Sustainability Principles that Stick: Empowering Future Civil Engineers through Student-Driven Case Studies

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Abstract
In the quest to produce future civil engineering technology (CET) graduates with experiential knowledge of sustainability principles, a shift from the didactic approach of teaching towards a student-centred approach was adopted. Lecturer-led case studies have been promoted as a viable student-centred approach to teaching and have been adopted in many higher education institutes (HEIs) modules. However, studies have noted that better critical thinking, ingenuity and logical reasoning among students can be achieved when students select their cases. As such, this paper presents the findings of an observation from student-driven case studies used in teaching sustainability principles to CET students across four years (2019 to 2022). The study adopted an observation and evaluation of CET students' learning outcomes and performance over a four-year period at the University of Johannesburg, South Africa. The findings revealed that students gained a better understanding and were more critical in their analysis and logical in proposing directions for improving sustainability in the assessed cases. Furthermore, students developed better relationships with industry stakeholders on the project they assessed and built a sense of belonging through interaction with projects within their locality. Empirical evidence shows that student-driven case studies can further improve students' performance when used to augment other forms of assessment like in-class tests and examinations. In practice, the findings should help lecturers effectively teach sustainability principles through a carefully selected student-centred approach that will ensure active and social learning and knowledge construction. The study offers a foundation for future works on student-driven case studies, particularly in the teaching of sustainability principles – an aspect that has received minimal attention in the discourse on the use of case studies in teaching civil engineering modules in HEIs.

Keywords
Civil engineering, Student-centred learning, Student-led case studies, Sustainability

1. Introduction
In today's architecture, engineering and construction (AEC) world, sustainability has become a crucial project success criterion, and professionals are expected to understand the core requirements for achieving sustainability on any given project. Sustainability has been described as a complex concept which covers a wide range of topics (Zhou *et al.*, 2013). This complexity has led to numerous definitions from diverse perspectives (Wood, 2005). The Brundtland Report (1987) gives the most widely accepted definition of sustainability as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. As such, while delivering projects, it is important not to exhaust available natural resources so that future generations can meet their own needs (Aghimien *et al.*, 2018a, b). Raynsford (2000) noted earlier that a sustainable AEC project should promote users' quality of life, accommodate future changes in users' needs, support the natural and social environments, and maximise the use of resources. In the view of Nazirah and Ijias (2006), professionals and stakeholders must navigate social, economic and environmental issues in the quest for a sustainable AEC project. Therefore, these professionals must understand the principles of sustainability right from their higher education stage, even before venturing into the AEC industry. Moreover, Vanderbilt University (2024) have noted that with limited resources and unlimited ingenuity in the world currently, higher education institutions (HEI) are saddled with the responsibility of preparing students to meet the sustainability challenges of the future. This further emphasises the importance of teaching sustainability principles to young and future AEC professionals.

The Engineering Council of South Africa (ECSA), which is the major Professional, Statutory and Regulatory Body (PSRB) accrediting the engineering and engineering technology programmes, has eleven well-defined graduate attributes (GAs) that students should meet for them to be deemed competent as an engineer/engineering technologist upon completion of their programme. GA number 7 – 'sustainability and impact of engineering activity' requires graduates of engineering and engineering technology programmes to demonstrate knowledge and understanding of the impact of engineering activity on the society, economy, industrial and physical environment and address issues by analysis and evaluation. It became apparent that students' understanding and knowledge in relation to GA number 7 must be assessed carefully to meet the PSRB's requirement. As such, case studies, which have been used significantly in teaching many sustainability programmes, have been adopted to ensure active learning (Russ and Taggart, 2018).

Case studies are scenarios designed to offer educative information through learning and solving complex problems to improve critical thinking (M-Gibes, 2023). While case studies exist in diverse forms, most case studies are given to students by lecturers to critically evaluate as a group or individual (Carlson and Velenchik, 2006). The effectiveness of a lecturer-led approach towards promoting critical thinking, ingenuity and logical reasoning among students is not fully known. The question remains: would these attributes be achieved if these case studies are student-driven? Allowing students to identify and select the cases they deem appropriate based on set criteria might promote criticality and a sense of attachment to these projects and their evaluation. Myszka (2002) noted that when students are allowed to drive the selection and investigation process in case study teaching, they gain a better understanding while demonstrating improved analytical skills as well as enhanced oral communication skills. Unfortunately, student-driven case studies are scarce in teaching civil engineering modules. There is hardly any documented evidence of the use of this approach to ensure better knowledge and understanding of sustainability principles among civil engineering students in South Africa. It is based on this notion that this study examined the impact of student-driven case studies as a means of assessing CET students' understanding of the principles of sustainability in civil engineering projects in South Africa. This was done with the aim of understanding how case studies driven by students can shape students' understanding and knowledge of sustainability principles as well as their performance. In practice, the findings should help lecturers effectively teach sustainability principles through a carefully selected student-centred approach that will ensure active and social learning and knowledge construction.

