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Status of climate change education within the European University Alliance Circle U

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Abstract

Climate change poses an unprecedented global challenge requiring transformative societal change and urgent educational responses. Universities, as key knowledge generators and educators, play a pivotal role in equipping societies to navigate this transition while fulfilling their "Third Mission" of addressing pressing societal challenges and by integrating climate change education across courses. The study found a general deficiency in the provision of climate change courses. A student survey ($n = 313$) revealed strong demand for enhanced climate change education: 97% expressed interest in enrolling in such courses, yet 48% had not taken any, highlighting a substantial gap between demand and provision. Students favored interdisciplinary approaches and short, flexible formats—particularly seminars—over traditional full-length courses. Motivations were primarily linked to personal engagement and societal relevance rather than immediate career prospects. Our findings demonstrate that, despite growing visibility, climate change remains inconsistently integrated into curricula, limiting students' ability to acquire the knowledge and skills necessary to support the green transition. We recommend revising catalogue structures, embedding climate perspectives across disciplines, and expanding accessible, interdisciplinary offerings. By aligning with Article 12 of the Paris Agreement and Target 13.3 of the Sustainable Development Goals, universities can strengthen their societal relevance and actively contribute to building a climate-resilient future.

1 Introduction

Climate change is a global challenge that demands transformative societal change. While the scope and pace of this change will vary across regions, no society is exempt from the need to adapt. This adaptation encompasses both managing the physical risks of gradual climatic shifts and extreme weather events and advancing towards a low-carbon, carbon-neutral economy to reduce greenhouse gas emissions. Such imperatives require fundamental changes in how we produce, consume, and interact with our natural and built environments – changes that will reshape economies worldwide.

The urgency of the agenda is reflected in Target 13.3 of the Sustainable Development Goals (improve education, awareness-raising, and human and institutional capacity on

climate change mitigation, adaptation, impact reduction, and early warning), the United Nations Decade of Action (2020–2030) and the Paris Agreement (2015), signed by nearly all nations. Article 12 of the Paris Agreement calls on states to cooperate in strengthening climate change education as a key enabler of effective action [1].

Universities are central to meeting this obligation. As the highest tier of education systems, they generate new knowledge and deliver high-quality teaching, as well as influence learning across society. Increasingly, attention has turned to their "Third Mission": the application of academic expertise to address urgent societal and economic challenges, such as climate change and the green transition (Central European Network, 2025 (https://www.central-network.eu/outreach/the-third-mission/)).

The accelerating impacts of climate change make this mission more urgent and more scrutinised, than ever. As Compagnucci and Spigarelli (2020) [2] note, universities' Third Mission is at a crossroads: their legitimacy in the eyes of stakeholders, from industry to civil society, will depend on how convincingly they align their strategies with the demands of a climate-constrained world. Climate action is therefore a defining measure of universities' relevance in the twenty-first century.

Yet, despite the scale of the challenge, many institutions have been slow to adapt. Hess and Collins (2018) [3] found that, although climate change is one of the most pressing global issues of this century, universities in the United States had largely failed to update their general educational curriculum to reflect it. They argued that climate change should be integrated across faculties, not confined to specialist programs. Increasingly, universities are also beginning to examine their own greenhouse gas emissions and to develop plans for their reduction [4].

Revising curricula, however, remains complex. As Leal Filho et al. (2021) [5] note, efforts are often hampered due to operational constraints, regulatory requirements, and entrenched disciplinary silos that characterise higher education. In a survey spanning 45 countries, they found that just over half of respondents (58.1%) reported the inclusion of climate change-related content in their university's course guidelines. Using a Likert scale from 1 ("strongly disagree") to 5 ("strongly agree"), respondents (n = 179) strongly endorsed the idea that universities should provide space for climate change education (4.6 +/−0.8sd); agreed that students are keen to training on the topic (3.8 +/−1.1sd); and believed that students with stronger climate literacy enjoy better career prospects (3.9 +/−1.0sd).

Recognising the urgency of the issue, French President Emmanual Macron, in a landmark speech at the Sorbonne in 2017, urged the development of European University Alliances to address major challenges – including climate change – with greater capacity. Supported by the Erasmus+ funding programme, the Alliances aim to enhance the global competitiveness of European universities through long-term strategies for excellence in education and research, emphasising innovative teaching and interdisciplinary approaches. By equipping societies to meet the defining challenges of our time, these initiatives also strengthen the universities' ability to fulfill their Third Mission. This paper, developed within the European University Alliance Circle U, is one such contribution to that shared effort.

