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EDITED BY

Marta Moskal,
University of Glasgow, United Kingdom

REVIEWED BY

Kerry Renwick,
University of British Columbia, Canada
Nese Soysal,
University of Bath, United Kingdom

*CORRESPONDENCE

Khalifatulloh Fiel'ardh
✉ Aldi@okayama-u.ac.jp

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Sustainable development goals in teacher education: comparing syllabi in a Japanese and a Slovenian university

Khalifatulloh Fiel'ardh^{1*}, Gregor Torkar², Hana Rožman² and Hiroki Fujii¹

¹Graduate School of Education, Okayama University, Okayama, Japan, ²Faculty of Education, University of Ljubljana, Ljubljana, Slovenia

Introduction: This research aims to explore the integration of Sustainable Development Goals (SDGs) within teacher education programs, focusing on the Faculty of Education at Okayama University, Japan and the University of Ljubljana, Slovenia.

Methods: We employed a qualitative content analysis of the syllabi (n=2,079 from Okayama University; n=504 from University of Ljubljana) and combined it with insights from semi-structured interviews.

Results: The analysis illuminated a strong emphasis on Quality Education (SDG 4) in both institutions. However, certain SDGs, like Climate Action (SDG 13), were less represented, marking potential areas for enhancement. Differences were also identified in the distribution of SDGs-related content between compulsory and elective courses, indicating institutional priorities. Interview reflections emphasized the pivotal role of educators in realizing SDGs and highlighted the necessity of collaboration to achieve these global objectives.

Discussion: The insights from interviews and syllabi content analysis underscore the urgency to bridge the identified gaps in SDG coverage. Disparities in emphasis between the two Education for Sustainable Development (ESD)-committed universities were noted, suggesting the importance of fostering strategy exchange and partnerships across institutions.

Conclusion: Enhancing the alignment of teacher education programs with SDGs requires collective efforts. By addressing the gaps and promoting effective collaboration, these programs can achieve greater relevance and efficacy in promoting the SDGs.

KEYWORDS

sustainable development goals, teacher education curricula, qualitative content analysis, semi-structured interview, Japan, Slovenia

1. Introduction

Established in 2015, the United Nations' Sustainable Development Goals (SDGs) provide a framework of 17 interconnected objectives to address global challenges. Among these, SDG 4 (Quality Education) emphasises the crucial role of education in empowering individuals to address sustainability concerns. Central to this is the role of teachers, who instil sustainable values and global citizenship in their students, as highlighted by multiple sources (Gough,

2016; Jegstad et al., 2018; Rieckmann, 2019; Ferguson et al., 2021; United Nations Educational, 2021; Fischer et al., 2022). Therefore, it is essential that teacher education not only encompasses sustainability concepts but also offers holistic and interdisciplinary teaching methods on the topic (Bourn et al., 2017; Yemini et al., 2019; Saperstein, 2020). However, the integration of SDGs into teacher education is influenced by regional, cultural, economic, and political contexts, requiring specialised strategies (Hopkins and McKeown, 2002; Little and Green, 2009; Leicht et al., 2018). By acknowledging these variations, we can boost program effectiveness, promote collaboration, and cultivate a global teacher community poised to tackle local sustainability challenges (Penger et al., 2015; Oikawa, 2016; Caniglia et al., 2018; Dür and Keller, 2018).

Universities worldwide are undertaking significant strides in weaving the SDGs into their higher education. Notable efforts have been observed in countries like Mexico, Portugal, Nigeria, and India, where institutions are actively embedding sustainability into their curricula and institutional practices (Omisore et al., 2017; Aleixo et al., 2018; Priyadarshini and Abhilash, 2020; Perales Franco and McCowan, 2021). In the United States and Germany, Arizona State University and Leuphana University, respectively, are setting a high standard by centralising sustainability in their educational offerings (Müller-Christ et al., 2014; Wiek et al., 2014). However, the global landscape is uneven. The commitment to integrate the SDGs into university programs is present, but the depth of this integration varies considerably. In Spain, while there is a reported high percentage of universities developing SDG-related strategies, the actual implementation and prominence of these goals within university agendas are not uniform (Poza-Vilches et al., 2022), which suggests a need for not just policy but also robust academic practices and structural support within institutions to ensure the SDGs' principles are genuinely ingrained in educational programs and campus culture. The path forward involves strengthening these elements to achieve more impactful integration across universities globally.

In Japan, SDGs have become a key policy driver, with the government prioritising initiatives to integrate them into teacher education programs (Nagata, 2017; Masuda et al., 2021; Sumida, 2022). Study programs at Japanese universities have been encouraged to emphasise global citizenship, environmental stewardship, and critical thinking skills, as well as the country's unique cultural and social values. Okayama University, for example, has made Education for Sustainable Development (ESD) a core component of its operations, with a dedicated Centre for ESD conducting research, education, and outreach activities to promote sustainable development (Fujii, 2021; Zen and Shibakawa, 2022). To ensure that ESD is seamlessly integrated into all aspects of the University's operations, the Centre collaborates with various departments and faculties. The University is actively involved in the local community and forms partnerships with organisations to advance sustainability, encouraging students and faculty members to participate in volunteer activities and community projects that promote sustainable development. It has also formed international collaborations and partnerships with other universities and organisations in order to share knowledge and expertise in ESD. Furthermore, the University offers undergraduate and graduate programs in environmental studies, sustainable development, and related fields, as well as research opportunities for students to work on sustainable development projects with faculty members.

The University of Ljubljana, on the other hand, is a prominent research institution in Slovenia that contributes significantly to sustainability and the achievement of the SDGs. Its Faculty of Education has a long history of updating study programs to align with the SDGs and goals of the European Green Deal (e.g., Knez et al., 2022), making it an essential component of the country's sustainability initiatives. The faculty is Slovenia's first eco-faculty, and it actively promotes sustainable practices among its students and faculty members. It encourages students to take part in sustainability-related events and projects, hosts public events and seminars, and has established itself as a European hub for ESD teacher education. The faculty is a member of the international partner network of the UNESCO Chair on Education for Sustainable Lifestyles, allowing it to collaborate with other leading research institutions around the world and share knowledge and expertise in ESD. Furthermore, the University of Ljubljana has been actively implementing the European Union's Recommendation on Learning for the Green Transition and Sustainable Development, emphasising the importance of prioritising teaching and learning for sustainability in education and training, thus demonstrating the University's dedication to promoting ESD.

Given the preceding context, it is clear that teacher education programs are critical to achieving the SDGs and driving sustainable development. Regional diversity, on the other hand, can have an impact on the SDG implementation in teacher education programs, emphasising the need for context-specific approaches to integrate sustainability concepts effectively. As a result, a comparative study, including syllabi analysis, can assist in identifying areas where sustainable development principles and practices are insufficiently integrated into teacher education programs. Analysing teacher education curricula from representative universities in different regions, such as Japan and Slovenia, can provide useful insights into each country's successes and challenges in incorporating the SDGs into their programs. Consequently, the current study used a qualitative content analysis approach to investigate the representation of the SDGs-related keywords [as exemplified by Murillo-Vargas et al. (2020) and Poza-Vilches et al. (2022)] in teacher education program syllabi at the Faculty of Education at two universities known for their commitment to the SDGs: Okayama University in Japan (OU) and University of Ljubljana in Slovenia (UL). This comparative analysis aims to inform the development of more effective teacher education programs by identifying potential areas for improvement and best practices. The findings may help to improve understanding of the role of regional diversity in shaping teacher education for sustainable development, as well as inform policy and practice at the national and international levels.

Three research questions were developed to achieve this goal:

- **RQ1:** How do the syllabi of teacher education programs (primary, secondary, or special education) align with the SDGs in OU and UL?
- **RQ2:** How are the SDGs represented in compulsory and elective courses in OU and UL's analysed teacher education programs?
- **RQ3:** What are the differences and similarities in the representation of the SDGs between OU and UL?

2. Materials and methods

2.1. Development of keywords

The keyword development commenced with an in-depth examination of the 17 Sustainable Development Goals (SDGs) and their 169 targets as delineated by the [United Nations \(2015\)](#), setting the context for the study. A meticulous strategy was paramount to pinpoint keywords mirroring each target's content and ambit. Initially, the Slovenian research team thoroughly assessed each target, extracting key themes and objectives to distil into specific keywords, capturing the SDGs' complex essence. Subsequently, the Slovenian keywords were translated into English, employing a back-translation method ([Behr, 2017](#)) to preserve semantic integrity. This process entailed retranslating the English rendition into Slovenian and rectifying any inconsistencies with the original version. The English list was transmitted to the Japanese cohort for translation upon validation. Subsequently, the Japanese version was back-translated to English, enabling a comparison to spot and amend any discrepancies. An additional validation tier was incorporated via expert review to bolster the keywords' validity. Scholars from varied disciplines, spanning science, social science, education, home economics, and special needs education, evaluated the keywords ([Table 1](#)) at both universities. This collective expertise ensured the keywords were reflective of the SDG targets and pertinent in their respective academic domains.

2.2. Syllabi collection

Utilising census sampling (e.g., [Malekipour et al., 2018](#)), all syllabi from the 2022 teacher education programs provided by the faculty of Education at Okayama University, Japan ($N=2,079$), and the University of Ljubljana Slovenia ($N = 504$) were collected. This method, chosen for its comprehensiveness, minimised sampling errors and ensured detailed insights into how SDGs are integrated across various courses and disciplines, providing a complete dataset for analysis.

2.3. Qualitative content analysis

In line with the qualitative inquiry approach ([Pipere et al., 2015](#)), this research employed qualitative content analysis (QCA) as its methodological approach, as described by [Mayring \(2014\)](#). The QCA was selected due to its systematic procedure for interpreting text while maintaining fidelity to the content's original intent and context. The study's core objective was to identify representations of the 17 SDGs and their 169 targets within the teacher education syllabi at OU and UL. For data analysis, a manual counting technique was applied within the QCA framework. Each syllabus from both universities was systematically reviewed. SDG-related keywords were identified, and their occurrences were tabulated. Individual researchers meticulously examined each syllabus to count and record the frequency of these validated keywords. The resultant dataset provided a quantitative overview of SDG integration based on keyword frequency within the teacher education programs of the two institutions.

2.4. Data triangulation

Data triangulation ([Denzin, 2017](#)), vital for in-depth research analysis, uses multiple data sources, methods, or researchers to strengthen research validity. In this study, focused on the integration of SDGs in teacher education programs of OU and UL, we employed three triangulation forms, incorporating literature as an additional data source. First, data source triangulation involved comparing data from different sources: keyword analysis, interviews with lecturers, and academic literature. The literature provided essential context and background, aiding in data interpretation. Second, methodological triangulation combines various investigative methods. We integrated insights from keyword analysis, interviews, and literature review, enabling a thorough examination of SDG integration in course syllabi. Third, researcher triangulation engaged multiple researchers in data collection and analysis. During interviews, while one researcher asked questions, another focused on note-taking and recording, ensuring diverse perspectives in data interpretation enriched by the literature's contextual insights.

2.5. Semi-structured interviews

Utilising purposive sampling, eight consenting lecturers—four from each institution—were recruited for interviews. The selection from each institution was based on a specific criterion: two lecturers who had a pronounced high frequency of SDG-related keywords in their syllabi and two who manifested a lower keyword frequency. The interview protocol was constructed around several core areas: reflections on predominant keywords, distinctions between elective and compulsory courses in terms of SDG content, the rationale behind the inclusion or omission of SDGs in the core curriculum, and personal experiences and emphases when designing syllabi with respect to the SDGs. Each question was aimed to augment the depth of understanding gained from the QCA. All interviews were conducted in the respective local languages (Japanese and Slovenian) of the respondents. Post-interview, the transcript was translated into English, followed by a rigorous member-checking ([Koelsch, 2013](#)). The interviewees were provided with the original transcript as well as summaries of their responses translated into English, enabling them to confirm the accuracy and authenticity of the content.

