BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

Curriculum Integration of the Sustainable Development Goals through Project-Based Capstones in Computing Education: A Mixed-Methods Case Study

Dr. Sanket Ramakant Lodha*
Postdoctoral Research Fellow, Lincoln University, Malaysia
D. Y. Patil Institute of and Management, Akurdi, Pune, 411044, Maharashtra, India
*Corresponding author: sanketrl1008@gmail.com

Dr. Chanpreet Kaur Ranjit Singh Gulati
Independent Researcher,Independent Scholar, Texas, USA
Management Science & Information Technology
gulaticpg@gmail.com

Ms. Bharati S. Bafana
Department of Physics, School of Basic and Applied Science, MGM University, Chhatrapati Sambhajinagar, Maharashtra, 431001, India
bhartibafana@rediffmail.com

Abstract

Background. Higher education is expected to prepare graduates who can apply disciplinary expertise to the Sustainable Development Goals (SDGs), yet empirical evidence on how the SDGs can be embedded in postgraduate computing programmes in India is limited. **Objective.** This case study examined the integration of the SDGs into the Semester 2 capstone project module of the Master of Computer Applications () programme at D. Y. Patil Institute of and Management, Akurdi, Pune, Maharashtra. **Methods.** A mixed-methods design combined a pre-/post-project survey with open-ended responses from 34 students (17 male, 17 female). Students were oriented to the 17 SDGs, selected goal-aligned problems, developed web, mobile or dashboard solutions under faculty guidance, and submitted reports explaining each project's SDG contribution. **Results.** SDG 9 (32.4%) and SDG 3 (20.6%) were the most frequently selected goals. Mean scores on all five awareness items rose from 3.18–3.47 before the projects to 4.32–4.47 afterwards on a five-point scale (increases of 0.91–1.29; all reported $p < 0.001$), with the largest gain in understanding how technology contributes to the SDGs. The seven project-experience items averaged 4.40, and 32 of 34 students (94.1%) wished to undertake SDG-aligned projects again. Thematic analysis

Type : Research Article
Language: English

Received: 22 October 2026
Revised: 23 October 2026
Accepted: 1 November 2026
Published: 3 November 2026
https://doi.org/10.5281/zenodo.23919537

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

identified learning outcomes (technology as a social solution, sustainability awareness, systems thinking, and resource optimisation) and challenges (SDG alignment, data scarcity, resource constraints, understanding user needs). **Conclusion.** Within the limits of a single-institution, single-group design, SDG-aligned capstones were associated with higher self-reported sustainability awareness and a positive project experience. The study offers a replicable integration model and practical implications for curriculum design.

Keywords: Sustainable Development Goals, Education for Sustainable Development, Capstone projects, Project-based learning, Computing education, programme, Curriculum integration, India

1 Introduction

1.1 The SDGs and the role of higher education

The 2030 Agenda for Sustainable Development, adopted by the United Nations in 2015, set out 17 Sustainable Development Goals (SDGs) as a universal framework for ending poverty, protecting the planet and promoting peace and prosperity (United Nations 2015). Education is both a goal in its own right (SDG 4) and an enabler of the others: UNESCO (2017) specifies cognitive, socio-emotional and behavioural learning objectives for each goal, and the review of the UN Decade of Education for Sustainable Development by Wals (2012) positioned learning as a central lever for societal change. Universities are therefore expected to prepare graduates who can act on sustainability challenges within their own professions. A worldwide survey by Leal Filho et al. (2019) found that many institutions had not yet engaged systematically with the SDGs in teaching, and argued that doing so could strengthen students' engagement with sustainability.

1.2 Sustainability in computing and education

Computing graduates design the software systems through which health, education, commerce, mobility and public services are increasingly delivered. Their decisions therefore shape social and environmental outcomes, and sustainability is relevant to computing education in two senses: computing as a means of addressing sustainability problems, and computing as a source of sustainability impacts in its own right. A systematic review of 89 primary studies by Peters et al. (2024) concluded that research on sustainability in computing education remains comparatively immature, with most articles being experience reports with limited empirical evaluation. Intervention studies that measure student learning are correspondingly valuable. Angelaki et al. (2024), for example, reported pre-/post-test results for 52 students after green-computing modules in a Greek informatics course, and Blanco et al. (2024) reported on 301 computer science students whose website projects embedded SDG-related content.

1.3 Project-based learning and capstones

Project-based learning (PBL) organises learning around sustained inquiry into authentic problems and the production of artefacts (Krajcik and Blumenfeld 2006). In a review of 76 empirical studies in higher education, Guo et al. (2020) found that affective outcomes, such as perceived benefits and motivation, were the most commonly evaluated, and called for better measurement instruments. Capstone courses are a natural vehicle for PBL in computing: a review of 127 primary studies by Tenhunen et al. (2023) found that software engineering capstones typically run for one semester, with students working in groups of four to

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

five, often for a client. Because capstones leave topic choice to students within a broad brief, they offer a low-cost point at which a sustainability lens can be introduced without adding a new course.

1.4 The Indian context and research problem

India's National Education Policy 2020 calls for holistic, multidisciplinary education (Ministry of Education 2020), and recent articles discuss how the policy aligns with the SDGs (Radha and Arumugam 2023) and how Indian institutions contribute to them (Narayanan 2025). Much of this work, however, concerns policy or institutional-level activity. Among the sources reviewed for this study, we found few reports that measure student-level learning from SDG-aligned projects in postgraduate computing programmes in India. The is a two-year postgraduate programme that feeds directly into software and IT employment, so evidence on how to embed sustainability thinking in its project work is of practical interest.

1.5 Aim and research questions

The aim of this study is to evaluate the integration of the SDGs into a Semester 2 capstone module and to describe students' learning, perceptions and difficulties. The research questions are:

1. Which SDGs do students select for their capstone projects? (RQ1)
2. Does working on SDG-aligned projects increase students' self-reported awareness of sustainability issues? (RQ2)
3. How do students perceive SDG-aligned project work? (RQ3)
4. What challenges do students encounter in aligning their projects with the SDGs? (RQ4)

1.6 Contributions

The study makes four contributions. First, it documents a practical, low-overhead model for embedding the SDGs in a postgraduate computing capstone (Fig. 1). Second, it provides pre-/post-project evidence from an Indian cohort on five aspects of sustainability awareness. Third, it offers a qualitative account of the learning outcomes, difficulties and suggestions reported by students. Fourth, it derives implications for curriculum design. We do not claim that the model is the first of its kind; rather, the study adds a context-specific case to a literature in which, as noted above, student-level evidence from Indian postgraduate computing programmes is scarce.

