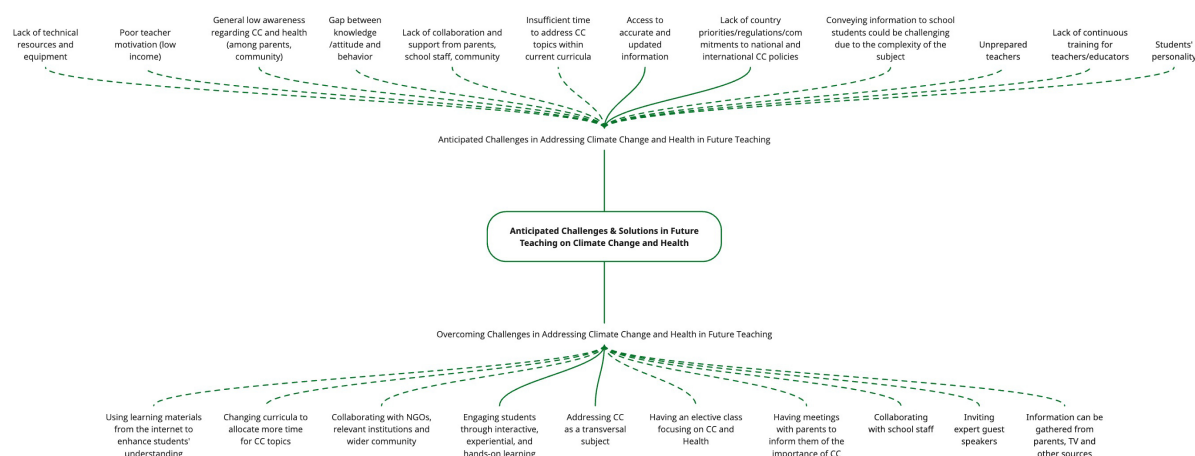

FIGURE 6
Anticipated Challenges and Solutions of PSTs in Future Teaching. Higher frequency codes (five or more mentions) are shown with solid lines, lower frequency codes (up to four) with dashed lines.

"I think STEM... plays an important role in the subject of climate change." (P.10, Bachelor Student, Female)

One of the main themes that emerged from the participants' suggestions to enhance learning includes conducting more research on climate change and health:

"I would suggest that master's students be involved in research directly related to climate change and its impacts, as this would enhance their learning. I believe this approach increases awareness and keeps students more updated on the subject." (P.18, Master Student, Female)

Similarly reported by other Bachelor students:

"Give research assignments to students so they can explore a topic themselves because they understand better and are more interested when they research on their own than when they receive ready-made information." (P.8, Bachelor Student, Female).

Additionally, conducting more research on the topic, whether through general research assignments or collaborations with institutions, can help deepen understanding. Generally, incorporating more practical and experiential learning methods, such as workshops, group activities, field visits, expert discussions, training, case studies, organizing events like Earth Day, and providing more preparation for school practicums, were mentioned as having the potential to make learning more engaging. The use

of interactive tools and methods, including games, visual aids, experiments, teacher-student dialogues, and technology can further improve comprehension. In addition, building faculty capacity by expanding their expertise and improving access to laboratory and data tools was also suggested.

Lastly, expanding the curriculum to include climate change and health topics, either as a dedicated subject or through additional lectures and information, was proposed to enhance education on climate change and health.

The participants emphasized the importance of covering a wide range of health topics, with a particular focus on mental health, infectious diseases, and their broader impacts. A few participants stressed the need to prioritize infectious diseases, as they can rapidly spread and impact entire communities, making awareness and prevention essential. Others advocated for a holistic approach, including food safety and clean water. As one participant noted:

> "When it comes to health, whether mental health, infectious diseases, or other areas, it is crucial to understand the connections between these phenomena." (P.14, Bachelor Student, Male).