In 2021, the Circle U partners conducted an initial mapping of the alliance's capacity to address climate change issues. A manual analysis of the institutions' web pages revealed that research teams within Circle U primarily carried out academic activities at

the disciplinary level, rather than at an interdisciplinary, systems level. An analysis of the Scopus database further showed that Circle U's potential was very high: between 2011 and 2021, partner teams published 10,965 peer-reviewed papers in the climate science domain. At that time, the Circle U partners also produced an initial mapping of climate-related courses across the Alliance. They identified a total of 43 educational elements – ranging from full courses and modules to seminars and lectures – with "climate" in the title, spread across the nine participating universities (Confidential report, Circle U 2021).

The present paper builds on that initial mapping to provide a more detailed assessment of the status of climate change education within Circle U. universities. Specifically, we examine the range and accessibility of such educational offerings, as well as students' expectations and perceived need for climate change education. Based on these findings, we propose opportunities and recommendations for strengthening provision, thereby advancing the objective of Article 12 of the Paris Agreement and Target 13.3 of the Sustainable Development Goals through enhanced climate change education within higher education institutions.

2 Materials and methods

We collected data on the supply of climate change-related education through a review of the course catalogues of the member universities in the Circle U. Alliance and on the demand through a student survey. The catalogue review was conducted from the perspective of a prospective student seeking relevant courses—i.e., by identifying instances where "climate change" appeared in the title or course description. We recognise that some courses may address climate change without explicitly stating it in these fields; however, such content would not be readily discoverable to a student searching the catalogue. For consistency, we use the United Nations Framework Convention on Climate Change Art. 1 definition of climate change as a distinct and well-defined concept encompassing both natural and societal dimensions:

"Climate change" - means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods.

*"Adverse effects of climate change" - means changes in the physical environment or biota resulting from climate change which have significant deleterious effects on the composition, resilience or productivity of natural and managed ecosystems or on the operation of socio-economic systems or on human health and welfare (*https://unfccc.int/resource/ccsites/zimbab/conven/text/art01.htm*).*

2.1 Course catalogue review

We mapped the existing climate change-related courses for the 2024/2025 academic year by searching the online course catalogues of the Circle U. universities using the keyword "climate change" and its equivalent in the local language. This approach reflects a typical student search process, as prospective learners are likely to rely on publicly available catalogues when identifying courses on specific topics, such as climate change. Not all nine universities provide an online catalogue with individual course listings, and therefore only those with publicly accessible listings were included. As a result, three institutions – the University of Belgrade, King's College London, and Université Paris Cité – could

not be assessed in a comparable manner to the other six universities. Our final sample included the course catalogues of the six Circle U universities found in Table 1.

Across the Circle U. Alliance, online course catalogues vary considerably in both availability and the level of detail. We discovered important variability in the search functionality: The online course catalogues from the University of Vienna and the University of Oslo returned results where the keywords appeared anywhere in the course description, including the title. The catalogues from Aarhus University, Humboldt University of Berlin, UCLouvain and University of Pisa returned results where the keywords were limited to titles. This indicates that not all relevant courses show up in the case of these last four universities, as some courses may not include the keyword explicitly in their titles, yet still cover climate change-related content. Manually reviewing all course descriptions was impractical, as it would require reading thousands of entries. To address this, we developed a web scraping program to automate the process.

The program was initially designed for Aarhus University's online course catalogue, which displays courses as a filterable list with keyword search functionality. Each course appears as a clickable hyperlink leading to a separate page containing a text-based course description. Because the catalogue spans hundreds of pages, the program was built to navigate between pages, accept cookies, and detect when the final page of results had been reached. While tailored to Aarhus University, the tool targets catalogues structured as lists of hyperlinks to individual course descriptions and can be readily adapted for other universities with similar formats. The program uses an automated browser to simulate user behaviour in opening the course catalogue. It reads the page HTML to identify hyperlinks to individual courses, then sequentially opens each link in a new tab. Within each course page, the program performs a text search (equivalent to using "Control + F") for the keyword "climate change" and the local equivalent keyword (e.g. "klimaforandringer" in Danish). If a match is found, the programme records the course URL in a list of climate change-related courses.

Table 1 List of Universities and their course catalogues with URLs

Name of University	Date	URL	Keyword
Aarhus University	19.06.25	https://kursuskatalog.au.dk/en	*"klimaforandring"* and *"climate change"*
Humboldt University of Berlin	29.06.25	https://agnes.hu-berlin.de/lupo/rds?state=change&type=5&moduleParameter=veranstaltungSearch&nextdir=change&next=search.vm&subdir=veranstaltung&_form=display&functberlin.de/lupo/rds?state=wtree&search=1&category=veranstaltung.browse&topitem=locallinks&subitem=lectureindex	*"Klimawandel"* and *"climate change"*
UCLouvain	06.03.25	https://catalogue-formations.uclouvain.be/en/search	*"changement+climatique"* and *"climate+change"*
University of Oslo	19.04.25	https://www.uio.no/english/studies/courses/	*"klimaendring"* and *"climate change"*
University of Pisa	30.06.25	https://unipi.coursecatalogue.cineca.it/cerca-insegnamenti	*"cambiamento climatici"* and *"climate change"*
University of Vienna	21.04.25	https://ufind.univie.ac.at/en/index.html	*"Klimawandel"* and *"climate change"*