2. Case-based Teaching of Sustainability Principles in Higher Education Institutions

Rajathi *et al.* (2017) have earlier noted that traditional didactic teaching is passive and produces students who are consumers of information. This has led to the clamour for a more student-centred teaching method, where students actively participate in what and how they are taught (McLoughlin and Lee, 2008). The student-centred pedagogy highlights the need to prioritise students in the learning process and gives students control over the content and process of learning (Atwal, 2019; Bremner *et al.*, 2022). Schweisfurth (2019) noted that student-centred pedagogy includes active-based, inquiry-based and problem-based learning, and this has gained popularity within many countries as an example of 'best practice' pedagogy. Bremner *et al.* (2021) noted that student-centred learning includes active participation, adapting to needs, autonomy, relevant skills, power sharing and formative assessment. Highlighting the different approaches to student-centred learning, M-Gibes (2023) mentioned presentations, workshops, experiments, group discussions, role play, gamification and case studies, among others.

Using case studies in teaching has been a long-standing tradition in education. Case studies take diverse forms, with most lecturers using the discussion of appropriate cases to buttress a topic. Boehrer and Linsky (1990) have earlier noted that a case discussion allows students to interact and explore realistic and specific issues. Myszka (2002) described education case studies as stories with educational messages. According to Carlson and Velenchik (2006), the case discussion follows the lecturer's approach of giving the case to students before the day of the lecture, and the students are expected to carefully assess the case. Students discuss this case study with the lecturer during class and develop an appropriate line of action. The practical nature of most engineering programmes has led to lecturers' demonstration of concepts and principles, which students are expected to replicate (Myszka, 2002). However, there has been a rise in the use of case methods of teaching to promote inductive learning, knowledge retention, improved reasoning and analytical skills, and the ability to recognise multiple perspectives, among others (Fitzgerald, 1995; Martin *et al.*, 2021; Newson and Delatte, 2011). Vashist (2022) noted that case studies in teaching AEC programmes are crucial because they provide practical examples of complex problems and how they have been solved. As such, exploring case studies' use in teaching civil engineering modules (sustainability principles inclusive) can ensure the intended goal of critical thinking and understanding is achieved, as noted by Chinowsky and Robinson (1997).

It has been noted that there is no 'correct' pedagogy for sustainability education. However, there is a need for active, participative, and experiential learning methods to keep students engaged (University of Plymouth, 2024). The UNESCO (2009) submission noted that teaching sustainability in HEI should develop sustainability attitudes, skills, and knowledge among students, which will, in turn, shape their decision-making and actions. Unfortunately,

Georgallis and Bruijn (2021) noted that the continuous rise in corporate sustainability is not reflected in how it is taught in the institution, as the traditional approach to teaching is still being used. However, there has been a trend in the use of case studies in teaching sustainability to students within HEIs (Russ and Taggart, 2018). Seatter and Ceulemans (2017) have noted that different types of case studies, such as dialogue cases, data cases, and illustrated cases, can prove very useful in teaching sustainability challenges to students. Russ and Taggart (2018) gave the learning process involved in the case study method of teaching environmental and sustainability issues. It was noted that this method of teaching is rooted in active learning, social learning, and knowledge construction theories. It can take the form of discussion and analysis of existing cases while proposing solutions to identified problems. It was noted that this approach allows critical thinking and better decision-making among students and is most suitable for teaching sustainability education. Also, Georgallis and Bruijn (2021) proposed an advancement to teaching sustainability through the use of case-based debate, which involved the use of traditional case studies with in-class debates. It was observed that by allowing an in-class debate of cases among students, lecturers can achieve active participation while ensuring critical thinking and improving reflexivity by ensuring students actively engage with opposing viewpoints.