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

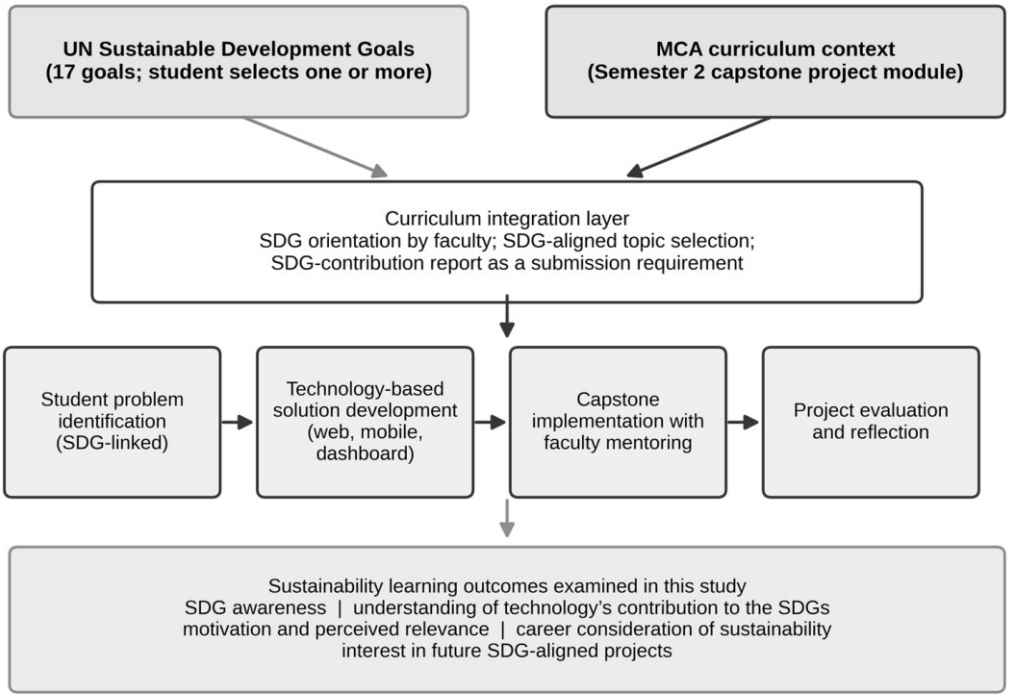


Fig. 1 Proposed SDG integration framework for capstone projects. SDG orientation and a reporting requirement connect the SDGs to the Semester 2 capstone module; outcomes are those examined in this study.

2 Literature Review

2.1 The SDGs and Education for Sustainable Development

Education for Sustainable Development (ESD) aims to equip learners with the knowledge, skills, values and dispositions needed to contribute to sustainable development. UNESCO (2017) translates the 17 SDGs into learning objectives across cognitive, socio-emotional and behavioural domains, giving educators a common vocabulary for curriculum design, while Wals (2012) reviewed the global Decade of ESD and its implications for educational practice. These frameworks are deliberately generic; their application to specific disciplines, such as computing, requires local design decisions about content, pedagogy and assessment.

2.2 SDG integration in higher education

The study conducted by Leal Filho et al. (2019) surveyed universities worldwide regarding integration of SDGs into their educational process, as well as reasons for not engaging and some proposals for more engagement in the process. Furthermore, according to Angelaki et al. (2024), the involvement of a university in SDGs can be made via curriculum, research, operations, community involvement and

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

governance, while the curriculum orientation was highlighted as one of the most important areas in this regard.

2.3 Project-based learning in technical education

The review by Guo et al. (2020) indicates that PBL in higher education is associated with a range of cognitive, affective and behavioural outcomes, but that affective outcomes dominate the evidence base and instruments need improvement. In engineering, Calvo et al. (2024) described a methodology for designing sustainability-related multidisciplinary activities and implemented it across eight subjects of an industrial electronics degree, using questionnaires before and after the activities. They reported that the project raised awareness of the SDGs, helped students see how to apply their skills to familiar problems, and led more students to consider sustainability as a possible professional activity. These findings are relevant here because the present study measures similar constructs in a different discipline and level.

2.4 Sustainability in computer science and IT education

Peters et al. (2024) synthesised 89 studies and proposed a framework of learning objectives, outcomes and pedagogical methods for sustainability in computing education; they also noted that few studies engage with calls for systemic change. Angelaki et al. (2024) introduced four green-computing modules into a Computer Networks course and compared pre- and post-test responses from 52 students. Most students had little prior awareness of the SDGs. Post-test scores for sustainability knowledge and for intention to engage in sustainability were significantly higher, whereas the change in perceived need to include sustainability in the curriculum was not statistically significant. Blanco et al. (2024) embedded SDG-related student-generated content in website projects in project management subjects at two universities, with 301 students; students reported greater understanding of the impact of information and communication technologies on the SDGs, and perceived more learning from searching for and generating content than from using peers' materials. Bambazek et al. (2025) reported an undergraduate software engineering course in which students identified effects of software systems on several sustainability dimensions, and concluded that sustainability can be integrated into existing courses with modest effort.

2.5 SDGs in Indian higher education

The National Education Policy 2020 provides the policy backdrop (Ministry of Education 2020), and Radha and Arumugam (2023) discuss the alignment of the policy with the SDGs in higher education. Narayanan (2025), using accreditation self-study reports, reported that Indian institutions contribute notably to goals such as green initiatives, water conservation and societal outreach, while identifying gaps in accessibility, renewable-energy adoption and funding for sustainability. At the school level, Varghese and Mathew (2026) reported that a structured intervention improved the ESD self-efficacy of 50 secondary school teachers in Kerala, measured before, immediately after and three months after the intervention. These studies show active interest in the SDGs in India, but none of them examines students' learning in a postgraduate computing capstone. The Indian literature identified for this study is also small relative to the policy interest, so the author is encouraged to extend this section with further peer-reviewed Indian studies before submission.

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

2.6 Capstone projects as a mechanism for sustainability learning

Tenhunen et al. (2023) characterise software engineering capstones as typically lasting one semester, with small teams and often with external clients, and note that assessments are varied. These features make capstones suitable for sustainability integration: students already select and scope real problems, work through a full development cycle and report on their outcomes. A sustainability lens can therefore be added through three low-cost design levers, namely orientation to the SDGs, SDG-aligned topic selection and a requirement to report each project's SDG contribution. This is the logic of the framework in Fig. 1. Bambazek et al. (2025) support the view that such integration need not require a new course.