3. Results

[Table 2](#) offers a deep dive into the curriculum structure at OU, showcasing the uneven terrain of SDG integration. The dominance of Quality Education (SDG 4) within these programs, especially the PST, reflects the University's commitment to fostering educational competence. However, this emphasis seems to overshadow critical global challenges encapsulated within other SDGs, notably those concerning environmental and societal well-being, such as Clean Water and Sanitation (SDG 6), Sustainable Cities and Communities (SDG 11) or Climate Action (SDG 13). The scant representation of these SDGs, particularly in compulsory courses, signals a potential gap in the holistic education of future teachers. This curriculum design suggests that while students are well-versed in education theories and practices, they may graduate with limited understanding

TABLE 1 English version of the SDG-keyword lists.

SDG	Keywords	Excerpt from the syllabi
1	Poverty; social exclusion; goods; income; social protection; ownership; disparity; survival/survive	<i>Women's education - a historical overview of their inclusion and exclusion in education.</i>
2	Nutrition; obesity; agricultural land; arable land; agriculture; food security; malnutrition; soil; genetic resources; food	<i>Human relationship to heritage, selected examples of heritage management in Slovenia (built heritage, economic endeavours, means of communication, handicrafts and crafts, customs and habits, food, social life, knowledge, heritage of festivals, monuments..).</i>
3	Lifestyle; diseases; preventive; health; well-being; life span; mortality; suicide; expected age; smoking; epidemics; communicable diseases; health-care services	<i>Explain the importance of active breaks and minutes for health.</i>
4	Education for sustainable development; literacy; environmental awareness; inclusion; teacher education; global citizenship (education); lifelong learning; youth and adults; child; disability/disabilities; access to education; equal opportunity	<i>Designs and presents a lifelong learning programme that ensures the activity of adults/older people, taking into account the characteristics of the individual.</i>
5	Early and forced marriage; gender equality; discrimination/discriminatory; gender; domestic work; human rights to education; empowerment	<i>Equality, universals and the right to diversity; acceptable inequality for justice; gender and equality.</i>
6	Hygiene; clean water; drinking water; water pollution/pollutants; underground waters; treatment plants; sanitation; sewage; water-saving; water resources management	<i>Mental-hygiene conditions for development (family, school) and the teacher's preventive work.</i>
7	Sustainable energy supply; sustainable energy; renewable sources/resources; green energy; clean energy; energy consumption; energy dependence; energy/energetically; energy efficiency	<i>Substances and energy in an ecosystem: what is ecology, ecosystem balance, energy flow, food chains, food webs, biomass pyramid, abundance pyramid, recycling.</i>
8	Industrial management; economy; employment; industry; infrastructure; unemployment; labour market; job; decent work; work-life balance; economic growth; enterprise; labour rights.	<i>Basic concepts of economics: definition of economics, scarcity and choice, opportunity costs, fundamental economic issues.</i>
9	Information and communication technology; innovation; technological development; research and development activities; transport; transportation; passenger; traffic; industrialization; labour rights	<i>Aids, support and information communicational technology.</i>
10	Democracy; inequality/gender inequality; equality; discrimination/discriminatory; non-discriminatory; immigration/migration/emigration; social inclusion; moving/relocation; migration/migrants; purchasing power; overcrowding/overpopulation	<i>Knowledge, understanding and orientation towards inclusive, non-discriminatory, multicultural work.</i>
11	Security; town/settlement; urbanisation/urbanization; packaging waste/waste materials; recycling; town/city; disaster; cultural and natural heritage; local community; people in vulnerable situations; waste reduction; slum; housing	<i>Sensitivity (awareness) to the natural and social environment, national cultural heritage, multiculturalism and non-discrimination.</i>
12	Environmental awareness/ environmentally conscious future life; production; consumer/consumerism; productivity; waste; sustainable lifestyles	<i>Based on newly acquired knowledge, practical case work and discussion, the student will be able to plan and organise household activities related to financial planning (investments, real estate, taxes), time management and consumer decisions.</i>
13	Climate change; climate action; mitigation and adaptation to climate change; global warming; carbon dioxide; emissions; greenhouse gases; environment protection; global changes; temperature rise; adaptation to climate change	<i>Numerical models for predictions of daily weather and climate change</i>
14	Sea; ocean; rising ocean levels; sea/marine; fishing; fish; coast; marine ecosystem; acidification of the seas; biodiversity; sustainable fisheries	<i>Natural ecosystems: forest, wetland, sea, mountain and cave worlds, typical ecosystems</i>
15	Degradation of the environment; biodiversity; inland waters; terrestrial ecosystems; forest; river; wetland; degradation/pollution (soil, terrestrial ecosystems); illegal hunting; mountains; freshwater (ecosystems); desert; lake; meadows; deforestation; desertification; species conservation; ecosystem services	<i>Understands the diversity of the living world.</i>
16	Legal protection; legislation/law; criminal; criminology; violence/non-violent; vandalism; corruption; court; peace; fairness; exploitation; freedom; democratic decision-making; international cooperation; non-discriminatory laws and policies	<i>In teaching practice, the student identifies current problems in ensuring equity and efficiency in education.</i>
17	Decision-making; human rights; peace; ODA (Official Development Assistance); debt sustainability; global learning; partnership; peacefulness; democratic decisions; inclusive society; progress indicators; policy coherence	<i>Develops and applies the principles of the ethics of participation, partnership and co-activity.</i>

TABLE 2 Frequency of SDG keywords in each study program of Okayama University.

Sustainable development goals		PST		SST		SET	
		C	E	C	E	C	E
1	No Poverty	2	12	2	12	2	12
2	Zero Hunger	0	9	0	9	0	9
3	Good Health and Well-being	24	26	3	47	3	47
4	Quality Education	47	106	35	114	35	118
5	Gender Equality	2	18	1	19	1	19
6	Clean Water and Sanitation	0	2	0	2	0	2
7	Affordable and Clean Energy	0	3	0	3	0	3
8	Decent Work and Economic Growth	0	2	0	2	0	2
9	Industry, Innovation and Infrastructure	0	4	0	4	0	4
10	Reduced Inequalities	0	12	0	12	0	12
11	Sustainable Cities and Communities	0	2	0	2	0	2
12	Responsible Consumption and Production	0	5	0	5	0	5
13	Climate Action	0	16	0	16	0	16
14	Life Below Water	0	2	0	2	0	2
15	Life on Land	0	10	0	10	0	10
16	Peace, Justice and Strong Institutions	9	14	8	15	8	15
17	Partnerships for the Goals	22	22	0	44	0	44
Total		106	265	49	318	49	322

TE, teacher education; PST, primary science teacher program; SST, secondary science teacher program; SET, special education teacher program; E, elective courses; C, compulsory courses.

or commitment to broader sustainability issues, which are integral to ESD.

Moreover, the variations in SDG emphasis between compulsory and elective courses are noteworthy. Elective courses often reflect emerging academic trends and student-driven demand. The higher presence of certain SDGs in these areas, such as Good Health and Well-being (SDG 3), might indicate a growing recognition of their importance. However, their elective status may lead to a lack of uniform exposure among students, contrasting with the consistent focus guaranteed by their inclusion in compulsory courses. Table 3, which examines UL's approach, mirrors some trends seen in OU—most prominently, the heavy emphasis on Quality Education (SDG 4) across all programs. However, there is a nuanced divergence in the attention given to other SDGs, suggesting a broader, more balanced integration of global sustainability challenges. For instance, the stronger representation of Good Health and Well-being (SDG 3) across courses could denote an institutional recognition of health and education's interdependence, a critical consideration in the modern world, especially in the wake of health crises.

Figures 1–6 provide a comparative visualisation of these trends, underscoring the discrepancy in SDG priorities between the two universities. Notably, OU's PST courses have a significant focus on SDG 4, potentially at the expense of other vital areas. In contrast, UL exhibits a more equitable distribution of SDGs within its courses. This difference could stem from diverse educational strategies, cultural priorities, or administrative decisions influenced by local and global policies. The graphs representing SST and SET courses further illustrate this disparity. OU maintains its pronounced focus on Quality Education (SDG 4), suggesting a potentially siloed approach to teacher education. On the other hand, UL's emphasis on Industry, Innovation,

and Infrastructure (SDG 9) and Sustainable Cities and Communities (SDG 11) within its SST courses indicates an appreciation for the interconnectedness of modern societal challenges and a multidisciplinary approach to teacher education.

The trends identified at OU and UL find intriguing parallels in the findings of Poza-Vilches et al. (2022). The study, focusing on Andalusian universities, also underscores a strong emphasis on the social aspects of sustainability embodied by SDG 4, 5, 10, 16, and 17. This commonality suggests a wider educational trend where social sustainability takes precedence in the curriculum. However, it is the underrepresentation of goals like SDG 6 and SDG 7 in the Andalusian context that resonates strikingly with the situations at OU and UL, pointing to a shared challenge across geographical and institutional boundaries. The consistency in findings between the Andalusian universities and those at OU and UL calls for a collective reflection on curriculum development processes. It underscores the necessity for a more nuanced, balanced approach to embedding sustainability in education, ensuring that educators are equipped not just with knowledge of select SDGs but also a holistic understanding of all 17 goals.

4. Discussion

4.1. General overview based on content analysis

In comparing the integration of the SDGs into the syllabi of the three courses TE programs at OU and UL, a deeper understanding of how these goals are incorporated into curricula can be achieved. This

TABLE 3 Frequency of SDG keywords in each study program of the University of Ljubljana.

Sustainable development goals		PST		SST		SET	
		C	E	C	E	C	E
1	No Poverty	0	3	2	2	1	1
2	Zero Hunger	0	2	10	14	0	0
3	Good Health and Well-being	5	8	11	14	9	6
4	Quality Education	16	17	28	28	26	9
5	Gender Equality	4	4	2	7	3	1
6	Clean Water and Sanitation	1	0	4	8	0	0
7	Affordable and Clean Energy	2	1	2	4	0	0
8	Decent Work and Economic Growth	3	7	13	12	2	0
9	Industry, Innovation and Infrastructure	8	4	33	37	7	2
10	Reduced Inequalities	11	16	3	9	0	1
11	Sustainable Cities and Communities	8	14	43	24	4	3
12	Responsible Consumption and Production	0	2	17	11	0	0
13	Climate Action	0	0	7	7	0	0
14	Life Below Water	1	0	0	1	0	0
15	Life on Land	1	3	5	11	0	0
16	Peace, Justice and Strong Institutions	4	8	11	16	5	3
17	Partnerships for the Goals	3	6	3	6	7	1
Total		67	95	211	194	27	64

TE, teacher education; PST, primary science teacher program; SST, secondary science teacher program; SET, special education teacher program; E, elective courses; C, compulsory courses.

comparison offers valuable insights into potential best practices, gaps, and opportunities for improvement in integrating the SDGs into the study programs of teacher education programs. Quality Education (SDG 4) emerges as a noteworthy point of similarity between both sustainability-oriented institutions. It is the most represented SDG across teacher education programs at both universities. The above finding indicates an expected shared emphasis on quality education in the teacher education programs of both institutions. It underscores the importance of addressing educational quality in preparing future teachers to foster sustainable development. The prominence of SDG 4 in the teacher education syllabi of both universities is consistent with the global recognition of the pivotal role that teacher education plays in the achievement of all other SDGs (Gough, 2016; Rieckmann, 2017; Bourn et al., 2017; Jegstad et al., 2018; Fischer et al., 2022).