3. Research Method

The study adopted an observation and evaluation of CET students' learning outcomes and performance over a four-year period at the University of Johannesburg, South Africa. This was done to ascertain the impact of the adopted student-driven case study on CET students' knowledge and understanding of the sustainability of engineering activities. The students across four years (2019 to 2022) evaluated ongoing construction projects within their immediate locality in groups. Each group of at least 5 to 10 students identified an ongoing project of their choice and assessed the economic, social and environmental sustainability of the selected project through careful observation and by asking questions from relevant experts on the project using some developed sustainability questions (Aghimien *et al.*, 2018a). Based on the assessment of the projects, each group determined the sustainability of the projects through critical thinking and evaluation. A comprehensive report was prepared by each group detailing the type of project assessed, the findings in terms of the sustainability criteria, and the conclusion on how they think the project has performed environmentally, socially and economically. A PowerPoint slide was further prepared for a class presentation, and the presentation and report were marked according to a set rubric detailing the requirements for grading. Through this approach, students demonstrated their knowledge and understanding of the sustainability impact of engineering activity through analysis and evaluation as required by ECSA's GA number 7, which must be achieved by each student to pass the module. Furthermore, adopting this student-driven case study approach has significant pedagogical reasoning behind it aside from meeting the PSRB's expectations. This includes promoting student-centred learning in the CET programme, improving the communication skills of CET students, improving students' collaboration skills, and allowing students to learn through interaction with the local community. The results of the assessment of the sustainability of the students' selected case studies were analysed using mean scores to show their view of the sustainability of selected construction projects. To further explore the impact of student-driven case studies on students' performance, the student's scores over the four years in this assessment component were compared against their scores from in-class tests. The average, minimum, maximum and median scores were all evaluated to draw logical conclusions. Furthermore, the feedback of students after the case studies was evaluated to note their experience.

4. Findings and Discussion

4.1 Understanding and knowledge of sustainability principles through student-driven case-studies

From 2019 to 2022, the students in groups of 5 to 10 students explored sustainability principles in projects that they have selected themselves. Each group sought the assistance of not more than three professionals on the selected case projects in exploring the economic, social and environmental sustainability of the projects. The selected projects were mostly buildings projects with significant structural engineering requirements. The previously designed survey instrument was used, and the feedback was analysed by the students to draw logical conclusions for their reports and in-class presentations. An excerpt of the students' findings from ten different projects and 22 experts is given in Figure 1-3.

From the overall analysis, the social dimension had a group mean of 4.1, while the economic and environment had a group mean of 3.8 and 3.6, respectively. This shows that while most of the projects assessed have emphasised the social dimension of sustainability, more can still be done around the economic and environmental dimensions. One of the groups assessed an international transport interchange and noted that effort was put into achieving economic sustainability, wherein jobs were created and employed individuals got to meet their economic needs and sustain themselves. When completed, the facility itself will be a place of economic activity where money will be exchanged.

This will promote the economic aspect of sustainable development. It was further noted that the social dimension of sustainability was encouraged through beautiful aesthetics, ease of access, and the safety and security of the facility. However, the environmental aspect of sustainability seems to be lagging behind in the assessed facility.

Another group of students recorded that following their observation and discussions, it can be concluded that the people involved in the construction of a new student housing that they studied have knowledge of sustainable development. It was further noted that most aspects that contribute towards such development are catered for within the facility. It is not perfect, but the result of great effort in making sure that a sustainable structure is built is vivid. Although it cannot be said that the facility is a sustainable building, some measures have been taken, and there is hope for the future of sustainability, especially in a developing country like South Africa. The further noted that in terms of individual performance, the social and economic dimensions of sustainability have gained prominence over the environmental dimensions. In the same vein, another group assessed a proposed student village and concluded that currently, in many engineering projects, sustainable development is perceived as essential. The project takes into consideration environmental sustainability in terms of the use of solar design for heating and cooling in the buildings. Solar design plays an important role in environmental sustainability as it utilises sun energy and the surrounding climate for heating and cooling. As such, the project pays extensive attention to keeping the use of non-renewable resources at a minimum. However, the project does not quite practice rainwater harvesting, which can improve the efficient use of water. In terms of economic sustainability, the project used local materials, thus reducing travelling costs and carbon footprint. Like many other projects within the country, the project used minimal recycled materials. It was further noted that social sustainability was perceived as the most important factor. Most of the ratings show that many aspects were applicable, including providing easy access to all kinds of individuals, including those with disabilities, and providing working space with high security and consistent locking systems, thus resulting in a socially sustainable project.