It processed courses at an average rate of approximately three seconds per course. On completion, all matched courses were compiled into a data frame containing the course URL, the matched keyword, and the number of keyword occurrences. The software is openly available via GitHub (https://github.com/HeatherLACole/Circle-U-CourseMapping). The program was applied, with light modifications, to all Circle U course catalogues in this study, except that of UCLouvain. At UCLouvain, courses appear only after performing a keyword search, which prevents identification of cases where "climate change" appears solely in the course description. Since the purpose of the program is to detect precisely such cases, this catalogue structure is incompatible with the method. King's College London's catalogue was technically compatible with the program, requiring minimal adaptations. However, King's catalogue lists only full degree programmes, rather than individual courses, limiting its usefulness for this analysis.

2.2 Assessment of curriculum data

The data from the online course catalogues were extracted between March and June 2025. If the course catalogue could provide courses with the keywords anywhere in the description, i.e., University of Oslo and University of Vienna, these are the courses included in this study; if the catalogue returned courses with the keyword only in the title, the automated program was applied. All search results are provided in full in the Supporting Information (SI). Some catalogues returned duplicate entries for the same course under different codes, typically corresponding to bachelor's and master's levels. These duplicates were removed through manual inspection, which may have introduced minor errors – either retaining two identical courses or removing a unique course. We assume that such errors are minimal and equally probable in both directions.

Programme structures vary considerably across the partner universities, leading to differences in the level of detail provided in course information – from brief overviews to detailed descriptions. To enable cross-institutional comparison, we recorded a set of three recurring parameters for later comparison: (1) the number of climate change-related courses; (2) the European Credit Transfer and Accumulation System (ECTS) value; and (3) the department or faculty offering the course.

By collecting the ECTS value of each course, we could calculate the total available ECTS credits allocated to climate change-related courses at each university. This measure provided an indication of the curricular weight given to the topic, complementing the simple count of courses offered.

Comparing the faculties or departments among the universities was complicated by structural differences: for example, the University of Pisa has twenty departments as its main structure, while the University of Oslo has eight faculties, each subdivided into departments, as well as interdisciplinary centres outside faculty structures. To standardise classification, courses were assigned to one of seven traditional faculty categories: humanities (arts); social science; natural science, mathematics and technical science; law; theology; health and life science. Courses outside these categories were grouped into "other". This rubric allowed us to examine whether climate change is concentrated in particular disciplines or integrated across multiple fields. The classification is based on the department or faculty specified in the course description and can be seen in the full list of results.

2.3 Student survey

We conducted a survey of students across the participating universities to assess their needs and aspirations on the inclusion of climate change in university curricula. The survey questions were co-developed and reviewed collaboratively by representatives from all participating institutions in Circle U.

2.4 Survey design and delivery method

To explore student expectations and needs regarding climate change education within the European University Alliance Circle U, we conducted an online questionnaire survey using Survey-Xact (https://rambollxact.com/). The survey was administered in spring 2025 and targeted students from all nine universities in the alliance, aiming to identify perceived gaps in climate change education. It was uploaded to each university's student portal, making it accessible to all students, regardless of discipline or study level, rather than to a pre-selected cohort [6].

The online survey addressed six thematic areas: (1) awareness and accessibility of climate change-related courses; (2) course availability and gaps; (3) interdisciplinarity; (4) internationalisation of the courses; and (5) relevance of the courses to the current needs of the job market. These thematic areas were derived from an extensive literature review and from the data extraction techniques described in Sect. 2.1. From these thematic areas, we developed 14 closed-ended questions. Responses were measured using a five-point Likert scale ranging from "very low" (1) and "somewhat low" (2) to "moderate" (3), "somewhat high" (4), and "very high" (5) [7].

Through an iterative review process, the questionnaire was refined to eliminate redundancy and to ensure that the items effectively captured the necessary data for assessing climate change education within the Circle U. network from the perspective of students. The full set of survey questions is provided in the Supporting Information (SI). The survey was conducted in English and distributed via the partner universities' internal student portals and platforms to guarantee broad accessibility. We designed our survey to ensure compliance with the General Data Protection Regulation (GDPR), thereby safeguarding research integrity and protecting student data privacy by not collecting any personal information at all.