While both universities demonstrate a strong focus on Quality Education (SDG 4) across all three teacher categories (PST, SST, and SET), the emphasis on other SDGs varies between the two institutions. This variation may stem from a range of influences, including historical, socio-political, and economic contexts, as well as the priorities of local communities and stakeholders. At OU, there is a notable presence of Good Health and Well-being (SDG 3) and Partnerships for the Goals (SDG 17) within the PST and SST programs. This emphasis may be informed by Japan's unique demographic challenges, such as its ageing population and the importance of maintaining strong international partnerships in the face of increasing global interdependence (Oikawa, 2014). Additionally, the focus on health and well-being could reflect a growing awareness of the need to address mental health issues, particularly in the context of an education system known for its high-stress environment for teachers (Matsushita and Yamamura, 2022).

On the other hand, the University of Ljubljana showcases a higher representation of Reduced Inequalities (SDG 10) and Sustainable Cities and Communities (SDG 11) within its PST program, as well as Industry, Innovation, and Infrastructure (SDG 9) and Sustainable Cities and Communities (SDG 11) in its SST program. These differences in the SDGs representation between the two universities may be attributed to regional priorities, cultural factors, or the specific focus areas of each institution. Slovenia's position within the European Union and its emphasis on social cohesion, equity, and sustainable urban development may have contributed to the increased representation of these particular SDGs (Plostajner et al., 2019; Walters, 2020).

However, discrepancies in the representation of other SDGs, such as Clean Water and Sanitation (SDG 6) and Climate Action (SDG 13), reveal areas for potential improvement in both universities' teacher education programs. The lower representation of these goals suggests that more attention should be given to their integration into teacher education programs. The underrepresentation of SDG 6 and SDG 13 within teacher education programs indicates a need for increased emphasis on these goals to ensure that educators are equipped to address the multifaceted challenges associated with sustainable development. To tackle this issue, both universities may need to undertake a comprehensive review of their programs to identify areas where these SDGs can be more effectively integrated. This process should involve input from faculty, students, and experts in respective fields to develop a more balanced and well-rounded approach to incorporating all 17 SDGs. Addressing these disparities may involve re-evaluating the curricula to ensure a more balanced approach to integrating all SDGs, as well as providing additional resources and professional development opportunities to support educators in

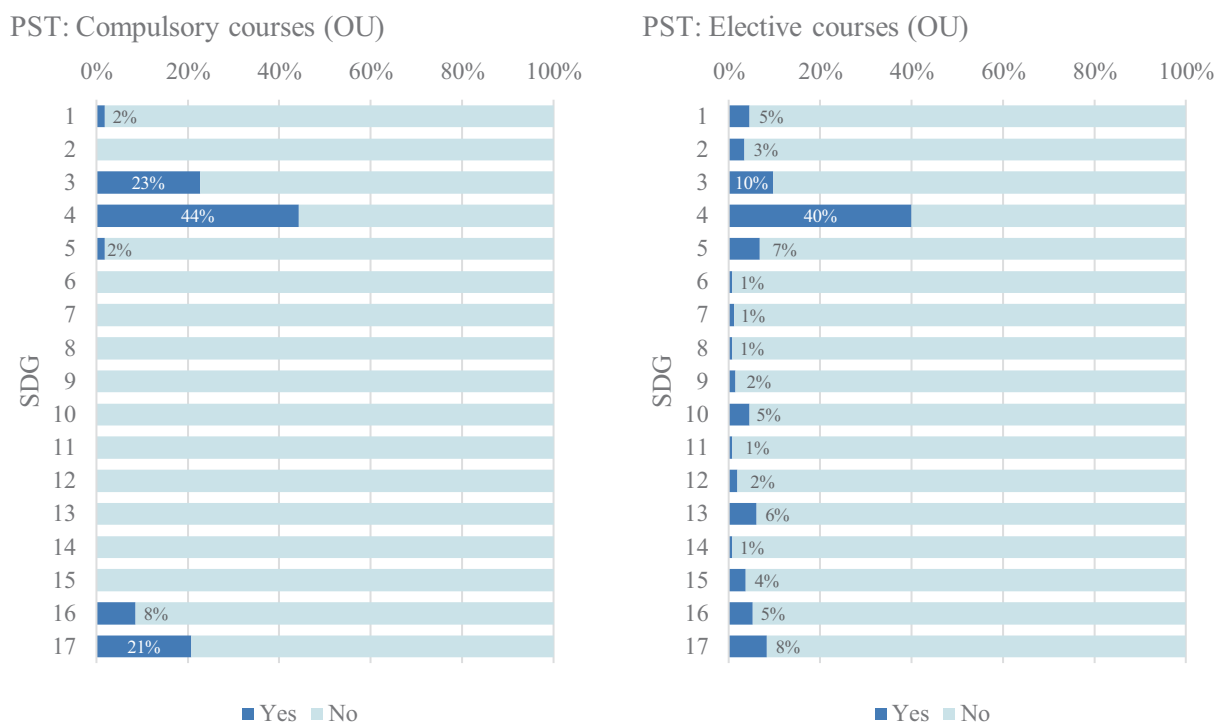


FIGURE 1 Representation of the SDGs in compulsory ($f = 106$) and elective ($f = 265$) courses' syllabi within the PST program at Okayama University (f indicates the keyword frequency).

teaching these less-represented goals effectively. It is important to acknowledge that each SDG contributes to a holistic vision of sustainable development, and therefore, ensuring comprehensive coverage of all goals in teacher education programs is crucial for equipping educators with the knowledge and skills necessary to address the interrelated nature of these global challenges (Berger et al., 2015; Oversby, 2015; Rieckmann, 2017; Benninghaus et al., 2018; Ojala, 2023).

Another point of comparison between the studied Japanese and Slovenian universities is the distribution of the SDGs' representation in compulsory and elective courses. Okayama University had a higher representation of the SDGs in elective courses. At the same time, the University of Ljubljana demonstrated a more balanced distribution between compulsory and elective courses. This difference may indicate varying approaches to the flexibility and mandate associated with teaching specific SDGs within each teacher education program. Examining how these differences in compulsory and elective course distribution might impact the overall integration of the SDGs in teacher education is crucial, as well as the potential implications for future curriculum development and policy interventions in both Japan and Slovenia. Therefore, it is essential to analyse the underlying reasons for these differences in course distribution to provide a more comprehensive understanding. Factors such as national and institutional priorities, availability of resources, and faculty expertise might influence the extent to which SDGs are integrated into compulsory and elective courses.

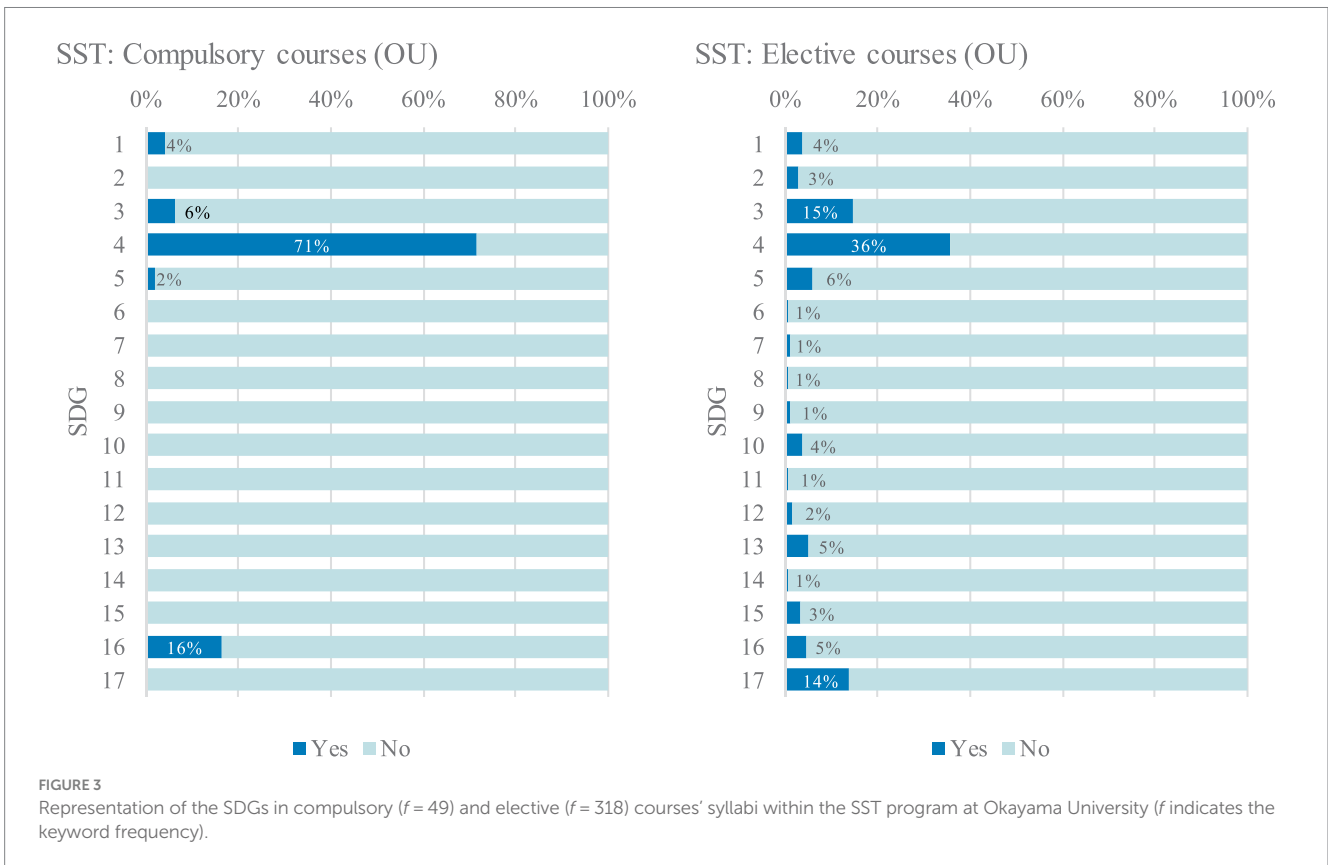
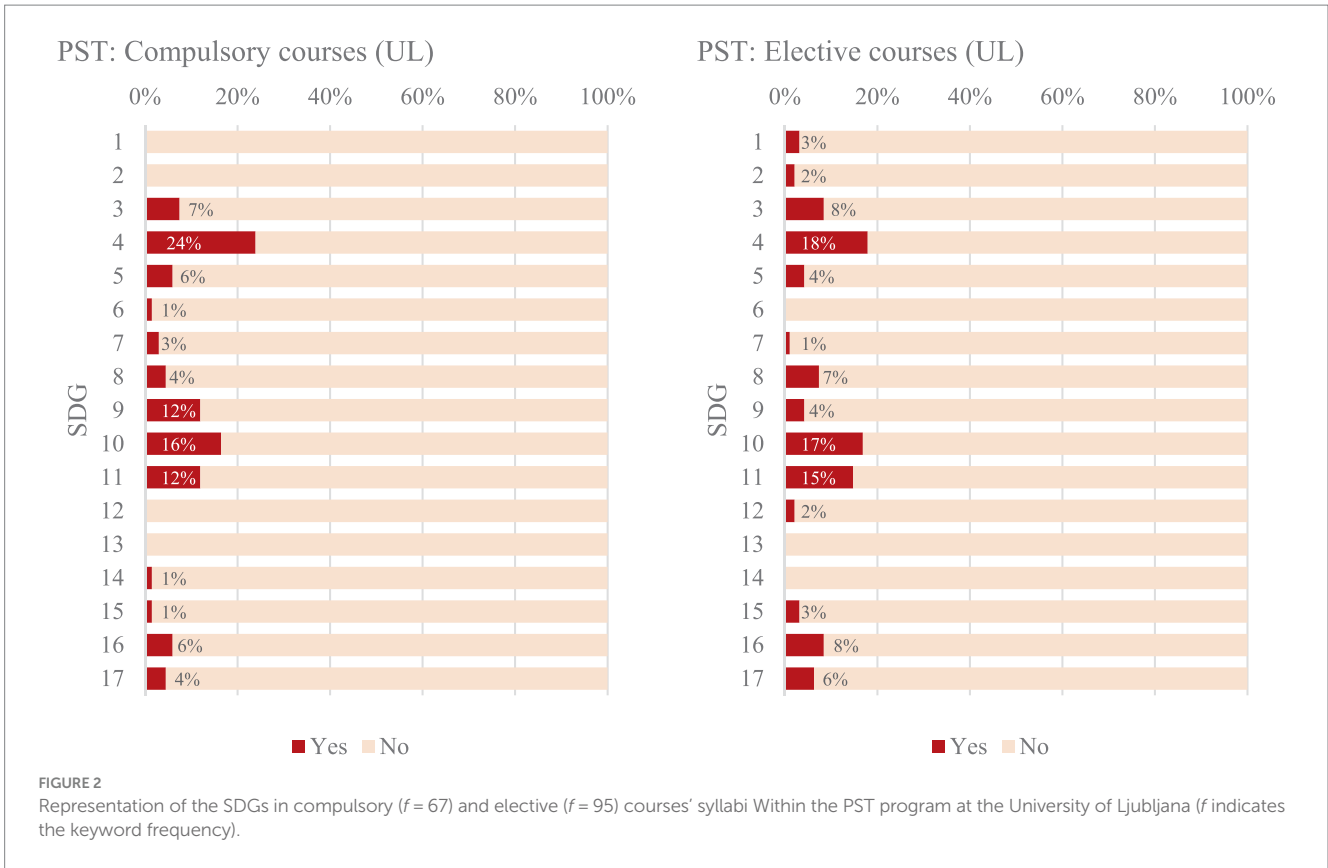
Additionally, the extent to which educators in Japan and Slovenia have the autonomy and support to choose and effectively teach SDG-related content in elective courses should be considered in light