2.7 Research gap and positioning

Table 1 summarises the studies discussed above and positions the present study. Three gaps are apparent: (i) student-level evidence from postgraduate computing programmes in India; (ii) capstone-based integration in which students choose their own SDG focus; and (iii) combined pre-/post-project and qualitative evidence from the same cohort. The present study addresses these gaps in a single-institution case.

Table 1 Selected studies relevant to SDG integration in computing and technical education and the positioning of the present study

Study	Context and design	Main reported findings	Relevance to the present study
Leal Filho et al. (2019)	Worldwide survey of universities on SDG use in teaching	Engagement with SDGs in teaching was uneven; reasons for non-engagement and recommendations reported	Establishes the institutional-level gap
Blanco et al. (2024)	301 computer science students, two universities; website projects with student-generated content	Greater understanding of ICT impacts on SDGs; more perceived learning from generating content	Project-based SDG work in computing; different design and country
Calvo et al. (2024)	Engineering degree; eight subjects; questionnaires before and after	Raised SDG awareness; more students considered sustainability a career option	Similar constructs; multi-subject rather than capstone
Angelaki et al. (2024)	52 ICT students, Greece; four green-computing modules; pre-/post-test	Significant gains in knowledge and intention; non-significant change in perceived curricular need	Closest quantitative comparator; module-based rather than capstone-based
Peters et al. (2024)	Systematic review of 89 studies on sustainability in computing education	Mostly experience reports; limited empirical research	Motivates evidence-based case studies

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

Study	Context and design	Main reported findings	Relevance to the present study
Tenhunen et al. (2023)	Systematic review of 127 studies on software engineering capstones	Typical capstone: one semester, groups of 4–5, often client-based	Supports capstone as integration point
Bambazek et al. (2025)	Undergraduate software engineering course; experience report	Students identified effects on several sustainability dimensions	Integration into an existing course
Narayanan (2025)	Indian HEIs; accreditation self-study data	Contributions in green initiatives, outreach; gaps in funding and accessibility	Indian institutional context
Present study	34 students, Pune; SDG-aligned Semester 2 capstone; pre/post survey plus open-ended responses	See Section 4	Student-level evidence from an Indian postgraduate computing capstone

3 Research Methodology

3.1 Research design

The study used a single-case, mixed-methods design (Creswell and Plano Clark 2018). The quantitative strand compared students' self-reported awareness before and after the capstone project and recorded their ratings of the project experience. The qualitative strand analysed open-ended responses on learning outcomes, challenges and suggestions. The two strands were collected with one questionnaire and interpreted together. There was no control group, so the design supports descriptive and associational conclusions rather than causal inference. Fig. 2 summarises the implementation and analysis process.

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

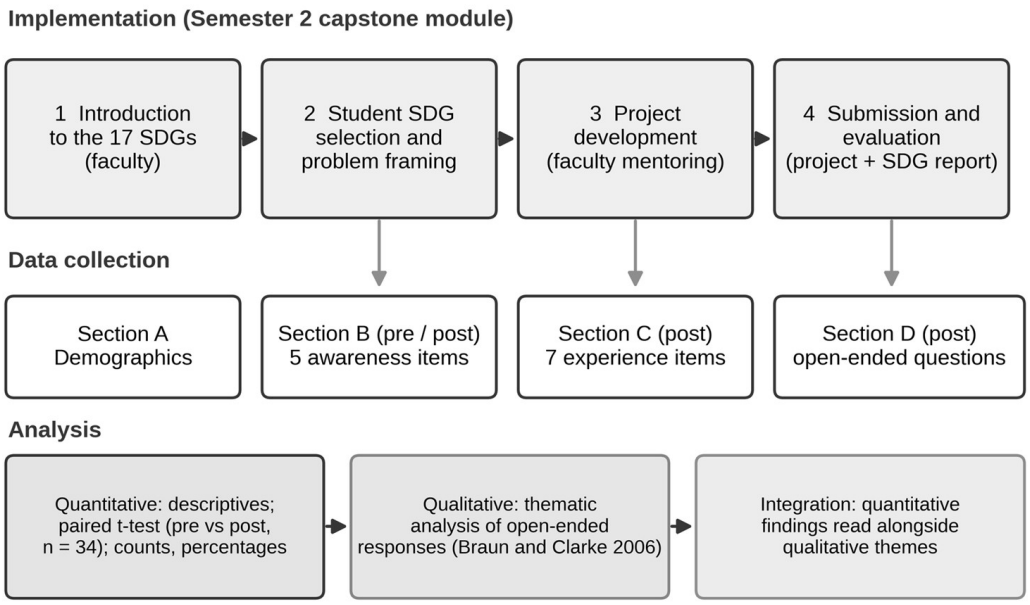


Fig. 2 Research methodology and implementation framework, from SDG introduction to quantitative and qualitative analysis.

3.2 Institutional context

The study was conducted at D. Y. Patil Institute of and Management, Akurdi, Pune, Maharashtra, which offers the programme. In Semester 2 of the programme, students complete a capstone project in which they apply their technical knowledge to a real-world problem. The institute introduced an initiative asking students to align their Semester 2 capstone topics with one or more SDGs. The source manuscript does not state project duration, team size, mentor allocation or the weight of the SDG-contribution report in assessment.

3.3 Participants

Participants were 34 students, comprising 17 male and 17 female students, who had completed the Semester 2 capstone project and were enrolled in Semester 3 at the time of data collection. The source manuscript does not state the size of the cohort from which the 34 participants were drawn or the response rate. No age or prior-background data were collected.

3.4 SDG integration intervention and project development process

The intervention comprised four steps. (1) **Introduction to the SDGs:** faculty introduced the 17 SDGs and explained how software solutions can contribute to them. (2) **SDG selection:** students selected one or more SDGs aligned with their interests, researched the goal objectives and identified problems that technology could address. (3) **Project Development:** Tasks relating to developing web application, mobile application, and dashboard were taken up by the students. (4) **Submission and Evaluation of the Projects:** Students

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

submitted their projects along with the report on how the project contributed to the achievement of selected SDGs.