One of the groups explored the construction of an ongoing hotel and concluded that all three pillars were considered in the project, although some criteria were met more efficiently than others. It was noted that the project promises economic sustainability in terms of reducing maintenance and project costs by utilising durable and eco-friendly materials. Transportation costs were also reduced by using locally based products. Unfortunately, this project contributed greatly to the carbon footprint due to a large coal-powered electricity demand. This is not only harmful to the environment but costly as well, especially when faced with the current situation of load shedding within the country. On the other hand, optimum use of rainwater was made by capturing it, and greywater was also recycled extensively to promote environmental sustainability. It was further noted that the project had a positive impact on social sustainability mainly due to the comfort level it sustains in terms of visual warmth and high–security. The design of the building allows easy accessibility of services for individuals with different needs. However, they lacked the provision of a proper parking system and the preservation of the heritage streetscape. The reason the heritage landscape was not preserved could be due to the fact that the project is constructed in one of the modernised parts of the city of Johannesburg, thus, the landscape could have been modified to meet the modern cityscape at which the project is located.

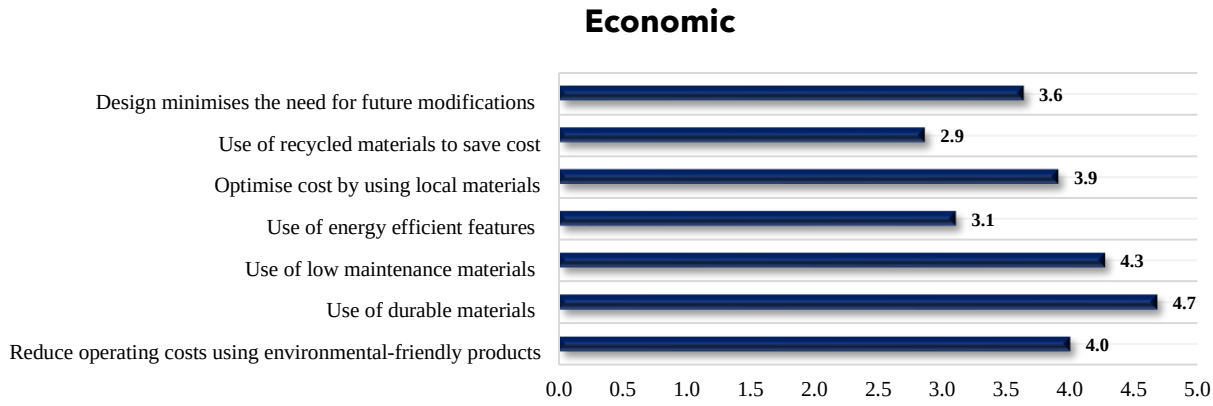

Figure 1. Feedback from student-driven case studies on economic sustainability principles

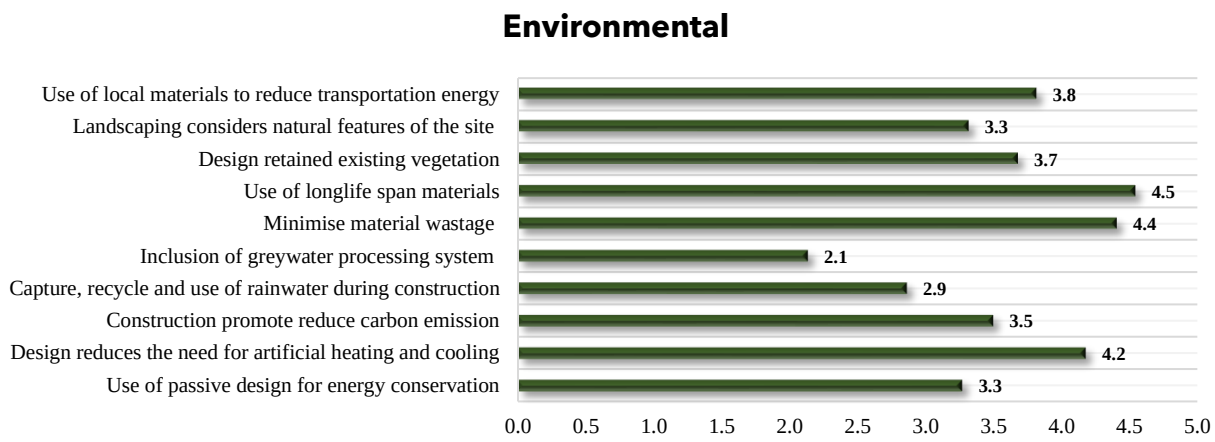

Figure 2. Feedback from student-driven case studies on environmental sustainability principles