2.5 Survey assessment method

Completed questionnaires were prepared and audited to ensure validity, reliability, and consistency prior to analysis. Descriptive statistical analysis was conducted using SurveyXact analytics tools to examine student perceptions of climate change education. Frequencies were calculated to determine response distributions for each survey item, while measures of central tendency (mean) were computed to identify overall trends in the dataset [8]. To enhance interpretation, tables and stacked bar charts were generated to allow comparative analysis across thematic areas [9]. Findings from the descriptive analysis were synthesised into the study's key thematic areas: (1) awareness and accessibility of climate change-related courses; (2) course availability and gaps; (3) interdisciplinary; (4) internationalisation of courses; and (5) relevance of the courses to the current needs of the job market. This analytical approach provided a structured framework for interpreting student perceptions and for generating evidence-based recommendations to strengthen climate change education in higher education curricula.

3 Results

Below is a summary of the results of the course catalogue review and the student survey regarding the inclusion of climate change in university curricula.

3.1 Course catalog review

A systematic search of climate change-related education across course catalogues from the six European universities revealed marked variation in both frequency and placement of relevant content. The University of Oslo and the University of Vienna offered the highest overall number of relevant courses. At an institution such as Aarhus University, climate change was frequently referenced within course descriptions but rarely appeared in course titles, potentially limiting discoverability for students relying on simple keyword searches. The course catalogue search found that in most cases, there were significantly more climate change courses found if one was able to conduct a search of the course description. This pattern suggests that while relatively few courses explicitly advertise climate change in their titles, a substantial number incorporate the topic within their broader content, as captured in Table 2 below.

When applied to Aarhus University's course catalogue, the program identified 20 unique climate change-related courses, but only 6 results from the manual search had the word "climate change" or "klimaforandringer" in the title. This raises the question of whether additional climate change-related courses exist that remain invisible to students who rely solely on standard keyword searches.

The University of Vienna showed the highest level of engagement, with 14 courses referencing climate change in their titles and 172 in their titles or descriptions. This indicates broad integration of climate change themes across the curriculum, even if not always highlighted in course titles. Humboldt-Universität zu Berlin and the University of Pisa presented lower overall counts but a more balanced distribution between title and description. At Humboldt-Universität zu Berlin, the keyword appeared seven times in titles and eleven times in descriptions, reflecting a more deliberate and consistent approach to course design.

Some limitations of the scraping method became evident at UCLouvain, where courses are accessible only via keyword-triggered searches. This prevented a systematic review of course descriptions. Nevertheless, six matches were found in course titles

Table 2 Number of unique courses containing the term "climate change" or its equivalent in the local language across six Circle U. universities

University	Number of courses		Sum of ECTS	
	Climate change only in title[a]	Climate change in title and/or description	Climate change only in title[a]	Climate Change in Title and/or Description
Aarhus University	6	20 [b]	55	165 [b]
Humboldt University of Berlin	7	11 [b]	30	48 [b]
UCLouvain	6	Not discernable	26	Not discernable
University of Oslo	8	110 [a]	53	988 [a]
University of Pisa	6	10 [b]	15	62 [b]
University of Vienna	14	172 [a]	67	832,5 [a]

See Sect. 2.2 for details on assessment methods

[a]Results from manual course catalogue search

[b]Results from automated course catalogue scraping

alone suggesting at least a baseline level of thematic visibility in the curriculum of comparable size to the other universities.

3.1.1 Distribution of courses by faculty

The disciplinary distribution of climate change course offerings also varied significantly across universities. The University of Vienna and the University of Oslo stood out, with 172 and 110 courses in different disciplines (Table 3), respectively, indicating a particularly high level of integration of climate change across faculties at those universities relative to the other universities.

For the University of Pisa, UCLouvain and Aarhus University, the course distribution was concentrated in STEM, the first two institutions exhibiting a moderate distribution, whereas the latter along with Humboldt University of Berlin had a slightly broader selection. These findings underscore disparities in course availability across the Alliance: while institutions such as the University of Oslo provide broad interdisciplinary curricula, others offer only minimal or narrowly focused provision. See Supporting Information for details.

3.2 Student survey results

The student survey was completed by 207 respondents, with an additional 106 partial responses, giving a total of 313 respondents. Given the open distribution method through student portals, the overall response rate cannot be meaningfully calculated. The respondents acted entirely on their own volition, and it is thus likely that the respondents were more interested in receiving climate change education than the student body in general. The sample size is relatively small compared to the total student population and is therefore not representative of the entire student body – hence these results should be seen as indicative, warranting further investigation. Nonetheless, the responses provide valuable indicative insights into student perspectives on climate change education. See the Supplementary Information (S.I.) section for more information and detailed results from the survey.

3.2.1 Respondent characteristics

The distribution of respondents across the participating universities is shown in Fig. 1. The majority of responses came from students at the University of Vienna, Aarhus University, and Humboldt-Universität zu Berlin.