3.3.3 The potentials and challenges of PSTs as change agents

3.3.3.1 Potentials

According to the study participants, informing PSTs about climate change and integrating it can bring various potentials such as developing informed and critical thinkers, raising awareness which serves as a foundation for acting, and promoting responsible behavior for future generations. Figure 5 summarizes the full potentials. Regarding educating PSTs on climate change, a master's level student (P.21) mentioned:

> "By educating new generations, I believe we can create a significant positive impact, ensuring that they are equipped to protect and sustain our environment for the future." (P.21, Master Student, Female)

3.3.3.2 Challenges

In addressing climate change and health for future teaching, the study participants mentioned various challenges, including poor or lack of motivation due to low income, lack of knowledge, technical, and financial resources, etc. Figure 6 demonstrates all challenges addressed. According to one participant (P.5) one of the major challenges in this regard is:

> "I think a major challenge would be economic conditions and the lack of necessary equipment. For instance, even though we know the importance of sorting trash, like separating plastic, we don't have the right economic conditions to do it, or we don't know where to take it, or the recycling facility is too far away, and we can't afford to get it there. This would be a big problem. In theory, it's a good idea, and we can explain it to students, but they may not have the means to follow through and end up neglecting it. So,

> economic conditions and resources are a significant challenge." (P.5, Bachelor Student, Female)

Apart from the mentioned structural barriers, the attitude-behavior gap among school students was also reported as a psychological or social barrier:

> "It is a challenge because we often know it is wrong to pollute nature, yet many people still do it. Children are in an environment where they see it is bad, and yet they still do it." (P.13, Master Student, Female)

3.3.3.3 Overcoming challenges

According to Figure 6, various solutions exist to overcome the above-mentioned challenges such as engaging students through interactive, experiential, and hands-on learning activities, using learning materials from the internet, modifying curricula, and collaborating with NGOs and relevant institutions. One participant (P.4) emphasizes the importance of involving parents and suggests that including environmental topics in parent-teacher meetings could raise awareness and encourage consistency between school and home:

> "We could involve these topics in parent-teacher meetings and show how hard we are trying at school to teach students about good environmental practices. If there's a chance, we could encourage them to do the same at home." (P.4, Master Student, Female)

4 Discussion

Pre-service teachers play a crucial role in advancing education for sustainable development, which requires them to develop knowledge of sustainability issues including climate change, skills for sustainable action, and values that promote sustainability through teacher education programs (UNESCO, 2017; Vidal and Kuckuck, 2025). Survey data indicates that most PSTs are willing to teach children about the health impacts of climate change and recognize its importance. They support making climate change education compulsory in schools, viewing schools as key to building awareness. Additionally, PSTs express readiness to learn about climate change causes, health effects, and preventive measures, as well as a willingness to adopt behavior changes. Data from focus groups and interviews further highlight the essential role of teachers in fostering critical thinking, raising awareness, and inspiring action.

According to the current Bachelor's and Master's degree curricula of the Faculty of Education available on the University of Prishtina's website, Education for Sustainable Development (ESD) is offered as an elective course and therefore does not reach all students (University of Prishtina, 2024). Although the website does not provide detailed information on the extent to which climate change and health are addressed within the ESD course, students report that the coverage of health impacts related to climate change is minimal, with insufficient focus on these topics. To enhance

learning, they suggested more research, practical and experiential activities, interactive methods, and curriculum expansion to include climate change and health as a dedicated subject.

Preservice teachers see themselves as key facilitators in climate change education, recognizing their potential in raising awareness, increasing knowledge and promoting responsible behavior. Challenges such as poor motivation, limited knowledge on climate change and health, resource constraints were reported as barriers in including climate and health topics in their future teaching. However, they emphasized solutions such as research-based learning, hands-on activities, curricula changes, and collaborating with NGOs (Non-governmental Organizations) and relevant institutions.

Preservice teachers are ideally positioned to incorporate CCE into their training, making them effective multipliers of knowledge and action. However, studies indicate that PSTs' pedagogical content knowledge (PCK) is insufficient, as they often lack the necessary attitudes and knowledge on climate change (Burmeister and Eilks, 2013; Meilinda et al., 2017; Competente, 2019). Apart from the misconceptions, PSTs also reported that CCE within their teacher education programs was insufficient and ineffective (Tolppanen and Kärkkäinen, 2022; Winter et al., 2022; Moshou and Drinia, 2023) due to the lack of institutional mandates, reliance on motivated individuals, and insufficient preparation for teaching climate-related content (Iacob, 2013; Beasy et al., 2023).