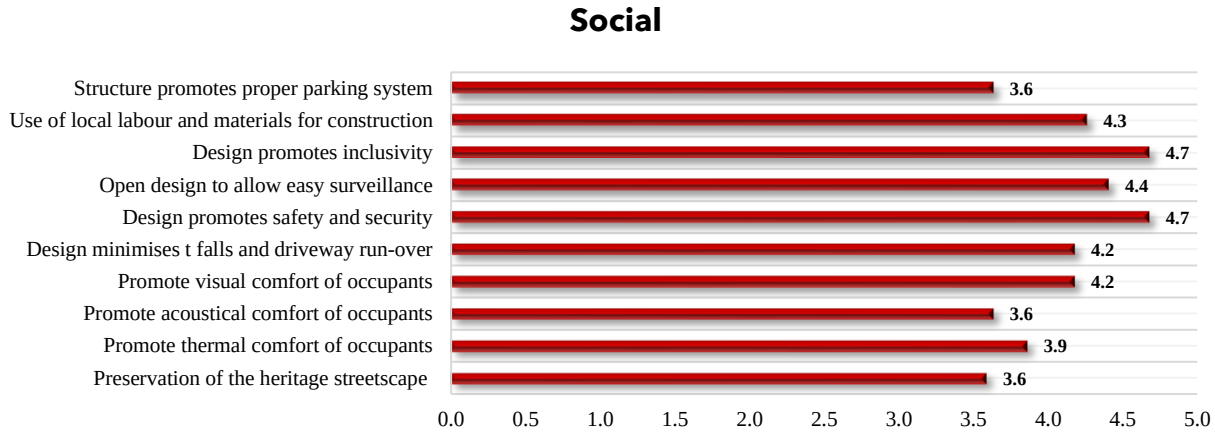

Figure 3. Feedback from student-driven case studies on social sustainability principles

4.2 Impact of student-driven case studies and student performance

Figure 4 shows a comparison of the student's performance in student-driven case studies and in-class tests used in assessing the students in the module. The result revealed that students performed very well across all four years in the student-driven case studies when compared to in-class tests. Across the four years, the student average for the use of student-driven case studies was 87, 88, 76 and 78, respectively. Furthermore, the class maximum mark for the use of this approach was 95, 95, 88, and 95 from 2019 to 2022, and these were higher than the class maximum mark for in-class tests aside from 2021, where the in-class test was 93. Again, the class median shows a very good performance of students using the student-driven case studies as the scores were 86, 90, 76 and 83 from 2019 to 2022, and these are higher than the scores for in-class tests. Overall, these results show that students performed better in student-driven case studies as against in-class tests. This better performance can be attributed to the fact that aside from writing a detailed report of their observations of the selected projects, students also gave presentations, which allowed them to further express their views regarding the project they were assessing. Unlike the in-class test, where students have only one attempt to showcase their knowledge and understanding of what has been taught, the student-driven case study approach offers considerable flexibility.

To further understand the impact of the student-driven case study approach on students' understanding and knowledge of the impact of engineering activity on the society, economy, industrial and physical environment, and their ability to address issues by analysis and evaluation, student feedback through one-on-one discussion was conducted. This discussion revealed several interesting outcomes, which are summarised accordingly.

i. Students were able to better understand the principles of sustainability in engineering projects through critical thinking and evaluation.
ii. Students built better interaction with projects within the local community as they were responsible for sourcing out the projects they evaluated.
iii. Students felt a sense of belonging as they interacted with construction professionals handling projects within their community.
iv. Students built better oral and written communication skills as they presented their findings through a class presentation and report.
v. Students improved their collaboration skills through teamwork.
vi. Students improved their understanding of the sustainable development goals (SDGs) and how they apply them to engineering projects.