Table 3 Distribution of climate change–related courses across faculties at six Circle U. universities

University	Humanities	Social Science	STEM	Law	Theology	Health	Inter-Disciplinary Centres	Total
Aarhus University	3	3	12	1	0	1	0	20
Humboldt University of Berlin	2	4	4	0	0	0	1	11
UCLouvain[a]	1	1	4	0	0	0	0	6
University of Oslo	21	39	22	6	4	6	12	110
University of Pisa	0	3	6	0	0	1	0	10
University of Vienna	30	61	64	14	2	0	1	172

[a]Based on the results with "climate change" only in the title, see Sect. 2.1 and Table 2

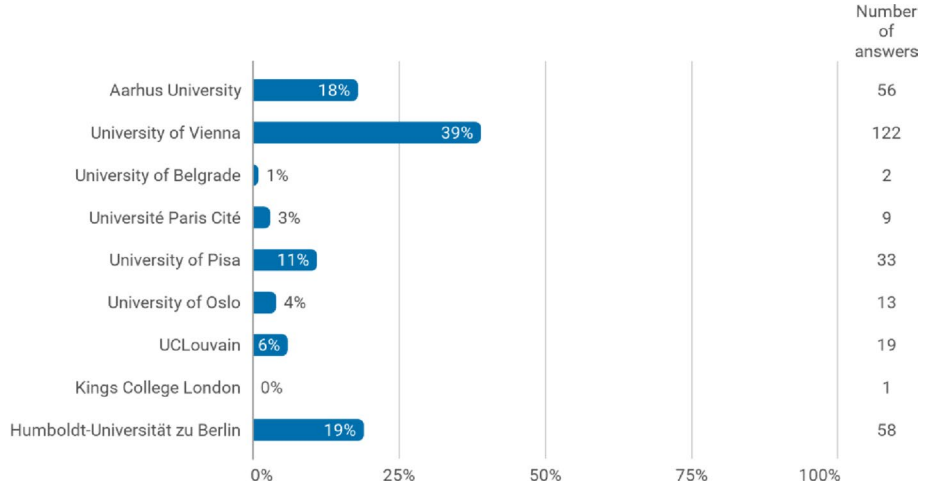

Fig. 1 Distribution of survey responses by university

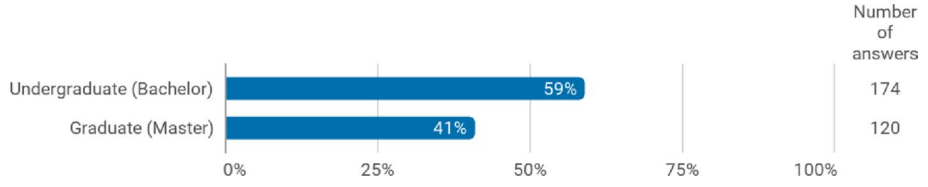

Fig. 2 Graduate level distribution of respondents

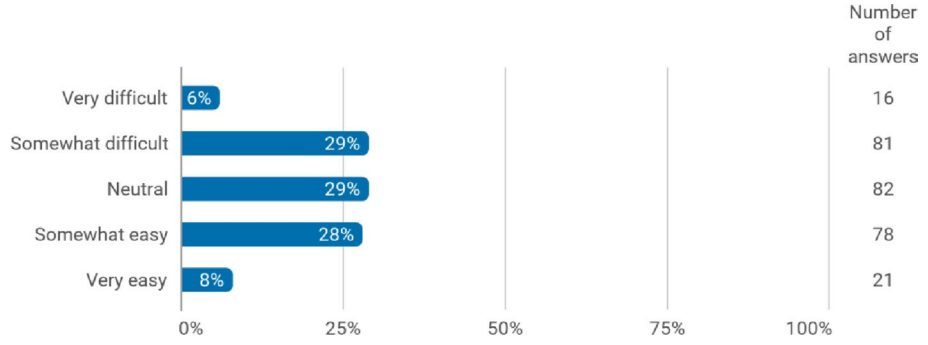

Fig. 3 Student perceptions of the findability of climate change courses in course catalogues (Question 1)

The respondents were fairly evenly distributed between undergraduate and postgraduate students (Fig. 2).

3.2.2 Course availability

This section presents students' perceptions of the extent to which climate change topics are integrated into their academic programmes, across both mandatory (M) and elective (E) courses. Overall, respondents indicated that climate change–related courses were generally not difficult to locate in their university catalogues, as seen in Fig. 3.