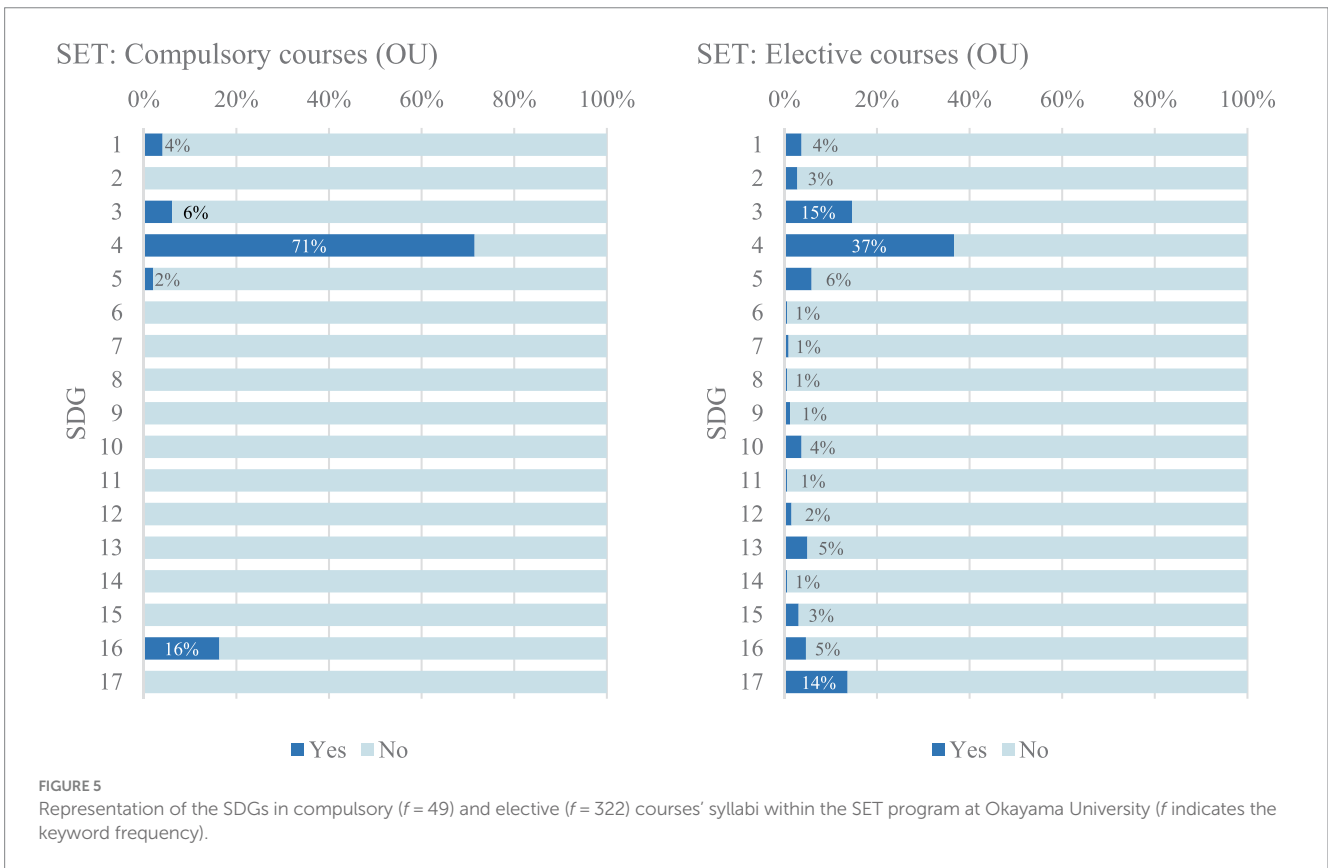
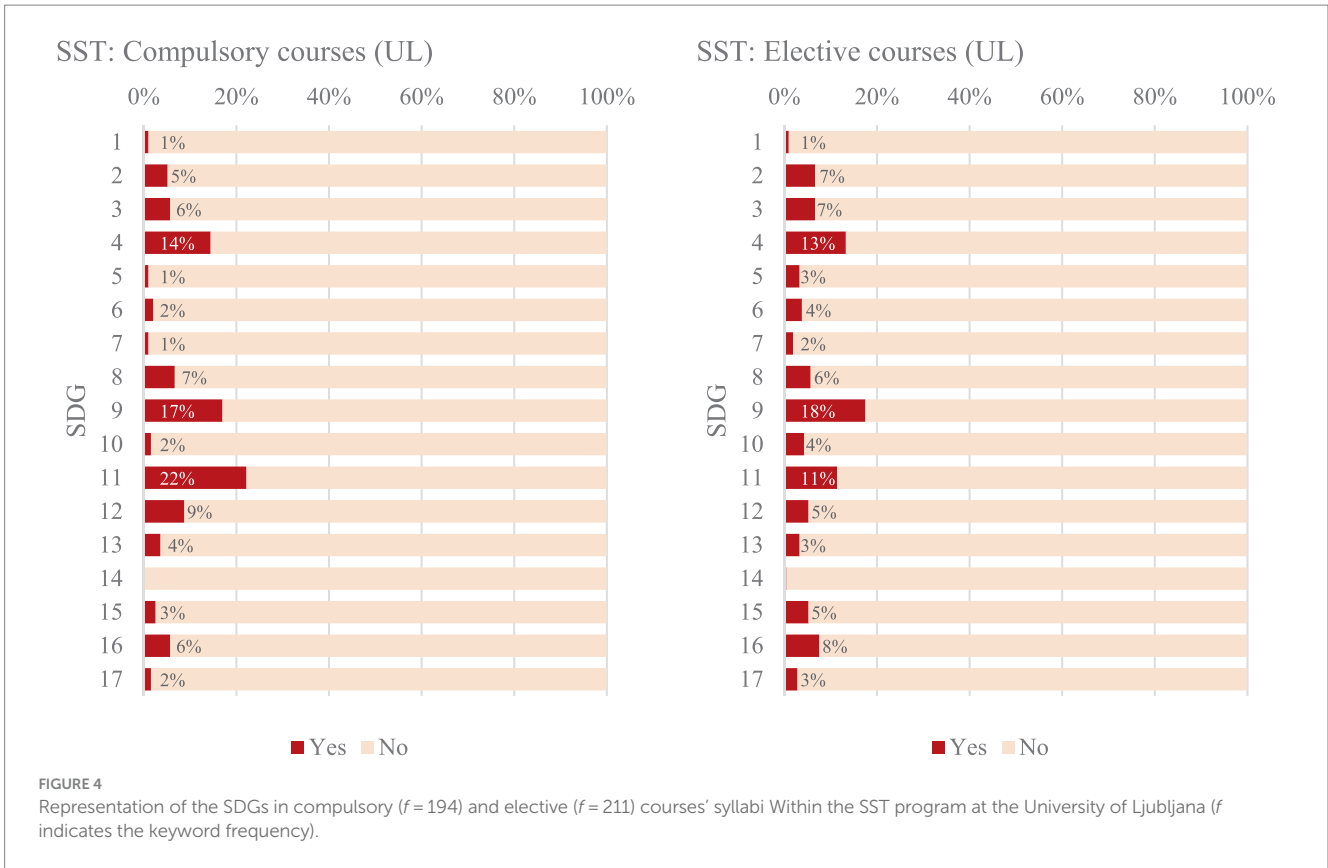
of these findings, which may have significant implications for the overall quality and depth of SDG integration in teacher education (Fujii, 2021; Rauch et al., 2021; Ferguson et al., 2022). By examining the role of faculty in the decision-making process and the availability of resources and support, we can better understand the challenges and opportunities in teaching SDGs effectively.