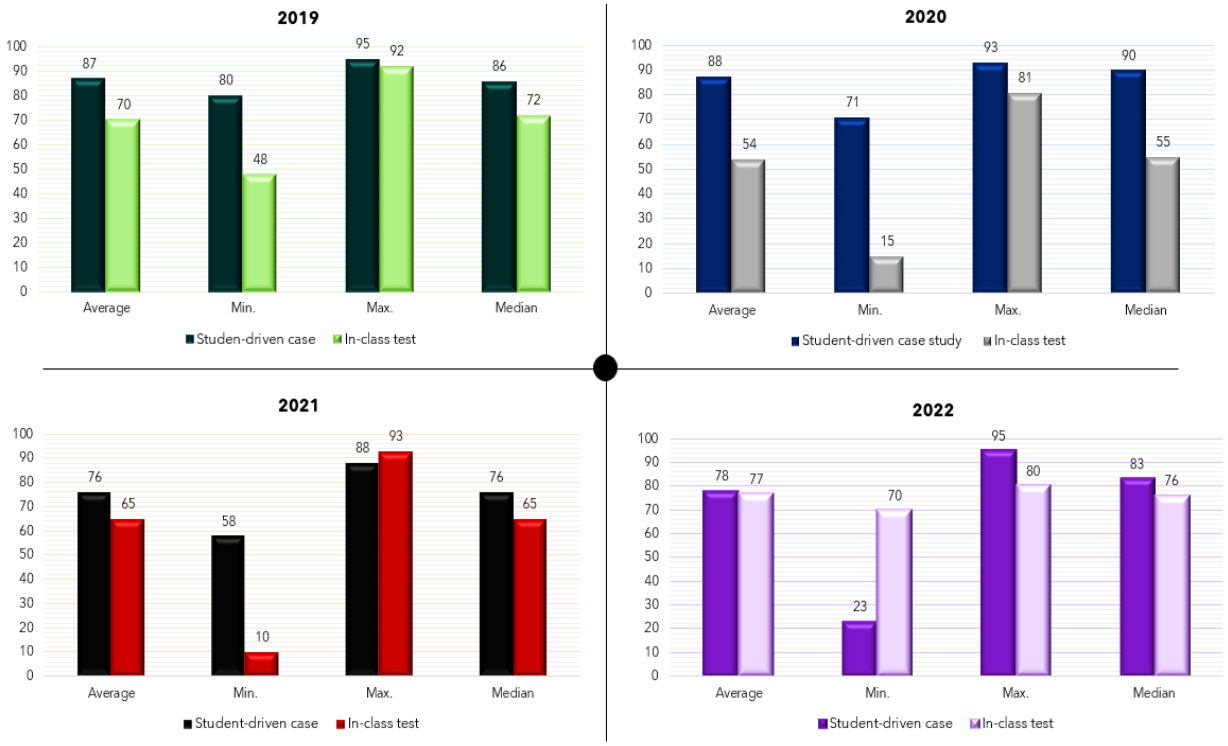

Figure 4. Student performance comparison of student-driven case study vs in-class test

4.3 Discussion and implication of findings

The study found that the use of student-driven case studies in teaching sustainability principles to CET students can prove highly beneficial in their understanding and knowledge of the concept and in attaining GA number 7 as proposed by ECSA. In tandem with existing studies (Myszka, 2002; Seatter and Ceulemans, 2017), the findings of the study show that the students gained in-depth knowledge when they were saddled with the responsibility of finding and exploring cases of their choice. Logical and ingenious solutions towards achieving sustainability were given based on the critical evaluation they conducted on their selected projects. The students were able to observe the attainment of social sustainability in most of the projects assessed and the need for more work to be done in the economic and environmental dimensions of sustainability. This is consistent with past submissions on the sustainability of many projects (Aghimien *et al.*, 2018a). Furthermore, the study found through empirical analysis that the use of student-driven case studies can help boost students' performance at the end of the session, which is used to augment the popular in-class tests or examinations. The implication of this finding is that for tutors seeking to improve their students' performance and achieve the much-needed diversity in their assessment approach, as proposed by Wakefield *et al.* (2023), a blend between student-driven case studies and in-class tests or examinations can prove very useful. As such, a revisit of curriculums, particularly as it relates to sustainability principles in engineering programmes, can be conducted to accommodate innovative student-centred learning, such as student-driven case studies.

It is important to state that one of the major challenges faced in the use of student-driven case study in teaching sustainability principles is the access to ongoing projects. Student in many cases struggled to gain access to construction practitioners due to the complex and bureaucratic issues of many projects. The situation was made worse during the COVID-19 pandemic where restrictions were placed on onsite activities and strict preventive measures were in place when onsite construction started (Aigbavboa *et al.,* 2022). With strict restrictions on the number of people onsite at every given time, it was difficult for students to gain free access to many projects. Moreover, these restrictions and the movement of teaching online meant the presentation of the findings and further discussion had to be done online. This placed some limitations on the participation of students during the presentation.