Table 4 shows that students generally perceived climate change as inadequately addressed within their programmes, with average ratings of 2.0 for mandatory courses and 2.7 for electives. Elective courses also received slightly higher ratings for alignment

Table 4 Course availability: average scores plus/minus standard deviation (SD) (Question 2, Question 3, and Question 6)

Type of course	To what extent is climate change covered as a topic in your studies? (*n* = 265 (± SD))	To what extent does your university offer courses on climate change that are relevant to your study? (*n* = 256(± SD))	To what extent would you like climate change topics to be part of your studies? (*n* = 230(± SD))
Mandatory courses (M)	2.0 (± 1.2)	2.2 (± 1.3)	3.4 (± 1.2)
Elective courses (E)	2.7 (± 1.2)	2.7 (± 1.2)	3.9 (± 1.0)

with students' academic interests (2.7), suggesting that elective curricula may be more adaptable to interdisciplinary themes such as climate change.

Furthermore, students expressed a strong desire for greater integration of climate change content, particularly in elective courses (E = 3.9) compared to mandatory ones (M = 3.4). Although elective courses performed better overall, neither course type currently meets student expectations.

3.2.3 Interest in courses

The section presents students' engagement with climate change-related coursework and their willingness to pursue additional studies on the topic. Nearly half of respondents (48%) reported that they had not taken any climate change-related courses during their academic programme (Fig. 4a). However, when asked about future intentions, an overwhelming majority (97%) expressed interest in enrolling in one or more climate change courses in the future (Fig. 4b).

This contrast highlights a significant unmet demand for climate change education among students. While interest in pursuing such courses is strong, actual enrolment remains comparatively low, suggesting that institutional barriers – such as limited course availability or insufficient integration of climate change-related content into existing curricula – may be constraining participation.enrollment.

3.2.4 Motivation and aspirations

The evaluation of student perceptions revealed important insights into their motivations and aspirations regarding climate change education. Table 5 shows that the sufficiency of existing course offerings received a relatively low to moderate average rating (2.5/5), indicating that students perceive a notable gap in current curricula. By contrast, student motivation to enrol in climate change-related courses was significantly higher (3.9/5), reflecting a strong interest in expanding opportunities to study the topic.

Further analysis showed that students recognised the potential contribution of such courses to climate change mitigation and adaptation (3.9/5), underscoring their perceived societal relevance. Career opportunities linked to climate change, however, were rated slightly lower (3.3/5), possibly reflecting uncertainty about the applicability of climate literacy within the job market. Notably, overall engagement with climate change-related issues received the highest rating (4.0/5), emphasising students' strong personal connection to the topic.

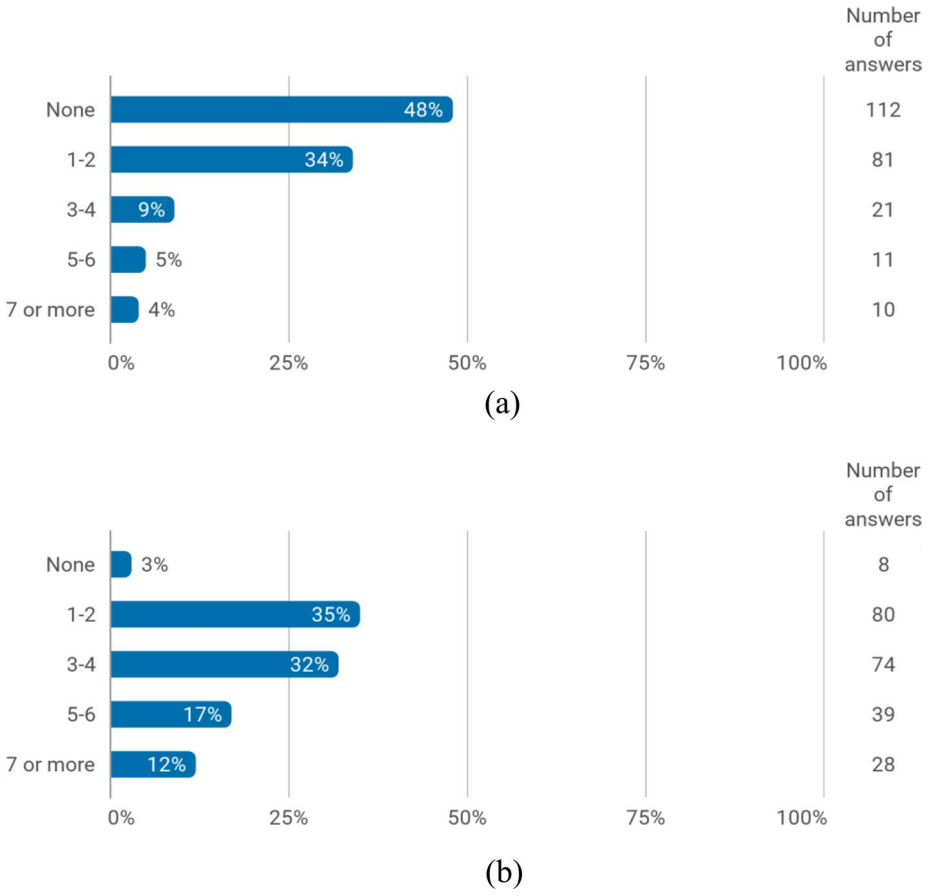

Fig. 4 **a**: Number of climate change-related courses taken (Question 5). **b**: Interest in taking climate change-related courses (Question7)