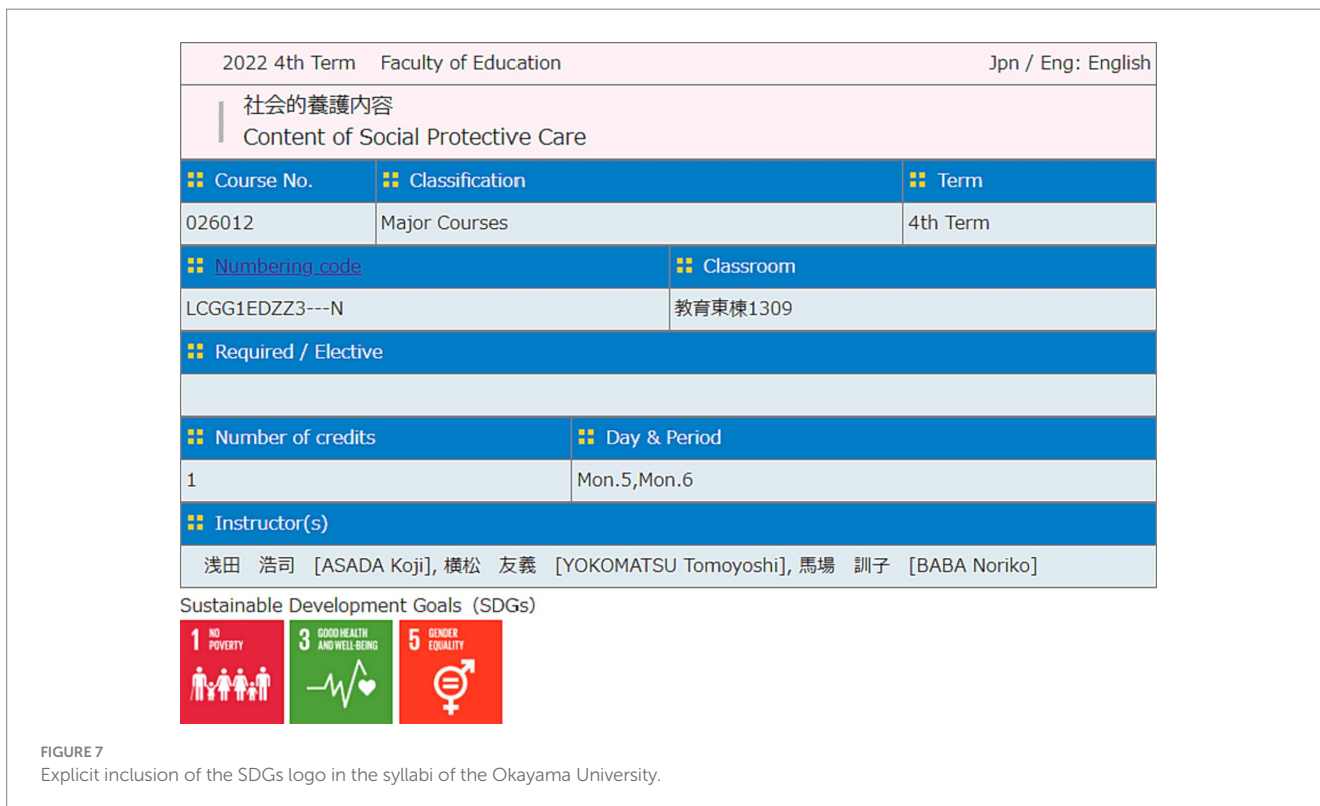
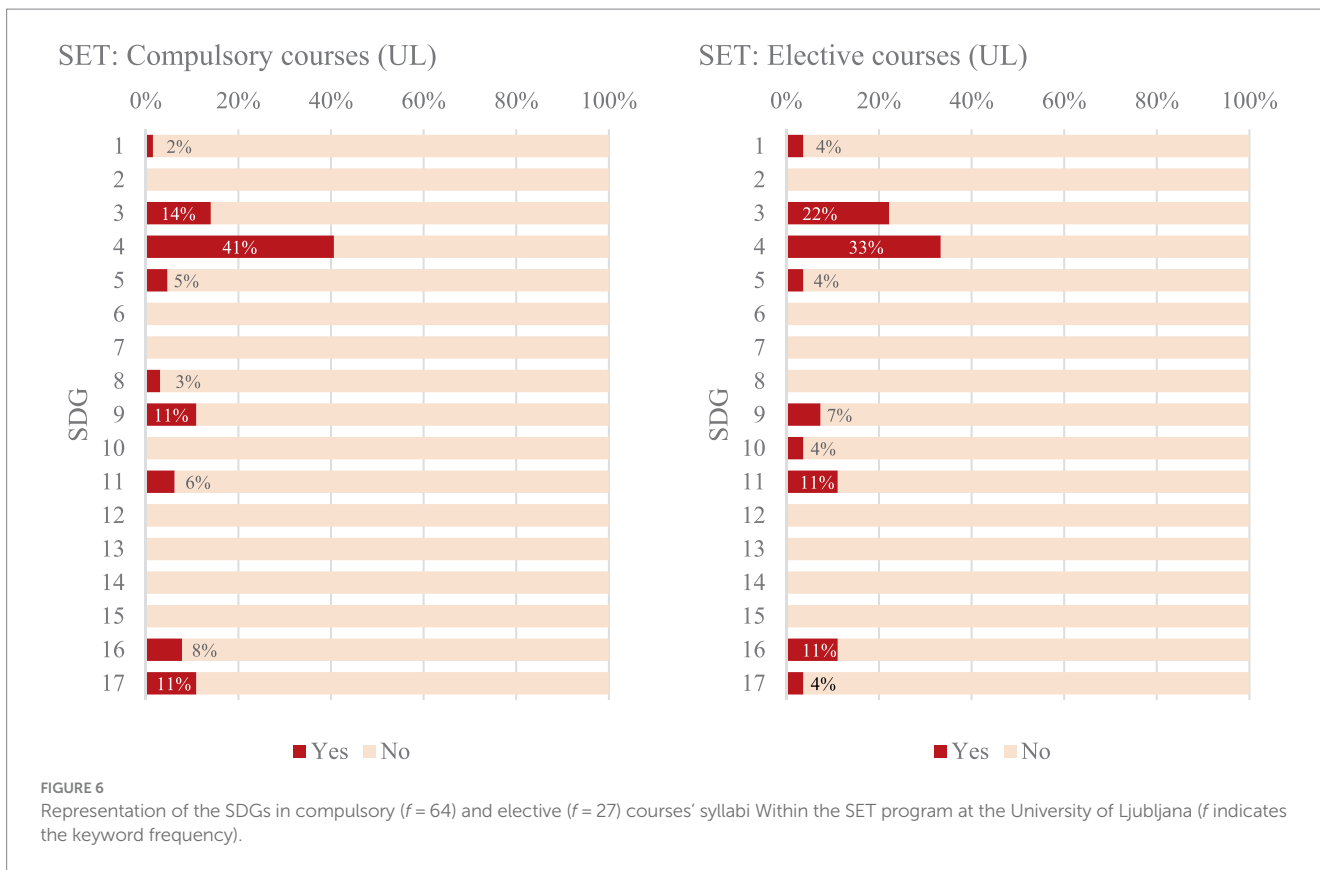
Finally, the qualitative content analysis revealed that both Okayama University in Japan and the University of Ljubljana in Slovenia had SDG-related content represented in various courses, from core education courses to subject-specific ones. Okayama University, however, displayed a greater number of courses that explicitly addressed SDGs, signifying a more concentrated representation of SDG integration (Figure 7). In contrast, the University of Ljubljana exhibited a more dispersed representation, with SDG-related content appearing across a wider range of courses. Both types of representation hold value, but the findings suggest that a more explicit focus on SDGs in teacher education programs could be beneficial for promoting heightened awareness and understanding of sustainable development among educators. In the case of Okayama University, where SDGs are more deliberately represented in specific courses, this may help to provide a strong foundation for educators, enabling them better to comprehend the goals and their relevance to teaching practice.

4.2. Insight from semi-structured interview

After delving into the systematic and methodical exploration of our subject through qualitative content analysis, we uncovered







patterns, themes, and associations that form the backbone of our understanding of the integration of SDGs into educational curricula. These results, while comprehensive, offer a predominantly

macroscopic view of the landscape and emphasise the ‘what’ of SDG integration. However, to truly comprehend the intricacies of this integration, it becomes imperative to transition into a space that

accommodates the 'how' and 'why,' which is richly provided by the first-hand narratives and experiential knowledge from those at the forefront of education - the faculty themselves.

4.2.1. Exploring the predominance of "quality education for all" across the syllabi

The investigation into the syllabi's noticeable bias towards SDG 4: Quality Education prompts a deeper exploration of the educators' motivations and the systemic influences at play. Insights from faculty members at both OU and UL reveal that this emphasis is not arbitrary but a reflection of a conscious alignment with their educational mandate. However, beneath this apparent uniformity, there lies a spectrum of personal understandings and institutional practices that may inadvertently limit the integration of other critical SDGs.

At OU, the faculty underscores the natural gravitation towards SDG 4 due to its role in shaping future educators. One member elaborates, "*This emphasis seems natural given our role in training future educators. When exploring SDG 4, it's critical to link the teaching methods and the curriculum content*" (OU 1). The sentiment is a reminder that the pursuit of quality education is at the heart of their professional commitment. Yet, another faculty member's admission reveals an obstacle: "*I think the reason other goals are not sufficiently incorporated is, from a personal standpoint, because I feel I do not fully understand the entire framework of the SDGs*" (OU 3). This gap in understanding suggests that the emphasis on SDG 4, while prominent, may not be the result of an informed evaluation of all SDGs but rather a comfortable default owing to its immediate relevance to education professionals.

Conversely, the faculty at UL also resonates with the focus on quality education, tying it back to the essence of their roles. "*The quality of education is the essence of the courses offered at the Faculty of Education. It must be shared by all*" (UL 1) asserts, indicating a deep-rooted belief in inclusive, quality education as a universal right. This inclination towards SDG 4 is seen not just as a preference but as a responsibility. However, the reflections also bring to light an implicit consensus that, while focusing on SDG 4 is positive, there exists a need to broaden the scope. As a faculty (UL 4) put it, "*Because we are a faculty of education, that is why it is often talked about. That is the main reason, and I think that is very positive*." This acknowledgement implies an awareness of the potential myopia and the necessity to integrate a more holistic view of the SDGs into the curriculum.

Overall, the predominance of "Quality Education for All" in the curriculum is both a natural outcome of the educators' focus and a nuanced issue with deeper implications for the comprehensive integration of sustainability goals. The discussion suggests an opportunity for institutions to expand professional development relating to SDGs, ensuring a balanced approach that recognises the interconnectivity of all goals in achieving sustainable development.

4.2.2. Addressing the disparity between elective and compulsory courses in integrating sustainable development goals

The integration of SDGs into academic programs marks a departure from conventional educational frameworks, eliciting a nuanced debate — their pronounced presence in elective courses contrasts starkly with their minimal visibility in compulsory ones. Delving into this dichotomy, reflections from faculty members at both OU and UL unveil a complex interplay of academic dedication,

curricular constraints, and the dynamic nature of educational priorities.

At OU, the discourse initiates with a strong endorsement for a more expansive embrace of SDGs. "*Our focus on SDG 4, 'Quality Education for All,' is critical, but our lectures should extend beyond this, engaging with a wider array of goals. This holistic approach can foster a faculty-wide, comprehensive contribution to the SDGs,*" one faculty member (OU 1) advocates. This viewpoint indicates an aspiration for academic strategies that encompass all SDGs without bias. Yet, the structure of compulsory courses presents a formidable challenge. "*Compulsory subjects are foundational for teaching licenses, necessitating a pivotal integration of SDGs. However, elective courses provide a unique, flexible platform to weave in SDGs, notably during practical teaching experiences,*" another faculty member (OU 2) notes. These reflections highlight both the institutional hurdles and the critical necessity of skilfully embedding SDG content within the curriculum.

The intensive nature of compulsory subjects compounds the challenge. "*The depth required in core subjects, such as geometry, constrains the capacity to introduce SDGs comprehensively, despite their relevance,*" a faculty member (OU 3) adds. This sentiment showcases the conflict between established academic demands and emerging global educational needs. Nevertheless, there is a pressing call for a more inclusive curricular ethos. "*SDG 4's significance is unquestionable, but it should not eclipse the others. Our curriculum needs to broaden to encapsulate all SDGs, providing our pre-service teachers, particularly in special education, with a panoramic perspective essential for crafting educational content that is as enlightening as it is captivating,*" asserts another (OU 4), stressing the need for a diverse educational spectrum.