3.5 Questionnaire design and validation

Questionnaire with four sections was conducted (see Table 2). Questions for Sections B and C were measured using five-point Likert scale. Options for the questions are not included in the source manuscript. The questionnaire was reviewed by three faculty members and piloted with five students before full administration. The source does not report how the review was conducted, whether the pilot students were excluded from the main sample, or any reliability coefficient.

Table 2 Structure of the questionnaire

Section	Content	Items and scale	Timing of administration
A	Demographics (gender, semester, project completion)	Categorical	Once
B	SDG awareness: awareness of the 17 SDGs; understanding how technology contributes; interest in social and environmental issues; understanding the role of computer professionals; connecting technical skills to societal problems	5 items; 5-point Likert	Before the project (pre) and after the project (post)
C	Project experience (relevance of SDG theme, understanding of social benefit of technical skills, motivation, problem-solving, faculty guidance, interest in sustainability, career consideration)	7 items; 5-point Likert	After the project
D	Open-ended questions: learning outcomes, challenges, suggestions; interest in future SDG-aligned projects	Open-ended	After the project

3.6 Data collection procedure

There were three data collection points. Prior to the project, the awareness survey was completed. Throughout the project, participants worked with faculty to complete projects related to SDGs. After the project, participants completed awareness, project experience surveys, and open-ended responses. The project manuscripts state that the data collection took place in July 2026. Because work for the second semester occurred prior to the project, it must be determined whether the pre-project measures were taken

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

during the project or collected retrospectively in July 2026. Retrospective evaluation of the pre-project measures can be subject to response shift bias.

3.7 Data analysis

Quantitative data were analysed in Microsoft Excel using descriptive statistics and paired-samples t-tests comparing pre- and post-project scores for each of the five awareness items (n = 34, df = 33). Treating five-point Likert item scores as approximately interval-scaled for parametric tests is common and has been defended when sample sizes and distributions are adequate (Norman 2010; Sullivan and Artino 2013); a non-parametric sensitivity check on the raw data is nonetheless advisable. Standard deviations, exact p-values and normality checks are not reported in the source manuscript. Percentages were calculated from counts of 34. Qualitative responses were analysed with thematic analysis to identify recurring themes (Braun and Clarke 2006). The number of respondents, the coding procedure and the number of coders are not reported.

3.8 Ethical considerations

The study follows the guidelines set out by the institute in relation to research and academics. The study asserts that participation in the research was voluntary and participants had consented before data collection could begin. In addition, the study indicates that no personal identifying information was collected during the research process. There are two problems that have to do with the author of the research which need clarification. One of the problems is that the part of the survey where demographic information was asked contained the question "Name" which contradicts the assertion made that no personal identifying information was collected. This also poses a problem because the research has to identify the respondents before and after the research in order to carry out the paired comparison. The other problem is that the research fails to mention whether the research has been reviewed by the institution's review board on ethics.

4 Results and Analysis

4.1 Demographic profile

Our research respondents were examined, and our research results are presented in the table below. The crucial characteristic of our research respondents is that the number of males and females is close in this study. All 34 students had finished their major projects in the second semester and were proceeding to the third semester when they were asked to fill in our questionnaire. It is necessary to emphasize that we did not know much about our respondents besides their academic achievements.

Table 3 Demographic profile of participants (n = 34)

Characteristic	Category	Count	Percentage
Gender	Male	17	50.0%
Gender	Female	17	50.0%
Current semester	Semester 3	34	100%

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

Characteristic	Category	Count	Percentage
Project completion	Completed Semester 2 capstone project	34	100%

Note: Percentages are calculated on n = 34.

4.2 SDG selection (RQ1)

Table 4 and Fig. 3 show the distribution of SDGs across the 34 projects. Thirty-one projects were each assigned to a single goal and three addressed two to four goals. SDG 9 (Industry, Innovation and Infrastructure) was selected most often (11 projects; 32.4%), followed by SDG 3 (Good Health and Well-Being; 7 projects; 20.6%) and SDG 4 (Quality Education; 4 projects; 11.8%). Together SDG 9 and SDG 3 account for 18 of 34 projects (52.9%). There are eight goals that appear individually as goals, while there are nine more goals which do not appear as individual goals although they can be components of the three multi-goals which have not been enumerated.

Table 4 Distribution of SDGs selected for the 34 capstone projects

SDG focus	Projects (n)	Percentage	Cumulative %
Goal 9: Industry, Innovation and Infrastructure	11	32.4%	32.4%
Goal 3: Good Health and Well-Being	7	20.6%	52.9%
Goal 4: Quality Education	4	11.8%	64.7%
Goal 8: Decent Work and Economic Growth	3	8.8%	73.5%
Goal 2: Zero Hunger	2	5.9%	79.4%
Goal 11: Sustainable Cities and Communities	2	5.9%	85.3%
Goal 12: Responsible Consumption and Production	1	2.9%	88.2%
Goal 13: Climate Action	1	2.9%	91.2%
Multiple SDGs (2–4 goals per project)	3	8.8%	100%
Total	**34**	**100%**	

Note: Counts and percentages as reported in the source manuscript; percentages recomputed from n = 34 and rounded to one decimal place. Cumulative percentages are calculated from unrounded values.

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

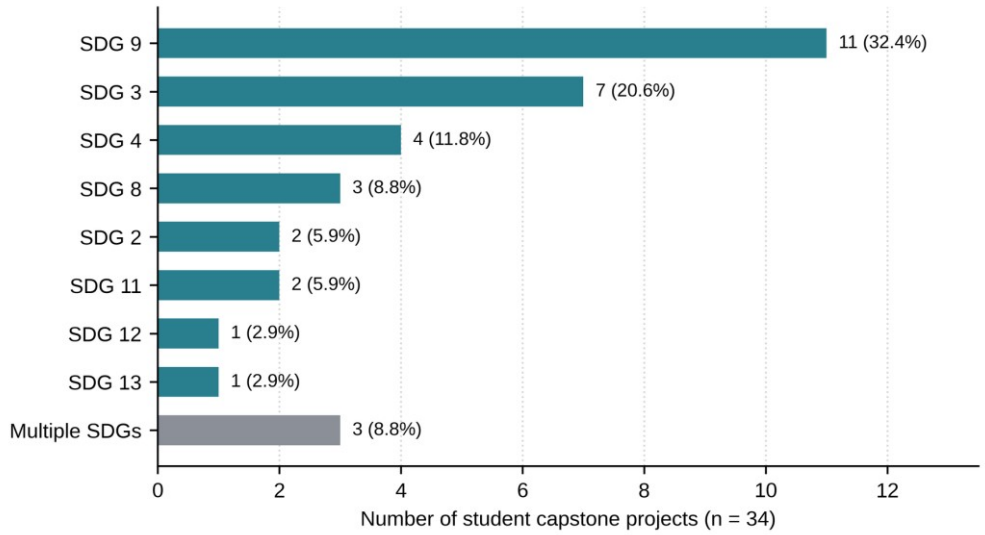


Fig. 3 Distribution of SDGs across the 34 student capstone projects (counts and percentages).