Table 5 Assessment of existing course provision and student interests (average scores plus/minus standard deviation (SD), Question 4 and Question 8)

Criteria for Assessment	Sufficiency with regard to existing course provision ($n = 240$, (± SD))	Student motivation for taking a course in climate change ($n = 221$ (± SD))
Contribution to climate change mitigation or adaptation	2.5 (± 1.3)	3.9(± 1.0)
Career opportunities related to climate change	2.3 (± 1.2)	3.3 (± 1.1)
Engagement in climate change related issues	2.5 (± 1.2)	4.0 (± 1.0)
Relevance to study programme	NA	3.9 (± 1.0)

3.2.5 Delivery of courses regarding climate change

Students' preferences for different delivery formats revealed varying priorities for climate change education, as seen in Table 6. Interdisciplinary approaches were particularly well received, with an average rating of (3.6/5), indicating that students value the integration of perspectives across multiple fields. By contrast, the international dimension scored lower, suggesting that while students recognise the importance of multidisciplinary approaches, they may not view globalisation or cross-border elements as essential in course design.

In contrast, short in-person seminars received higher ratings for both the interdisciplinary (3.7/5) and international (3.1/5) components, indicating that condensed,

Table 6 Preferred formats for the delivery of climate change courses (average scores plus/minus standard deviation (SD) from Questions 10 and 11)

Criteria	Interdisciplinary ($n = 216$) (± SD))	International ($n = 213$) (± SD))
Full physical course	3.6 (± 1.1)	2.7 (± 1.4)
Short physical seminar	3.7 (± 1.1)	3.1 (± 1.4)
Full online course	3.0 (± 1.4)	3.1 (± 1.3)
Short online seminar	3.1 (± 1.4)	3.3 (± 1.3)

face-to-face sessions may be more effective at accommodating diverse and global perspectives. Similarly, short online seminars scored slightly higher than longer online formats in both categories, suggesting that brief digital engagements may provide a more accessible and engaging platform for fostering cross-border and cross-disciplinary learning. See Supporting Information 2 for details.

4 Discussion and conclusions

The aim of this paper was to provide a more accurate overview of climate change education across six of the nine universities in the European University Alliance, Circle U. We examined both the availability of climate change-related courses and students' expectations regarding the integration of climate change into their education. In 2021, an initial mapping exercise by Circle U of all nine universities identified 43 educational elements/courses across the Alliance with "climate" in the title and 22 elements with "climate change" in the title. By 2025, our review of six out of nine universities found 47 courses explicitly referencing *climate change* in their titles and a total of 329 courses mentioning climate change in their titles or their descriptions. While this suggests an overall expansion from 2021 to 2025 in the visibility of climate change within curricula, it is not possible to determine conclusively whether the increase reflects genuine growth in provision or is due to differences in data collection methods.

The course catalogue review revealed that climate change remains poorly represented in most university curricula, both in terms of the number of courses available and the total ECTS credits assigned. Across the six universities assessed, the distribution of courses by faculty showed little evidence of a coherent or structured approach for including climate change in the curricula. Instead, climate change content appeared inconsistent and scattered across the universities, echoing the concerns raised by Leal Filho et al. (2021) [5] regarding the absence of systematic integration of climate change across higher education. Furthermore, the structure of course catalogues themselves often hinders interdisciplinarity. Students searching by keyword are unlikely to discover courses that engage with climate change indirectly, even when these offer substantial contributions to climate change related education. Muccione et al. (2025) [10] concluded based on their review that climate change education is an interdisciplinary field of research embedded in key climate research topics such as climate change adaptation, disaster risks and education, mitigation, and sustainability. They also found that the bulk of the literature falls within three main topics that deal with (1) student and learning methods, (2) sustainability and learning/teaching for sustainable development, and (3) the pivotal role of education in adaptation and resilience. Interestingly, in other words, they found that climate change is not integrated in all or most other disciplines.

The survey results reinforce these findings by highlighting a pronounced gap between student demand and the availability of climate change education. Nearly half

of respondents (48%) reported never having taken a change-related course, and 82% indicated they had taken no more than two. At the same time, 97% expressed a desire to enroll in a climate change course, with 67% indicating interest in taking one to four such courses. This discrepancy points to both an inadequacy of current provision and urgency of curricular reform.