Conversely, at UL, there is recognition of an evolutionary trend in electives embracing SDGs. "*I have noticed a greater number of electives that meet the SDGs, which I attribute primarily to the new courses added to the program after its original development. These courses are more content-oriented and less exclusively focused on the goals of special and rehabilitation education. Because they are more content-oriented, they also have more references to the SDGs,*" a faculty member (UL 1) observes. The versatility of electives emerges as a key factor in this integration. "*Elective subjects broaden the range of study content not covered by compulsory subjects. Everything shows that with selectivity, the treatment of SDGs increases,*" another faculty member (UL 2) confirms.

This perspective stands in contrast to the stagnation perceived in compulsory courses, which "*tend to be standardised and reflect some tradition of the study program, so they change less. Elective subjects tend to change more and provide opportunities to implement new content and teaching approaches. Obviously, compulsory subjects do not change and adapt enough, or the SDGs are not only directly evident from the descriptions in the curricula,*" another (UL 3) elaborates. Addressing the difficulty in revising core courses, a faculty member explains, "*it is difficult to accommodate all the new social challenges in the compulsory subjects, because professors who teach compulsory subjects find it hard to decide to shorten the existing learning content that has been part of the program for years, and making room for new content,*" (UL 4) acknowledging the friction inherent in academic evolution.

To summarise, while the infusion of SDGs into education is commendable, it is fraught with complexities and demands careful consideration. The dialogue among faculty from both universities underscores the imperative for curriculum development that is

adaptive, inclusive, and holistic, ensuring that both core and elective courses contribute effectively to the broader mission of the SDGs. In this journey, faculty stand at the forefront, shaping a curriculum that is transformative in its ability to educate, inspire, and respond to global developmental agendas.

4.2.3. Evaluating the limited integration of sustainable development goals in compulsory subjects

In addressing the question of the limited representation of many SDGs within the compulsory subjects, insights from faculty members from both OU and UL bring to light the complexities and challenges faced in integrating these global objectives. In the case of OU, one faculty member emphasises the need for a holistic approach: *"While focusing on SDG 4, 'Quality Education for All,' is crucial, I advocate for each lecture to potentially embody goals closely related beyond just that specific goal,"* they (OU 1) explain, proposing that this broader engagement could amplify the faculty's collective contribution to the SDGs. However, there is an acknowledgement of the current gaps. *"There's room for improvement in the inclusion of SDGs in syllabi across the board,"* (OU 2) asserts another educator, suggesting that professors could benefit from guidance on integrating these pivotal goals into their courses seamlessly.

The practical challenges of this integration are not understated, with one faculty member pointing out: *"Compulsory subject in mathematics department requires a deep understanding of content like geometry and basic instructional methods for the subject. Teaching these requires a lot of time, making it hard to find time to touch upon SDGs within them"* (OU 3), which can restrict the incorporation of SDGs due to time constraints. Special education presents unique challenges, as noted by another faculty member: *"These constraints make it a complex task to incorporate broader subjects or additional SDGs into both elective and compulsory courses. Yet, this challenge does not negate the necessity; it merely complicates the implementation"* (OU 4). This statement reflects the intricate balancing act required to modify existing curricula.

In contrast, some UL faculty members recognise the incidental inclusion of certain SDGs despite them not being a primary focus. *"For example, we mention very often the importance of poverty, which is SDG 1,"* one professor (UL 1) shares, noting that the original course design did not specifically consider the SDGs, yet some topics naturally align with them (UL 1). The call for a more intentional approach is evident: *"If faculty are oriented toward achieving the SDGs, I believe that professors of compulsory courses should think carefully about where the missing SDGs can be integrated into curricula and instruction,"* argues another faculty member (UL 2). This sentiment is particularly poignant given the observed lack of focus on specific SDGs: *"I am surprised that almost no attention is paid to SDG13 and SDG14. Obviously, the focus in our curricula is more on terrestrial ecosystems than on aquatic ecosystems."* (UL 3), emphasising the need for a more balanced approach to global challenges.

Yet, the task is not simple. As one faculty member (UL 4) highlights, the additional effort and strategic planning required to integrate new content are substantial: *"It is necessary to go deeper into the preparation of new lectures and the planning of practical exercises,"* they note, suggesting collaborative planning to avoid overlap and create space for new content. However, they also acknowledge the limitations. Not all professors can be equally

proficient in all SDGs, especially if they fall outside their expertise. In essence, while the necessity and benefits of integrating a more comprehensive array of SDGs into Compulsory curricula are clear, the path forward requires strategic planning, collaborative effort, and support for faculty members. This approach will not only enhance the educational experience but also ensure that future generations are equipped with the knowledge and empathy required to tackle global challenges.

4.2.4. Experiences in integrating sustainable development goals into the syllabi

When it comes to integrating SDGs into their syllabi, faculty members employ diverse strategies, reflecting their unique experiences and the distinct needs of their disciplines. Their insights paint a rich tapestry of the varied ways SDGs can be woven into educational contexts. *"In the realm of plant sciences, biodiversity is paramount, aligning closely with SDGs 13 and 15,"* a faculty member (OU 1) elucidates, adding that students demonstrate profound engagement with topics resonating with real-world environmental concerns. *"Fieldwork,"* they note, *"enhances their understanding, transforming education into a practical, immersive experience."* Transitioning to home economics, another faculty (OU 2) reflects on the evolution within the fashion industry, highlighting a significant shift towards the principles of the circular economy. *"The industry's focus has extended beyond mere recycling initiatives, embracing a more holistic 'circular economy' model that emphasises the continual use of resources and waste reduction,"* they observe. This approach involves the repurposing of materials like fibres, encouraging sustainable design and production practices.

This commentary underscores the necessity of evolving curricula that reflect current global shifts and challenges. Tackling the integration of SDGs in more complex fields like mathematics poses challenges. *"Linking themes like poverty and climate change to mathematics is crucial, but establishing them in lessons is challenging,"* an OU faculty member (OU 3) admits. However, they also recognise a positive shift: *"The spirit of the SDGs is gradually permeating education, indicating a slow but promising change."* In special education, the approach is more nuanced. *"We avoid buzzwords like 'sustainability,' opting instead for language that resonates on a personal level with pre-service teachers,"* a professor (OU 4) explains. This emphasis on authentic, relatable language over jargon underscores the importance of personal connection in education.

Conversely, at UL, the approach varies. One professor (UL 1) focuses on SDGs related to special needs and inclusion, striving to *"exclude inequality from society."* Another (UL 2) highlights the importance of practical life skills, focusing on *"waste management, sustainable mobility, health, and well-being."* These insights demonstrate the breadth of SDGs' applicability in various educational contexts. Adaptability in curriculum development plays a crucial role as well, as the geography professor (UL 3) explains: *"I adjust the curriculum based on students' existing knowledge, trying to fill in gaps where necessary."* This approach emphasises the need for dynamic, responsive education that addresses both global goals and individual student needs. In language courses, current challenges serve as a vibrant backdrop for learning. *"I incorporate topics like poverty and climate change into my English classes, drawing from trusted sources to encourage student engagement with contemporary issues,"* shares another faculty member (UL 4).

4.2.5. Considerations while teaching through the lens of sustainable development goals

The task of integrating SDGs into academic discourse and practice is both intricate and essential, demanding a nuanced approach that extends beyond traditional pedagogy. Faculty members navigate this complexity, drawing from a spectrum of strategies to embed these global imperatives into their teaching, thereby shaping informed, critically-thinking future leaders.

At OU, faculty approaches to education are distinct and innovative. One faculty member delves into environmental conservation through cutting-edge research, stating, *“My current interest lies in exploring environmental DNA in which citizens provide the samples, and then we conduct analysis to characterise the biodiversity”* (OU 1), highlighting the role of modern science in public outreach and awareness. Concurrently, another professor accentuates experiential learning in sustainability, stating, *“Through project-based learning and tools like Life Cycle Assessment (LCA), we are not just educating students about sustainable choices; we are transforming their behaviour, especially in their clothing purchases”* (OU 2). This approach highlights the importance of students understanding the environmental impact of their consumer choices, cultivating a generation that places sustainability at the forefront of their decision-making.

The practical application of theoretical concepts is evident, *“Themes like modelling have become prominent.. Mathematics education has become more linked to real-world scenarios”* (OU 3). Herein lies an explicit acknowledgement of the relevance of mathematics in solving real-world issues, an approach that potentially enhances student engagement and understanding. The value of experiential learning is also prominent, *“I hold a firm belief in the value of practical, real-world experiences.. Some of my undergraduate students have taken the initiative to explore SDGs in their undergraduate work”* (OU 4). This approach highlights the growing student-driven demand for a curriculum that intersects with global challenges, advocating for a more experience-based learning trajectory.

On the other hand, at UL, the strategies, while varied, echo similar themes. One faculty member addresses societal biases in education, *“At work, I draw particular attention to gender differences in the treatment of people with special needs”* (UL 1). This focus spotlights the necessity of an education system that is aware of and addresses societal disparities. Holistic education is another key theme, *“Even without highlighting the SDGs, I would do so.. knowing about the SDGs allows me to address home economics, food, and consumer education more holistically”* (UL 2). This faculty member emphasises the significance of an education that, while implicit, comprehensively addresses the principles at the heart of the SDGs. Adaptability and relevance feature strongly in another's strategy, *“I examine where the strengths and weaknesses are in students' knowledge and try to adjust instruction accordingly.. I put a lot of emphasis on water in recent years”* (UL 3). This tailored approach ensures that teaching is pertinent to both the students' immediate context and global issues. Lastly, the integration of SDGs through innovative educational frameworks is highlighted, *“When we use CLIL (Content and Language Integrated Learning), the SDGs are automatically included because CLIL is meant to be a synergistic process”* (UL 4). This faculty member underscores the multifaceted nature of learning, where understanding is amplified through various lenses — content, cognition, communication, and culture.

To summarise, feedback from faculty members at both OU and UL indicates a variety of approaches being used to incorporate SDGs into their educational programs. These methods show commonalities in emphasising real-world applicability, critical thinking, experiential learning, and adaptiveness in the curriculum. The strategies suggest a broader role for educators beyond conventional teaching, expanding into areas that contribute to global sustainability and citizenship. The data indicates an acknowledgement among faculty members regarding their part in advancing the SDGs. They recognise the educational environment as a potential catalyst for achieving these global objectives, highlighting the sector's instrumental role. However, this recognition is part of a larger operational framework that requires an understanding and application of the SDGs, not solely within the confines of academia but as part of a broader societal goal.

Moreover, the responses suggest an understanding of the necessity for collaboration in this endeavour. The complexity and scope of the SDGs appear to drive a need for interdisciplinary cooperation and a move towards a more integrated approach within educational institutions, and that involves coordination among various stakeholders, suggesting a structural and strategic shift in both curriculum development and delivery. In essence, the integration of SDGs into the curriculum is being approached with various methodologies by faculty at OU and UL. These approaches, while diverse, aim to prepare students with a more global perspective on societal issues. The teacher educators' role is seen not just as disseminators of knowledge but as facilitators in a larger dialogue about sustainable development and global responsibility. However, it is also evident that the practical application of these goals requires a balance between educational objectives and the broader, more complex global targets set by the SDGs. The summary, therefore, reflects a neutral observation of ongoing academic adaptations in response to global sustainability goals.