Table 5 maps each goal to the example applications named in the source manuscript. The examples show that students chose problems with direct social relevance, such as blood-donor connection, health portals, food donation and women's safety, as well as more general information systems. The breadth of SDG 9 deserves comment: examples such as event booking and inventory management are conventional information systems, and their contribution to sustainability is more indirect than that of, for example, a food-donation platform. The source data do not allow depth of SDG alignment to be assessed, which is a limitation of any count-based distribution (see Section 7).

Table 5 Mapping of selected SDGs to student capstone project applications

SDG	n	Example applications reported	Dominant sustainability dimension (interpretive)
SDG 9	11	Event booking; inventory management	Economic and infrastructural
SDG 3	7	Blood Connect; Smart Health Portal	Social (health)
SDG 4	4	AI Study Planner; Skill Exchange	Social (education)
SDG 8	3	Career platforms; eco-friendly products	Economic
SDG 2	2	Anna Seva food donation	Social (food security)
SDG 11	2	Women Safety System	Social (safety, inclusive cities)
SDG 12	1	AI Expense Analyzer	Economic (consumption)
SDG 13	1	Fish waste recycling	Environmental

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

SDG	n	Example applications reported	Dominant sustainability dimension (interpretive)
Multiple	3	Projects addressing 2–4 SDGs (not itemised in the source)	Not assessable

4.3 Pre- and post-project awareness (RQ2)

Table 6 and Fig. 4 compare awareness scores before and after the capstone project. All five items increased, by between 0.91 and 1.29 points on the five-point scale. The largest gain was in understanding how technology contributes to the SDGs (3.18 to 4.47; +1.29), followed by awareness of the 17 SDGs (3.26 to 4.47; +1.21). The smallest gain was in interest in social and environmental issues (3.47 to 4.38; +0.91), which also had the highest pre-project score, suggesting that students began with a moderate general interest but less conceptual understanding of how technology and the SDGs connect. Post-project means were between 4.32 and 4.47, close to the upper end of the scale.

Table 6 Pre-project and post-project awareness scores (n = 34; five-point scale)

Awareness item	Pre mean	Post mean	Difference	t (df = 33)	p (as reported)
Awareness of the 17 UN SDGs	3.26	4.47	+1.21	8.45	< 0.001
Understanding how technology contributes to SDGs	3.18	4.47	+1.29	9.12	< 0.001
Interest in social and environmental issues	3.47	4.38	+0.91	6.34	< 0.001
Understanding role of computer professionals in sustainable development	3.29	4.32	+1.03	7.21	< 0.001
Connecting technical skills to real-world societal problems	3.38	4.41	+1.03	7.56	< 0.001

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

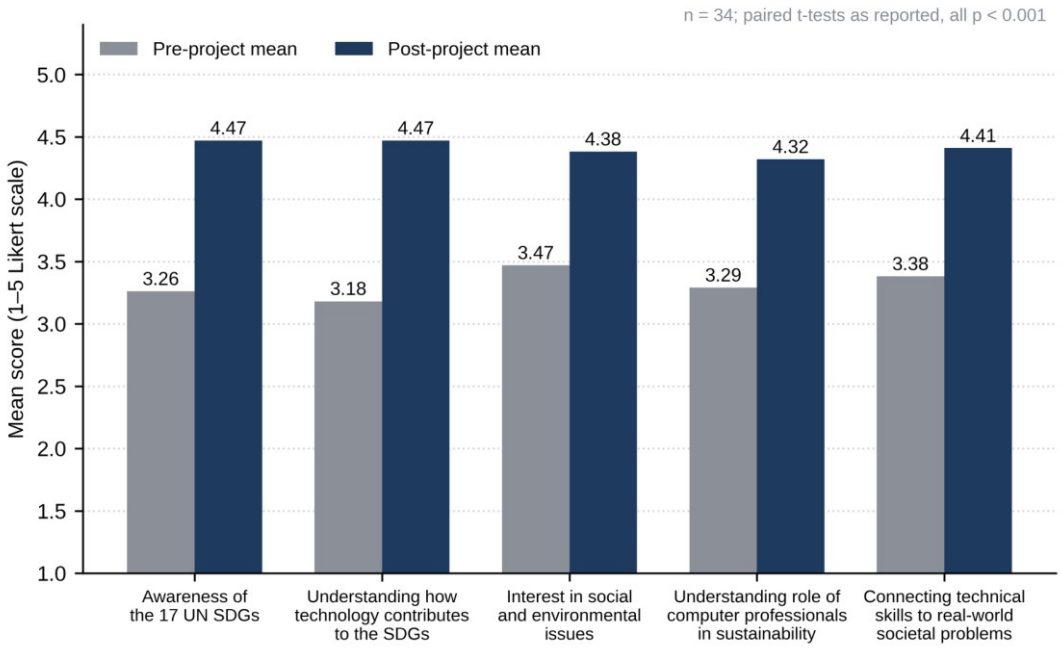


Fig. 4 Pre-project and post-project mean awareness scores for the five awareness items (1–5 scale; n = 34).

In statistical terms, it can be seen that the mean after the project is greater than the mean before the project each time. Nevertheless, there are a few things that can be said about the application of statistics in the design. First, as there is no control group in the research design, it is impossible to say that the improvement is as a result of the implementation of the SDGs, because other elements might be responsible for the findings. Second, there is no information as to when the pre-test was taken. Consequently, if it was done retrospectively, the pre-project data will be biased. As five tests have been performed, the correct alpha level of 0.01 should be applied.

4.4 Student perceptions of the project experience (RQ3)

Table 7 and Fig. 5 present students' ratings of the seven project-experience items. The overall mean across the seven items was 4.40. Students rated the relevance of the SDG theme to their project work highest (4.56), followed by motivation arising from addressing a real-world problem (4.50). Understanding of how technical skills benefit society and improvement in problem-solving and critical thinking were both rated 4.44. Interest in sustainability (4.35) and consideration of sustainability in a future career (4.32) were somewhat lower. The adequacy of faculty guidance received the lowest rating (4.18). The source manuscript labelled the means with verbal interpretations ("strongly agree", "agree", and intermediate labels), but the labels were not applied by a consistent cut-off; they are replaced here by ranks, and the verbal scale should be reinstated only with a stated rule.