Student motivations provide further insight into this demand. Respondents judged existing climate change provision insufficient across three parameters: availability, sufficiency, and relevance. Their motivation to pursue further climate change education was not primarily career-driven but instead rooted in strong personal engagement with climate change issues and recognition of their societal relevance. One student respondent captured this sentiment succinctly: "*As a starting point, it would be nice if it was possible to encourage professors to review their already existing lectures and courses and to analyse if it would work to include some climate change-related topics in them. As a next step, such entire courses related to climate change as brought up in this survey sound like a good idea.*"

Preferences regarding delivery formats further illustrate how students envision climate change education. Interdisciplinary courses, were particularly valued, and short seminars – whether in-person or online – were rated higher than longer formats, suggesting that condensed and flexible offerings may be most effective. Accessibility, and cost were also noted as important considerations. Importantly, responses revealed that many students answered with their own study track in mind, suggesting that climate change education may be most impactful when tailored to disciplinary contexts while still drawing on interdisciplinary perspectives. There is still a great need to further explore the students' preferences regarding education in climate change.

Our research design specifically addresses the challenges students face when searching for climate change courses. While courses that engage with climate change-related issues without explicitly using keywords like "climate change" undoubtedly exist, these courses are at risk of remaining invisible to students unless programme design and catalogue structures are revised. Revisiting these structures and encouraging faculty to embed climate change perspectives into existing courses as well as developing dedicated modules, can help address this misalignment between supply and demand.

Taken together, these findings confirm Leal Filho et al.'s (2021) [5] conclusion: there is high student demand for climate change education but low and uneven provision. No structured process yet exists to systematically incorporate climate change into curricula, despite Article 12 of the Paris Agreement mandating the enhancement of climate change education and the target 13.3 of the Sustainable Development Goal agenda. Students are eager for opportunities to engage, particularly through interdisciplinary and accessible formats, but universities must overcome institutional inertia to meet this demand.

The green transition rests on the shoulders of many actors, but without the active contribution of universities, progress will be severely constrained. An informed society is better able to recognise challenges, envision solutions, take action to realise them, and accept any necessary changes in the process. This study shows clearly that students are asking for the tools to guide the next generation of society. The task now lies with universities to lighten their institutional inertia and ensure that climate change education becomes a structured and widely accessible component of higher education, thereby maintaining their relevance and impact relative to their third mission in the decades

ahead. Clearly, this is not an easy task, but one that will demand deeper research and collaboration if its full potential is to be realised.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1007/s44217-026-01527-5.

Additional file 1.

Additional file 2.

Additional file 3.

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Author contributions
HS; JHA; MCMM; HB; FAD wrote the main manuscript text made the analysis and prepared figures. TDS and MV contributed to the concept. All authors reviewed the manuscript.

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Data availability
The authors declare that the data supporting the findings of this study are available within the paper and its [Supplementary Information files](https:/www.nature.com/articles/s41557-022-01049-1). Should any raw data files be needed in another format, they are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study was conducted in accordance with recognized ethical standards for research in education. Approval for the research protocol was obtained from the Ethics Committee review board at the Department of Environmental Science at Aarhus University (Approval Number: 2025_10_waived). All participants were fully informed of the purpose and procedures of the study and provided voluntary consent prior to participation in the online survey. For participants under the age of 18, informed consent was obtained from parents or legal guardians, and assent was secured from the students themselves. The survey was distributed to enrolled students older than 18 years of age. Participant confidentiality and anonymity were strictly maintained throughout the research process. No identifying personal information is reported in this manuscript, and data were stored securely in compliance with institutional and legal data protection requirements. Participation involved no foreseeable risk or harm. The research adhered to the ethical principles outlined in the Declaration of Helsinki and followed the editorial and publication ethics guidelines of *Discover Education*. There are no known conflicts of interest associated with this work. The authors affirm that there was no original research involving human research participants or live vertebrates. The survey was distributed on the different universities' websites, where students could freely take part in it or not at any time. No minors were invited to the survey, which was only directed towards adult university students. The survey, moreover, complies with the GDPR regulation of the EU – no personal data was collected, and the research use of the results was given in the preamble of the survey. Hence, the protocol, on original research that does not involve human research participants or live vertebrates, was approved by the relevant IRB ethics committee at the Dept. of Environmental Science at AU, as the research was carried out following the guidelines of the ethics committee, which hence approved the study and waived the need for further approval. Not applicable. The authors affirm that a survey was distributed on the different universities' websites. Students could freely take part in it or not, anonymously. No minors were invited to the survey, which was only directed towards adult university students. Informed consents were obtained from all participants or, if participants are under 18, from a parent and/or legal guardian. However, no informed consents were received from a parent and/or legal guardian, as none of the respondents at the universities were under 18 yrs. The survey, moreover, complies with the GDPR regulation of the EU – no personal data was collected. Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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