Research highlights several recommendations for improving CCE both within teacher education programs and through broader professional learning opportunities. These include developing professional capacity by creating opportunities and providing support services to help educators address challenges in teaching climate change (Beasy et al., 2023). For instance, development workshops, for both faculty and PSTs, are essential for preparing educators across disciplines and integrating climate change topics into various subjects (Competente, 2019). Furthermore, specialized learning materials and pedagogical approaches, such as sustainability-focused lesson plans, should be developed to address gaps in PSTs' knowledge (Burmeister and Eilks, 2013). In addition, systemic changes are necessary to integrate CCE into program outcomes, including faculty and student development initiatives, and curricula, which is supported by appropriate teaching materials (Competente, 2019). It is also recommended that CCE should be engaging and personally relevant, promoting reflection on barriers to climate action and fostering action competence (Tolppanen and Kärkkäinen, 2022). Likewise, Beasy et al. (2023) recommend expanding training beyond science to include social and emotional aspects. Interactive and experiential approaches have also shown to enhance the effectiveness of CCE (Jeong et al., 2021). These methods and approaches also align with the themes emerging from the focus groups.

Another critical issue is that misconceptions about climate change, once introduced, can be difficult to correct. Studies highlight the importance of early environmental education in shaping accurate climate change understanding, as misconceptions often persist with age rather than diminishing, potentially leading to deeply rooted beliefs that are harder to correct later (Boyes and Stanisstreet, 1996; Jeffries et al., 2001). To counter this, teacher education programs should equip PSTs with the scientific knowledge to correct misconceptions (Meilinda et al., 2017). Overall, this highlights the importance of well-prepared PSTs, since

their understanding may influence how students perceive climate issues. If PSTs hold or repeat misconceptions, these may be passed on to their future students. However, environmental education is frequently sidelined in school schedules, with core subjects taking priority, making it even more difficult to integrate CCE effectively (Tan and Pedretti, 2010). These challenges also emerge in the focus groups, where PSTs highlighted the limited time available to address climate change topics unless they are specifically included in the school curricula.

While some studies attempted to counter the misconceptions through short interventions, persistent misconceptions among students, highlight the need for longer, more robust, and holistic education programs to increase knowledge and positive environmental behavior (Ikonomidis et al., 2012; Dal et al., 2015; Competente, 2019). To this end, Lester et al. (2006) emphasize the importance of fostering both cognitive awareness and social activism simultaneously, to ensure that knowledge and attitudes effectively translate into action. This aligns with one of the themes that emerged from the focus groups, which identified the knowledge/attitude and behavior gap among school students as a challenge in their future teaching. Although increasing knowledge and fixing misconceptions is vital, Liu et al. (2020) and Vukelić and Rončević (2021) argue that environmental knowledge does not always directly translate into pro-environmental behavior. Positive attitudes, behavioral intentions, and perceived effectiveness also influence actions. The causes of this gap are not fully understood but it may stem from habitual behavior or attitudes diminishing when action is deemed costly or high effort (Farjam et al., 2019; Linder et al., 2022). Considering these challenges, Cordero et al. (2020) suggests that long-term holistic university courses focusing on climate change can influence positive individual climate action among students. The 1-year university course fostered pro-environmental behavior by building empathy, personal connection, and empowerment through interactive activities. Students engaged in climate negotiations, career-focused research, and hands-on projects like carbon footprint reduction and community action initiatives. By integrating climate science, solutions, and communication, the course equipped students with knowledge, skills, and a sense of agency to drive lasting environmental action.

Despite these challenges, PSTs generally hold positive attitudes toward environmental education and climate change topics (Pérez-Mesa et al., 2025), consistent with the results of our survey and focus groups. The positive attitudes toward climate change should be leveraged to adequately prepare PSTs as future educators and change agents. To further enhance engagement and learning outcomes, involving students as co-creators of curricula can be beneficial. For instance, Favier et al. (2021) involved PSTs in designing and implementing lessons on local climate change and water issues, which built their confidence, agency and PCK, particularly when they chose topics of study. In our focus groups, students were asked to assess the effectiveness of the university's CCE with a focus on health and suggest improvements. The PSTs input from surveys and focus groups provides valuable guidance for developing more inclusive and contextually relevant curricula. While locally grounded, this collaborative approach supports the broader goal of co-creation and offers a practical, adaptable model for designing programs that reflect students' needs and empower future generations to address the health impacts of climate change in diverse educational contexts.