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

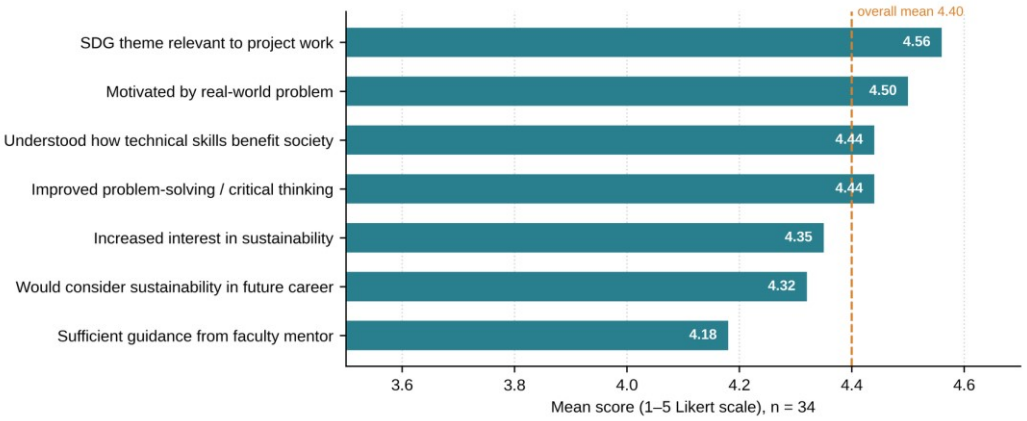


Fig. 5 Mean ratings of the seven project-experience items (1–5 scale; n = 34); the dashed line marks the overall mean of 4.40.

4.5 Interest in future SDG-aligned projects

Of the 34 students, 32 (94.1%) expressed interest in working on SDG-aligned projects in future semesters, and two (5.9%) did not express clear interest (Table 7, Fig. 6). These figures have been rounded off to 94% and 6% in the source document. There is no information available on the way this question has been asked and answered, and therefore this response must be taken to indicate an attitude that is favorable rather than action.

Table 7 Interest in future SDG-aligned projects (n = 34)

Response	Students (n)	Percentage
Interested in working on SDG-aligned projects in future semesters	32	94.1%
Did not express clear interest	2	5.9%
Total	**34**	**100%**

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

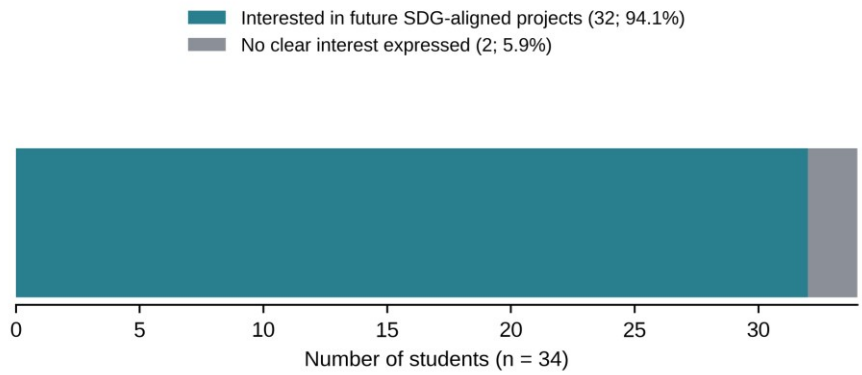


Fig. 6 Students' interest in future SDG-aligned projects (n = 34).

4.6 Qualitative findings (RQ3 and RQ4)

Thematic analysis of the open-ended responses yielded four themes, summarised in Table 8. The source manuscript does not report how many students contributed to each theme, so the findings describe the range of responses and not their prevalence.

Theme 1: Learning outcomes. Students described realising that technology can address social as well as technical problems; developing awareness of sustainability issues and of how software can create social and economic benefit; moving from isolated problem-solving to systems-level thinking; and learning to optimise resources and technology use for the benefit of ordinary users. **Theme 2: Challenges.** Students found it difficult to understand SDG objectives and to design features that reflected them; reported data scarcity and difficulty ensuring the fairness of the algorithms they built; were constrained by the absence of paid APIs, cloud servers or large datasets; and found it hard to understand end-user needs and translate them into effective solutions. **Theme 3: Reasons for future interest.** Students valued applying technical knowledge for social impact, improving practical and problem-solving skills while contributing to sustainable development, and the sense of purpose that the work carried. **Theme 4: Suggestions.** Students asked for more practical exposure through industry-based projects, workshops, mentorship and real-world case studies; more interdisciplinary collaboration; earlier introduction of the SDGs, from the first semester, with case studies; and stronger partnerships with industry and non-governmental organisations.

Table 8 Qualitative themes and associated learning outcomes or implications

Theme	Sub-themes reported by students	Associated learning outcome or implication
1. Learning outcomes	Technology as a social solution; sustainability awareness; systems thinking; resource optimisation	Links technical competence to societal purpose; supports the quantitative gain in understanding technology's contribution

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

Theme	Sub-themes reported by students	Associated learning outcome or implication
2. Challenges	SDG selection and alignment; data scarcity and algorithmic fairness; limited paid APIs, cloud and datasets; understanding user needs	Indicates need for guidelines and examples, data partnerships, resource support and user-research training
3. Reasons for future interest	Applying skills for social impact; practical skill development with contribution to sustainability; sense of purpose	Consistent with high motivation (4.50) and future interest (94.1%)
4. Suggestions	Industry-based projects, workshops, mentorship, case studies; interdisciplinary collaboration; SDG introduction from Semester 1; industry and NGO partnerships	Direct inputs for curriculum redesign (Table 10)

5 Discussion

5.1 How capstone projects may improve SDG awareness

All five awareness items rose after the SDG-aligned capstone, and the largest gains were in the two items closest to the intervention's content: knowing the goals and understanding how technology contributes to them. This pattern is plausible given the intervention design. To choose an SDG-aligned problem, students had to read about the goals, interpret their objectives and translate them into software requirements, which is an active form of engagement with the content. Similarly, Blanco et al. (2024) pointed out that students perceived that they gained more knowledge from the act of searching for and generating SDG information rather than consuming the efforts of others, while Calvo et al. (2024) saw heightened awareness through an activity on sustainable projects. The direction of our findings is therefore consistent with that literature.