4.3. Implication of the study

The disparity in the representation of several SDGs within the teacher education programs at Okayama University (OU) and the University of Ljubljana (UL) may be linked to several factors and obstacles identified in previous research on Education for Sustainable Development (ESD; [Stevenson et al., 2015](#); [Wolff et al., 2017](#); [Tulloch, 2019](#); [Fujii, 2022](#)). These challenges include the independent operation of universities, which leads to the absence of a uniform set of ESD guidelines and recommendations, causing differences in focus and implementation. Moreover, teacher education primarily consists of compulsory attendance courses, creating practical difficulties when aligning courses from other degrees with the teacher education schedule. The representation of the SDGs can also be uneven across various programs and institutions, as ESD often relies on the interests of teacher educators. Additionally, there are typically only a limited number of Compulsory ESD courses, with slightly more elective options. These challenges contribute to the observed discrepancies in the SDG representation in this study. Therefore, it is crucial to recognise the importance of continuous evaluation and improvement in the integration of SDGs into teacher education programs ([Giangrande et al., 2019](#); [Kioupi and Voulvoulis, 2019](#); [Chang and Lien, 2020](#); [Murillo-Vargas et al., 2020](#); [Sato et al., 2020](#); [Pálsdóttir and Jóhannsdóttir, 2021](#)). To ensure that teacher education programs

effectively equip future educators with the necessary knowledge and skills to promote sustainable development, institutions must engage in ongoing reflection and adaptation (Fischer et al., 2022). This process should involve regular assessment of curricular content, pedagogical approaches, and learning outcomes to identify strengths, weaknesses, and areas for development in the integration of the SDGs across different teacher categories and course types.

One potential strategy to enhance the SDGs integration in teacher education programs is to establish collaborative networks and partnerships between universities and relevant stakeholders, which would facilitate the sharing of best practices, resources, and expertise (Oikawa, 2016; Didham et al., 2017; Caniglia et al., 2018; Dür and Keller, 2018). Through collaboration, institutions can learn from each other's experiences, identify innovative SDG integration methods, and develop joint strategies to address common challenges. This collaborative approach can also foster interdisciplinary and intercultural perspectives on sustainable development, which are crucial for addressing the complex, interconnected nature of the SDGs (Summers et al., 2005; Oikawa, 2016; Caniglia et al., 2018; Dür and Keller, 2018; Purvis et al., 2019; Fredriksson et al., 2020; Shulla et al., 2020). Additionally, institutions should recognise the importance of aligning their teacher education programs with national and international policy frameworks related to sustainable development (United Nations Educational, 2021). By ensuring their study programs and pedagogical approaches align with these frameworks, universities can better equip future educators to effectively contribute to the achievement of the SDGs on both local and global scales. This alignment can also promote greater coherence and consistency in the SDGs integration across various contexts.

In the case of OU and UL, there have already been instances of successful collaboration between the two institutions. By working together, both universities have been able to share best practices, resources, and expertise in the field of teacher education and sustainable development. These collaborations have not only allowed both universities to learn from each other's experiences but also fostered an environment of mutual growth and improvement. Through joint projects and initiatives, such as the development of joint courses, faculty exchange programs, and collaborative research projects, OU and UL have been able to address common challenges in SDG integration and develop innovative pedagogical approaches that benefit both institutions. This cooperation has also led to the incorporation of interdisciplinary and intercultural perspectives on sustainable development, further enriching the teacher education programs at both universities. The positive outcomes of the collaboration, including enhanced curricular alignment, increased faculty engagement, and the development of shared resources, serve as a testament to the potential benefits of forging partnerships between universities to strengthen the integration of the SDGs in teacher education programs globally.

Ultimately, ongoing professional development opportunities for teachers are essential to equip them with the knowledge, skills, and tools necessary to integrate the SDGs into their teaching practices effectively. This professional development can take various forms, including workshops, seminars, and online courses. It should focus on building teachers' capacity to incorporate the SDGs into their teaching and learning practices. Effective professional development opportunities should provide teachers with practical strategies and resources to integrate the SDGs into their curricula, such as project-based learning, service learning, and interdisciplinary approaches.

They should also focus on building teachers' capacity to address the complexities and interconnectedness of sustainable development issues and to foster critical thinking, problem-solving, and collaboration among their students. Research has shown that effective professional development can have a significant impact on teachers' ability to integrate the SDGs into their teaching practices (Rieckmann, 2017; Jegstad et al., 2018; Leicht et al., 2018; Bezeljak et al., 2020; Fischer et al., 2022).

By prioritising ongoing professional development opportunities for teacher educators, institutions can help ensure that their teacher education programs effectively prepare future teachers to contribute to sustainable development efforts. Institutions must also engage in continuous evaluation and improvement, collaborate with other universities and stakeholders, align their programs with policy frameworks, and prioritise ongoing professional development to ensure that their teacher education programs effectively address the diverse and interconnected challenges of sustainable development. By comparing and analysing the representation of the SDGs in the study programs of different universities, institutions can gain valuable insights into potential best practices, gaps, and opportunities for improvement. By addressing these challenges and prioritising ongoing professional development opportunities for teacher educators, institutions can play a crucial role in preparing future teachers to address the multifaceted challenges of sustainable development effectively.

4.4. Limitations and future recommendations

This study's limitations are acknowledged, particularly its scope, confined to two universities, hence not fully capturing the global landscape of SDG integration in teacher education programs. The analysis, primarily based on course descriptions, might not accurately portray the depth of engagement or the strategies employed within the classroom environment. The research also lacks an evaluation of the long-term influence of SDG-focused education on students' professional trajectories and their ability to contribute to sustainable development initiatives. Considering these aspects, future research should explicitly employ a whole-school approach (e.g., Mogren et al., 2019; Gericke and Torbjörnsson, 2022) to understand the SDG integration, encompassing not only the curriculum but also the pedagogical practices, institutional policies, and the overall educational culture. Expanding the research to include more universities worldwide, investigating actual classroom practices, and assessing the sustainability ethos across entire educational institutions would provide a more accurate and comprehensive picture. Furthermore, employing a whole-school approach could reveal insights into how the permeation of SDGs within the academic environment influences students' learning experiences and outcomes. Longitudinal studies, essential for gauging the sustained impact of this education, should be integral to future research, assessing how educators trained under this approach further the cause of sustainable development in their professional practice.

5. Conclusion

This study, through qualitative content analysis and semi-structured interviews, evaluated the integration of SDGs in the syllabi

of Okayama University, Japan ($n=2,079$) and the University of Ljubljana, Slovenia ($n=504$). It aimed to understand the alignment within teacher education programs with global sustainability goals and identify disparities in SDG treatment. Notably, a significant focus was observed on Quality Education (SDG 4), affirming its essential role in sustainable development. However, the sparse representation of other SDGs indicates room for broader integration and mutual learning. Respondents understood their integral role in weaving SDGs into education, recognising the system's influence in achieving these global objectives. The necessity for a systematic, whole-school approach emerged, positioning education as pivotal in sustainability strategies. Collaboration was another critical element, with shared efforts seen as key in amalgamating resources, expertise, and best practices.

Nonetheless, the inconsistency in SDG coverage across mandatory and elective subjects signals a need for a more inclusive, balanced methodology. A strategic, wider incorporation of SDGs, promoting inter-institutional cooperation and knowledge exchange, is advisable. In conclusion, a recalibration in the SDG integration methods within teacher education programs is advocated, which entails addressing present shortcomings, bolstering collaborative initiatives, and diversifying applied methods, crucial steps in augmenting the range and pertinence of teacher education. Embracing a whole-school approach becomes essential, influencing educational structures significantly and equipping future educators comprehensively in this global journey toward sustainable development.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

GT and HF: conceptualization, methodology, software, supervision, project administration, funding acquisition, validation, and data collection. KF and HR: formal analysis, investigation,

resources, and writing—review and editing. KF: data curation and writing—original draft preparation. KF and GT: visualization. All authors contributed to the article and approved the submitted version.

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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.

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References

- Aleixo, A. M., Leal, S., and Azeiteiro, U. M. (2018). Conceptualisation of sustainable higher education institutions, roles, barriers, and challenges for sustainability: an exploratory study in Portugal. *J. Clean. Prod.* 172, 1664–1673. doi: 10.1016/j.jclepro.2016.11.010
- Behr, D. (2017). Assessing the use of back translation: the shortcomings of back translation as a quality testing method. *Int. J. Soc. Res. Methodol.* 20, 573–584. doi: 10.1080/13645579.2016.1252188
- Benninghaus, J. C., Kremer, K., and Sprenger, S. (2018). Assessing high-school students conceptions of global water consumption and sustainability. *Int. Res. Geograph. Environ. Educ.* 27, 250–266. doi: 10.1080/10382046.2017.1349373
- Berger, P., Gerum, N., and Moon, M. (2015). Roll up your sleeves and get at it climate change education in teacher education. *Can. J. Environ. Educ.* 20, 154–172.
- Bezjak, P., Scheuch, M., and Torkar, G. (2020). Understanding of sustainability and education for sustainable development among pre-service biology teachers. *Sustain. For.* 12:6892. doi: 10.3390/su12176892
- Bourn, D., Hunt, F., and Bamber, P. (2017). A review of education for sustainable development and global citizenship education in Fischer et al. 521 teacher education. United Nations Educational, Scientific and Cultural Organization. Retrieved from: <https://discovery.ucl.ac.uk/id/eprint/10030831>
- Caniglia, G., John, B., Bellina, L., Lang, D. J., Wiek, A., Cohner, S., et al. (2018). The local curriculum: a model for transnational collaboration in higher education for sustainable development. *J. Clean. Prod.* 171, 368–376. doi: 10.1016/j.jclepro.2017.09.207
- Chang, Y. C., and Lien, H. L. (2020). Mapping course sustainability by embedding the SDGS inventory into the university curriculum: a case study from national University of Kaohsiung in Taiwan. *Sustain. For.* 12:4274. doi: 10.3390/su12104274
- Denzin, N. K. (2017). *Sociological methods: A sourcebook*. UK: Routledge
- Didham, R. J., Ofei-Manu, P., and Nagareo, M. (2017). Social learning as a key factor in sustainability transitions: the case of Okayama City. *Int. Rev. Educ.* 63, 829–846. doi: 10.1007/s11159-017-9682-x
- Dür, M., and Keller, L. (2018). Education for sustainable development through international collaboration. A case study on concepts and conceptual change of school-students from India and Austria on gender equality and sustainable growth. *Educ. Sci.* 8:187. doi: 10.3390/educsci8040187
- Ferguson, T., Roofe, C., and Cook, L. D. (2021). Teachers perspectives on sustainable development: the implications for education for sustainable development. *Environ. Educ. Res.* 27, 1–17. doi: 10.1080/13504622.2021.1921113
- Ferguson, T., Roofe, C., Cook, L. D., Bramwell-Lalor, S., and Gentles, C. H. (2022). Education for sustainable development (ESD) infusion into curricula: influences on Students' understandings of sustainable development and ESD. *Brock Educ. J.* 31, 63–84. doi: 10.26522/bricked.v31i2.915
- Fischer, D., King, J., Rieckmann, M., Barth, M., Büssing, A., Hemmer, I., et al. (2022). Teacher education for sustainable development: a review of an emerging research field. *J. Teach. Educ.* 73, 509–524. doi: 10.1177/00224871221105784