4.1 Limitations

Volunteer bias may be present, as participation was self-selected, potentially leading to an overrepresentation of individuals with strong opinions on the intersection of climate change and health. In addition, the study relies on self-reported data, which is inherently susceptible to bias. Moreover, the findings are context specific and derived from a single institution (University of Prishtina), limiting their generalizability to other educational programs in Kosovo or beyond due to potential differences in curricula. Further limiting generalizability, the participant pool at the Faculty of Education, where most PSTs were women and of Albanian ethnicity, may not necessarily reflect the perspectives of individuals of other genders or ethnicities.

Another potential limitation is that participants may have reported higher satisfaction with the teacher education program due to social desirability bias, despite the program's limited effectiveness in equipping them with knowledge on climate change and health. Due to logistical constraints and participant availability, a full focus group could not be conducted. Instead, individual interviews and, at times, smaller focus groups with fewer participants were used, which may have limited the richness of group dynamics and interactive discussion. Finally, the translation of qualitative data from Albanian to English may have affected some nuances in participants' responses, although two bilingual researchers (LR and FC) reviewed the translations to maintain accuracy.

5 Conclusion

The findings indicate a clear readiness and eagerness among future educators to teach and learn more about climate change and health. This readiness presents an opportunity for educational institutions and policymakers to support and provide resources for integrating these important topics into educational curricula. Addressing the uncertainty and enhancing confidence in teaching these subjects could further empower future educators to contribute positively to student awareness and understanding of climate change and health. The enthusiasm from PSTs is a great opportunity for universities to step up and provide the training and tools needed to make climate education a core part of their teaching. Furthermore, the authors encourage the full implementation of the Law on Climate Change by developing capacity-building programs on environment and climate change education at all levels, including increased training of professors at the University of Prishtina and other academic institutions about the respective topics. Considering the lack of climate and health literacy in Kosovo's pre-university curricula (Ramadani et al., 2025a), there should be a wider climate change integration in the educational programs, either by designing specific courses on climate change and related impacts on health or integrating respective topics in other courses that are part of the core curricula. While there is interest among the PSTs to learn more about climate change and its impact on health, and their role in educating and influencing future generations is highly acknowledged, institutions should utilize this potential to better prepare current and future generations to deal with the adverse impacts of climate change. Beyond formal educational programs, there should also be increased involvement of the academic community in hands-on climate action and policy development. Furthermore, there should also be increased institutional support for related scientific research since climate change is still insufficiently addressed in health sciences (including public health, environmental and occupational health) (Caka and Caka, 2022). Increased scientific knowledge on respective topics would support more informed policy making and climate action.

Data availability statement

The original contributions presented in this study are included in this article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Informed consent was obtained from survey participants and focus group members, emphasizing voluntary participation, confidentiality, anonymity of data, length of study, data use and protection and purpose of study. Approval was retrieved from the Ethics Committee at Bielefeld University (No. 2024-031 of 2023/01/31).

Author contributions

LR: Visualization, Formal analysis, Project administration, Writing – original draft, Investigation, Data curation, Methodology, Conceptualization, Writing – review & editing. PR: Writing – review & editing, Writing – original draft, Formal analysis. FC: Writing – review & editing, Writing – original draft, Investigation. MB: Conceptualization, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that Generative AI was used in the creation of this manuscript. AI tools such as Bielefeld AI Portal – BIKI (https://www.uni-bielefeld.de/einrichtungen/bits/services/kuz/biki/) and Shqip.ai were used for transcription and translation of a portion of the qualitative data. However, the authors carefully cross-checked all content to ensure accuracy, with personal identifiers removed before AI processing.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2025.1613246/full#supplementary-material

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