The comparison with Angelaki et al. (2024) is instructive. In their study, knowledge and intention to engage in sustainability rose significantly but perceived need for curricular inclusion did not. Our study did not measure perceived curricular need, but the students' own suggestions for earlier and broader SDG exposure point to a favourable view of curricular integration. A methodological contrast is also worth noting: Angelaki et al. matched anonymous pre- and post-questionnaires through a student-generated identification code, which is a way to reconcile pairing with anonymity that could be adopted here. Finally, like most studies in the PBL review by Guo et al. (2020), our outcomes are affective and self-reported. The study shows that students felt more aware and motivated; it does not show that they performed better or behaved differently.

5.2 Technology and sustainable development

The largest gain, in understanding how technology contributes to the SDGs, is the result most directly relevant to a computing programme. Students' projects, from health portals to food-donation and safety applications, show technology being used as a means to social ends. The qualitative themes add nuance: students recognised that technology is not a neutral solution, as shown by their concerns about data scarcity

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

and algorithmic fairness. This echoes the observation by Peters et al. (2024) that few studies in computing education engage with calls for deeper systemic change. The present intervention focused on computing for sustainability; it did not address the environmental footprint of computing itself, which a fuller curriculum would also cover.

5.3 Experiential and interdisciplinary learning

Although the intervention under consideration was aimed at sustainability with regard to computing rather than the environmental aspects of computing, they are all discussed in the course outline. These findings fit the logic of PBL as inquiry into authentic problems (Krajcik and Blumenfeld 2006). Students also asked for interdisciplinary collaboration and links with industry and non-governmental organisations. Calvo et al. (2024) designed their intervention as a multidisciplinary itinerary across subjects, and Tenhunen et al. (2023) note that capstones are often client-based; both suggest ways in which an capstone could draw in external problem owners.

5.4 The role of faculty guidance

Faculty guidance received the lowest of the seven ratings (4.18), although it remained above 4 on a five-point scale. A single item cannot show why, but the qualitative requests for mentorship, workshops and clearer examples suggest that students wanted more structured support on SDG alignment specifically, not only on technical development. Evidence from school-level ESD indicates that structured professional development can raise educators' self-efficacy for ESD (Varghese and Mathew 2026); by analogy, faculty development on SDG-aligned project supervision may be worthwhile, although this inference goes beyond the present data.

5.5 Challenges encountered by students

The four challenges point to design responses that institutions can adopt at low cost. Difficulty in selecting and aligning SDGs can be reduced with clear guidelines, worked examples and templates before topic selection. Data scarcity can be addressed by partnerships with non-governmental organisations or local bodies that can supply data or problem statements. Resource constraints can be eased by providing access to cloud credits, APIs and datasets. Difficulty understanding users can be addressed through short workshops on user research and design thinking. These suggestions are proposals derived from the students' reports; their effectiveness has not been tested.

5.6 Implications for and computer science curriculum design

Table 9 translates the findings into an SDG integration framework for the capstone. The central design idea is to use the SDGs as a problem-framing device within an existing capstone, so that sustainability is learnt through the practice of building software for real needs. The enhancements in the last column draw on students' suggestions and on the challenges identified above; they should be treated as hypotheses for future implementation and evaluation.

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research
@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

Table 9 SDG integration framework for the capstone module

Stage	Activity in the studied module	Evidence from this study	Proposed enhancement (to be evaluated)
1. SDG orientation	Faculty introduce the 17 SDGs and their relevance to software	Largest gains in SDG awareness (+1.21) and understanding of technology's contribution (+1.29)	Introduce SDGs from Semester 1, with case studies (student suggestion)
2. Problem identification and SDG selection	Students select SDGs and identify problems	SDG 9 and SDG 3 most selected; selection and alignment was a challenge	Provide guidelines, examples and templates; offer NGO or industry problem statements
3. Solution development	Web, mobile and dashboard projects	Motivation from real-world problems rated 4.50; data and resource constraints reported	Provide datasets, APIs and cloud resources; add user-research and design-thinking workshops
4. Faculty mentoring	Faculty guidance during development	Guidance rated 4.18, the lowest item	Train mentors on SDG-aligned supervision; add structured mentoring checkpoints
5. Evaluation and SDG reporting	Project plus report on SDG contribution	Criteria not documented	Add an SDG-contribution criterion with a rubric; consider impact evidence
6. Reflection and feedback	Open-ended feedback on learning, challenges, suggestions	Four themes identified	Collect structured reflections each cycle; track longer-term outcomes

6 Research Contributions and Implications

Theoretical contribution. The study supports an experiential account of sustainability learning in which SDG awareness, understanding of technology's contribution, motivation and career consideration develop together when students construct solutions to goal-aligned problems. It adds a postgraduate computing case to a literature that has relied heavily on experience reports (Peters et al. 2024). The evidence is associational and should be treated as hypothesis-generating.

Methodological contribution. The study pairs a short, repeatable awareness instrument with project-experience items and open-ended responses, and it makes explicit the points at which such evaluations need stronger documentation: timing of the pre-measure, pairing with anonymity, reliability evidence and reporting of dispersion. These points are offered as a checklist for similar institution-level evaluations.

Practical contribution. The framework in Fig. 1 and Table 9 shows how an institution can introduce the SDGs through orientation, topic selection and a reporting requirement, without a new course.

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

Contribution to computing education. The findings suggest that the SDGs can serve as a problem-framing device in capstone projects, and that students' main difficulties lie in alignment, data, resources and user understanding, which are addressable through curriculum support.

Implications for Indian higher education institutions. Institutions seeking to operationalise the SDG orientation of national policy (Ministry of Education 2020; Radha and Arumugam 2023) can use capstone modules as a practical entry point. Accreditation-based evidence of institutional SDG activity (Narayanan 2025) could be complemented by student-level outcome measures of the kind reported here.

7 Limitations and Future Research

There are several significant limitations of the research. First, it was conducted at one institution and included only 34 students. Thus, there is no guarantee that the outcomes of the study can be applied to other settings. Second, the experimental design included only one sample of students who participated in the project both before and after, which means that causal relationships cannot be identified. Third, all data collected during the research come from self-reports, which can be distorted since respondents often provide socially desirable answers rather than the truth. Finally, the survey that was applied has not been validated properly and there is no information about reliability and variance. The approach that was used to evaluate how much the project aligned with the objectives is not able to measure depth and quality of this relationship. Quantitative data collection, which includes student's self-reporting, does not provide enough information about the number of participants and ways of the analysis. And finally, the study evaluated only the perception of the project among the students, but did not analyze the project itself or its impact on the reality.