- Fredriksson, U., Kusanagi, N. K., Gougoulakis, P., Matsuda, Y., and Kitamura, Y. (2020). A comparative study of curriculums for education for sustainable development (ESD) in Sweden and Japan. *Sustain. For.* 12:1123. doi: 10.3390/su12031123
- Fujii, H. (2021). "Towards the identification of ESD competencies required for pre-service science teachers" in *Science education research and practice from Japan*. eds. T. Isozaki and M. Sumida (Singapore: Springer)
- Fujii, H. (2022). "Trends and perspectives of climate change education in the Asia-Pacific" in *International handbook on education development in Asia-Pacific*. eds. W. O. Lee, P. Brown, A. L. Goodwin and A. Green (Singapore: Springer)
- Gericke, N., and Torbjörnsson, T. (2022). Identifying capital for school improvement: recommendations for a whole school approach to ESD implementation. *Environ. Educ. Res.* 28, 803–825. doi: 10.1080/13504622.2022.2045256
- Giangrande, N., White, R. M., East, M., Jackson, R., Clarke, T., Saloff Coste, M., et al. (2019). A competency framework to assess and activate education for sustainable development: addressing the UN sustainable development goals 4.7 challenge. *Sustain. For.* 11:2832. doi: 10.3390/su11102832
- Gough, A. (2016). "Teacher education for sustainable development: past, present and future" in *Teaching education for sustainable development at university level*. *World sustainability series*. eds. W. Leal Filho and P. Pace (Cham: Springer)
- Hopkins, C., and McKeown, R. (2002). "Education for sustainable development: an international perspective," in *Education and sustainability: responding to the global challenge*. 13–24. Available at: <https://portals.iucn.org/library/efiles/documents/2002-002.pdf>
- Jegstad, K. M., Sinnes, A. T., and Gjøtterud, S. M. (2018). Science teacher education for sustainable development: from intentions to realisation. *Nordic Stud. Sci. Educ.* 14, 350–367. doi: 10.5617/nordina.3263
- Kioui, V., and Voulvoulis, N. (2019). Education for sustainable development: a systemic framework for connecting the SDGs to educational outcomes. *Sustain. For.* 11:6104. doi: 10.3390/su11216104
- Knez, S., Štrbac, S., and Podbregar, I. (2022). Climate change in the Western Balkans and EU Green Deal: status, mitigation and challenges. *Energy, Sustain. Society* 12, 1–14. doi: 10.1186/s13705-021-00328-y
- Koelsch, L. E. (2013). Reconceptualising the member check interview. *Int J Qual Methods* 12, 168–179. doi: 10.1177/160940691301200105
- Leicht, A., Heiss, J., and Byun, W. J. (2018). Issues and trends in education for sustainable development (Vol. 5). UNESCO publishing. Retrieved from: <http://unesdoc.unesco.org/images/0026/002614/261445e.pdf>
- Little, A. W., and Green, A. (2009). Successful globalisation, education and sustainable development. *Int. J. Educ. Dev.* 29, 166–174. doi: 10.1016/j.jedudev.2008.09.011
- Malekipour, A., Hakimzadeh, R., Dehghani, M., and Zali, M. R. (2018). Analysis of entrepreneurial competency training in the curriculum of bachelor of physical education in universities in Iran. *Cogent Educ.* 5:1462423. doi: 10.1080/2331186X.2018.1462423
- Masuda, H., Okitasari, M., and Morita, K. (2021). SDGs mainstreaming at the local level: case studies from Japan. *Sustain. Sci.* 16, 1539–1562. doi: 10.1007/s11625-021-00977-0
- Matsushita, M., and Yamamura, S. (2022). The relationship between long working hours and stress responses in junior high school teachers: a nationwide survey in Japan. *Front. Psychol.* 12:775522. doi: 10.3389/fpsyg.2021.775522
- Mayring, P. (2014). Qualitative content analysis: Theoretical foundation, basic procedures and software solution. Klagenfurt. Retrieved from Social Science Open Access Repository (SSOAR) <https://nbn-resolving.org/urn:nbn:de:0168-ssoar-395173>
- Mogren, A., Gericke, N., and Scherp, H. Å. (2019). Whole school approaches to education for sustainable development: a model that links to school improvement. *Environ. Educ. Res.* 25, 508–531. doi: 10.1080/13504622.2018.1455074
- Müller-Christ, G., Sterling, S., van Dam-Mieras, R., Adomšent, M., Fischer, D., and Rieckmann, M. (2014). The role of campus, curriculum, and community in higher education for sustainable development—a conference report. *J. Clean. Prod.* 62, 134–137. doi: 10.1016/j.jclepro.2013.02.029
- Murillo-Vargas, G., Gonzalez-Campo, C. H., and Brath, D. I. (2020). Mapping the integration of the sustainable development goals in universities: is it a field of study? *J. Teacher Educ. Sustain.* 22, 7–25. doi: 10.2478/jtes-2020-0013
- Nagata, Y. (2017). A critical review of education for sustainable development (ESD) in Japan: beyond the practice of pouring new wine into old bottles. *Educ. Stud. Japan* 11, 29–41. doi: 10.7571/esjkyoiku.11.29
- Oikawa, Y. (2014). "Education for sustainable development: trends and practices" in *Education for sustainable development and disaster risk reduction*. *Disaster risk reduction*. eds. R. Shaw and Y. Oikawa (Tokyo: Springer)
- Oikawa, Y. (2016). "International cooperation: ESD and DRR in Japan" in *Disaster resilience of education systems*. *Disaster risk reduction*. eds. K. Shiwaku, A. Sakurai and R. Shaw (Tokyo: Springer)
- Ojala, M. (2023). Climate-change education and critical emotional awareness (CEA): implications for teacher education. *Educ. Philos. Theory* 55, 1109–1120. doi: 10.1080/00131857.2022.2081150
- Omisore, A. G., Babarinde, G. M., Bakare, D. P., and Asekun-Olarinmoye, E. O. (2017). Awareness and knowledge of the sustainable development goals in a University Community in Southwestern Nigeria. *Ethiop. J. Health Sci.* 27, 669–676. doi: 10.4314/ejhs.v27i6.12
- Oversby, J. (2015). Teachers learning about climate change education. *Procedia Soc. Behav. Sci.* 167, 23–27. doi: 10.1016/j.sbspro.2014.12.637
- Pálsdóttir, A., and Jóhannsdóttir, L. (2021). Signs of the United Nations SDGs in university curriculum: the case of the University of Iceland. *Sustain. For.* 13:8958. doi: 10.3390/su13168958
- Penger, S., Dimovski, V., and Peterlin, J. (2015). Rethinking dialogue and education between Slovenia and China: sustainability—our common language? *JEEMS J. East European Manag. Stud.* 20, 153–173. doi: 10.1688/JEEMS-2015-02-Penger
- Perales Franco, C., and McCowan, T. (2021). Rewiring higher education for the sustainable development goals: the case of the intercultural University of Veracruz, Mexico. *High. Educ.* 81, 69–88. doi: 10.1007/s10734-020-00525-2
- Pipere, A., Veisson, M., and Salite, I. (2015). Developing research in teacher education for sustainability: UN DESD via the journal of teacher education for sustainability. *J. Teacher Educ. Sustain.* 17, 5–43. doi: 10.1515/jtes-2015-0009
- Plostajner, K., Medved, P., Cerar, A., and Simoneti, M. (2019). Is Ljubljana being ecogenitred?: the case of sustainable urban development of the city Centre. *Sociologia Urbana e Rurale* XLI, 117–133. doi: 10.3280/SUR2019-119008
- Poza-Vilches, F., García-González, E., Solís-Espallargas, C., Velasco-Martínez, L. C., López-Alcarria, A., Estrada-Vidal, L. I., et al. (2022). Greening of the syllabus in faculties of education sciences through sustainable development goals: the case of public Andalusian universities (Spain). *Int. J. Sustain. High. Educ.* 23, 1019–1044. doi: 10.1108/IJSHE-02-2021-0046
- Priyadarshini, P., and Abhilash, P. C. (2020). From piecemeal to holistic: introducing sustainability science in Indian universities to attain UN-sustainable development goals. *J. Clean. Prod.* 247:119133. doi: 10.1016/j.jclepro.2019.119133
- Purvis, B., Mao, Y., and Robinson, D. (2019). Three pillars of sustainability: in search of conceptual origins. *Sustain. Sci.* 14, 681–695. doi: 10.1007/s11625-018-0627-5
- Rauch, F., Elmenreich, W., Hübner, R., Jungmeier, M., Gracner, E., and Sposato, R. G. (2021). Designing and implementing an interfaculty elective sustainable development course at a university: concepts, developments and lessons learned. *Action Res. Innov. Sci. Educ.* 4, 33–36. doi: 10.51724/arise.43
- Rieckmann, M. (2017). *Education for sustainable development goals: learning objectives*. UNESCO publishing.
- Rieckmann, M. (2019). "Education for sustainable development in teacher education. An international perspective" in *Environmental education*. ed. S. Lahiri (Delhi: Studera Press), 33–48.
- Saperstein, E. (2020). Global citizenship education starts with teacher training and professional development. *J. Global Educ. Res.* 4, 125–139. doi: 10.5038/2577-509X.4.2.1121
- Sato, S., Hashimoto, T., and Shirota, Y. (2020). Evaluation for ESD (education for sustainable development) to achieve SDGs at university. In *2020 11th international conference on awareness science and technology (iCAST)* (pp. 1–6). IEEE.
- Shulla, K., Leal Filho, W., Lardjane, S., Sommer, J. H., and Borgemeister, C. (2020). Sustainable development education in the context of the 2030 agenda for sustainable development. *Environ. Educ. Res.* 27, 458–468. doi: 10.1080/13504509.2020.1721378
- Stevenson, R. B., Ferreira, J. A., Evans, N., and Davis, J. (2015). "Beyond science education: embedding sustainability in teacher education systems" in *Educating science teachers for sustainability*. eds. S. Stratton, R. Hagevik, A. Feldman and M. Bloom, ASTE Series in Science Education (Cham: Springer)
- Sumida, S. (2022). Exploring SDG 4.7's monitoring framework: ESD and GCEd in the case of Japan. *Glob. Soc. Educ.*, 1–17. doi: 10.1080/14767724.2022.2155934
- Summers, M., Childs, A., and Corney, G. (2005). Education for sustainable development in initial teacher education: issues for interdisciplinary collaboration. *Environ. Educ. Res.* 11, 623–647. doi: 10.1080/13504620500169841
- Tulloch, L. (2019). "Embedding education for sustainability (EFS) into teacher education in the South Pacific, challenges and opportunities" in *Encyclopedia of teacher education*. ed. M. Peters (Singapore: Springer)
- United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. Retrieved from: <https://sustainabledevelopment.un.org/post2015/transformingourworld>
- United Nations Educational. (2021). Scientific and cultural organization (UNESCO). Education for sustainable development – A roadmap. Paris: UNESCO. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000374802>
- Walters, R. (2020). "Human rights, identity and social cohesion" in *National Identity and social cohesion in a time of geopolitical and economic tension: Australia – European Union – Slovenia* (Singapore: Springer)
- Wiek, A., Xiong, A., Brundiers, K., and Van der Leeuw, S. (2014). Integrating problem- and project-based learning into sustainability programs: a case study on the School of Sustainability at Arizona State University. *Int. J. Sustain. High. Educ.* 15, 431–449. doi: 10.1108/IJSHE-02-2013-0013
- Wolff, L. A., Sjöblom, P., Hofman-Bergholm, M., and Palmberg, I. (2017). High performance education fails in sustainability? — a reflection on Finnish primary teacher education. *Educ. Sci.* 7:32. doi: 10.3390/educsci7010032
- Yemini, M., Tibbitts, F., and Goren, H. (2019). Trends and caveats: review of literature on global citizenship education in teacher education. *Teach. Teach. Educ.* 77, 77–89. doi: 10.1016/j.tate.2018.09.014
- Zen, I. S., and Shibakawa, H. (2022). Quintuple Helix Lens for transformation: an Okayama model of education for sustainable development. *Front. Sustain.* 3:21. doi: 10.3389/frsus.2022.798330