Further studies can employ multi-institution samples and comparison groups, track career choice of students over time, assess project artifacts using SDG-contribution rubric, validate the instrument and report its reliability, and examine the sustainability footprint of the software created by the students. Qualitative research with employers and non-governmental partners can provide insights on the value of SDG-oriented capstone projects.

8 Conclusion

This case study examined an SDG-aligned Semester 2 capstone module in an programme in Pune. Students most often chose SDG 9 and SDG 3. Their self-reported awareness increased on all five measured aspects, most strongly in understanding how technology contributes to the SDGs. They rated the project experience highly (overall mean 4.40 of 5), and 94.1% wished to undertake further SDG-aligned projects. Their reports identified clear learning outcomes and four practical challenges, and their suggestions point to earlier SDG exposure, stronger mentoring and external partnerships. Given the single-institution, single-group design and the open points on measurement, the results are best read as encouraging, context-specific evidence that SDG-aligned capstones are a feasible and well-received way to integrate sustainability into computing education, which warrants testing in larger and better-controlled studies.

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

References

1. Angelaki ME, Bersimis F, Karvounidis T, Douligeris C (2024) Towards more sustainable higher education institutions: implementing the sustainable development goals and embedding sustainability into the information and computer technology curricula. Educ Inf Technol 29(4):5079–5113. https://doi.org/10.1007/s10639-023-12025-8
2. Bambazek P, Groher I, Seyff N (2025) Integrating sustainability into undergraduate software engineering education: an experience report. In: Proceedings of the 2025 Conference on Innovation and Technology in Computer Science Education (ITiCSE 2025), Nijmegen, 30 June–2 July 2025. ACM, New York. https://doi.org/10.1145/3724363.3729079
3. Blanco JM, Domínguez C, Jaime A, Usandizaga I (2024) Connecting sustainability and computer science curricula through website learning projects embedding different types of student-generated content. Educ Technol Res Dev 72(4):2237–2265. https://doi.org/10.1007/s11423-024-10376-8
4. Braun V, Clarke V (2006) Using thematic analysis in psychology. Qual Res Psychol 3(2):77–101. https://doi.org/10.1191/1478088706qp063oa
5. Calvo I, Carrascal E, González JM, Armentia A, Gil-García JM, Barambones O, Basogain X, Tazo-Herran I, Apiñaniz E (2024) A methodology to introduce sustainable development goals in engineering degrees by means of multidisciplinary projects. Educ Sci 14(6):583. https://doi.org/10.3390/educsci14060583
6. Creswell JW, Plano Clark VL (2018) Designing and conducting mixed methods research, 3rd edn. Sage Publications, Thousand Oaks
7. Guo P, Saab N, Post LS, Admiraal W (2020) A review of project-based learning in higher education: student outcomes and measures. Int J Educ Res 102:101586. https://doi.org/10.1016/j.ijer.2020.101586
8. Krajcik JS, Blumenfeld PC (2006) Project-based learning. In: Sawyer RK (ed) The Cambridge handbook of the learning sciences. Cambridge University Press, Cambridge, pp 317–334
9. Leal Filho W, Shiel C, Paço A, Mifsud M, Ávila LV, Brandli LL, Molthan-Hill P, Pace P, Azeiteiro UM, Vargas VR, Caeiro S (2019) Sustainable Development Goals and sustainability teaching at universities: falling behind or getting ahead of the pack? J Clean Prod 232:285–294. https://doi.org/10.1016/j.jclepro.2019.05.309
10. Ministry of Education, Government of India (2020) National Education Policy 2020. Government of India, New Delhi
11. Narayanan P (2025) The role of Indian higher education institutions in sensitizing young minds to Sustainable Development Goals (SDGs). J Appl Res High Educ. https://doi.org/10.1108/jarhe-09-2024-0487
12. Norman G (2010) Likert scales, levels of measurement and the “laws” of statistics. Adv Health Sci Educ Theory Pract 15(5):625–632. https://doi.org/10.1007/s10459-010-9222-y
13. Peters AK, Capilla R, Coroamă VC, Heldal R, Lago P, Leifler O, Moreira A, Fernandes JP, Penzenstadler B, Porras J, Venters CC (2024) Sustainability in computing education: a systematic literature review. ACM Trans Comput Educ 24(1):Article 13. https://doi.org/10.1145/3639060

BODHIVRUKSHA JOURNAL OF DIVERSE DISCIPLINE
E-ISSN : 3139-1486
An Open Access, Peer-Reviewed, Multidisciplinary Scholarly Journal
Bi-monthly | Multilingual (English, Hindi, Marathi) | Academic Research

@ Volume 2, Issue 6 (November-December 2026) https://bjddjournal.org/ (E-ISSN : 3139-1486)

14. Radha L, Arumugam J (2023) Integrating the Sustainable Development Goals (SDGs) in the curriculum and strengthening teacher training programs to align with NEP 2020. Shanlax Int J Educ 11(4):63–68. https://doi.org/10.34293/education.v11i4.6302
15. Sullivan GM, Artino AR Jr (2013) Analyzing and interpreting data from Likert-type scales. J Grad Med Educ 5(4):541–542. https://doi.org/10.4300/JGME-5-4-18
16. Tenhunen S, Männistö T, Luukkainen M, Ihantola P (2023) A systematic literature review of capstone courses in software engineering. Inf Softw Technol 159:107191. https://doi.org/10.1016/j.infsof.2023.107191
17. UNESCO (2017) Education for sustainable development goals: learning objectives. UNESCO Publishing, Paris
18. United Nations (2015) Transforming our world: the 2030 Agenda for Sustainable Development. Resolution A/RES/70/1. United Nations, New York
19. Varghese S, Mathew PM (2026) A multi-cognitive approach to empowering secondary school teachers' self-efficacy and practices related to education for sustainable development. Asian Educ Dev Stud. https://doi.org/10.1108/aeds-09-2025-0491
20. Wals AEJ (2012) Shaping the education of tomorrow: 2012 full-length report on the UN Decade of Education for Sustainable Development. UNESCO Publishing, Paris