Albeit these challenges, if this is done correctly, both students and lecturers can benefit in terms of (1) better understanding, critical thinking and evaluation in the module being taught, (2) better interaction with local projects selected by students as case studies, (3) better relationship between students and stakeholders on the selected case study, (4) better oral and written communication skills, (5) better collaboration skills through teamwork, and (6) improved understanding of the stated goals and learning outcomes of the module.

5. Conclusion

The advancement in sustainability and global embrace of sustainability principles means that graduates of AEC programmes must be well equipped from within the institution to face the sustainability demand of projects. This has made teaching sustainability principles a crucial aspect of teaching and learning within the CET programme. Contrary to the popular lecturer-led case study approach that has been used in teaching sustainability in many HEIs, this study explored the use of student-driven case studies and its impact on students' knowledge and understanding of the impact of engineering activity on the society, economy, industrial and physical environment, and address issues by analysis and evaluation as proposed in ECSA's GA number 7. The study concludes that students gained a better understanding of sustainability principles as they applied them to the project they selected and explored. Assessing this knowledge through a written report and in-class presentation, the study noted that students were more critical in their analysis and logical in proposing directions for improving sustainability in the assessed cases. Furthermore, the study found that students developed better relationships with industry stakeholders on the project they assessed and built a sense of belonging through interaction with projects within their locality. The students gained better written and oral communication skills, better collaboration skills through teamwork and an improved understanding of the SDGs applicable to their selected projects. Empirical evidence shows that student-driven case studies can further improve students' performance when used to augment other forms of assessment like in-class tests and examinations. Practically, this study's findings should help lecturers effectively teach sustainability principles through a carefully selected student-centred approach that will ensure active and social learning and knowledge construction. Theoretically, the study offers a foundation for future works on student-driven case studies, particularly in teaching sustainability principles – an aspect that has received minimal attention in the discourse on using case studies in teaching civil engineering modules. A major shortcoming of the study is the lack of emphasis on the challenges of implementing student-driven case studies and the measures needed to combat these challenges. Therefore, future studies are encouraged to explore more practical usage of this learning method and observe the issues faced in the implementation.

References

Aghimien, D. O, Awodele, O. A., Oke, A. E. and Aghimien, E. I. (2018). Stakeholders' perception of sustainability in educational buildings in Nigeria. International Journal of Sustainable Construction Engineering and Technology, 9(1), 1-13

Aghimien, D. O., Adegbemo, T. F., Aghimien, I. E., and Awodele, A. O., (2018). Challenges of sustainable construction: a study of educational buildings in Nigeria. International Journal of Built Environment and Sustainability, 5(1), 33-46. https://doi.org/10.11113/ijbes.v5.n1.244

Aigbavboa, C. O, Aghimien, D. O, Thwala, W.D., and Ngozwana, N. (2022). Unprepared industry meet pandemic: COVID-19 and the South Africa construction industry. Journal of Engineering Design and Technology, 20(1), 183-200. https://doi.org/10.1108/JEDT-02-2021-0079

Atwal, K. (2019). Dialogic teaching: 10 principles of classroom talk. TES magazine, Available at: https://www.tes.com/magazine/teaching-learning/general/what-is-dialogic-teaching-10-principles-classroom-talk [accessed 30-06-2024]

Boehrer, J. and Linsky, M. (1990). Teaching with cases: learning to question. New Directions for Teaching and Learning, 42, 41-57.

Bremner, N. (2021). The multiple meanings of 'student-centred' or 'learner-centred' education, and the case for a more flexible approach to defining it. Comp. Educ. 57(2), 159–186. https://doi.org/10.1080/03050068.2020.1805863

Brundtland Report, (1987). Our Common Future. United Nations Assembly, Report of the World Commission on Environment and Development. Annex to General Assembly Document A/42/427.

Carlson, J.A. and Velenchik, A. (2006). Using the case method in the economics classroom. In Becker, W.E., Becker S.R. and Watts, M.W. (Eds), Teaching Economics: More Alternatives to Chalk and Talk, Edward Elgar, Cheltenham, pp. 59-74.

Chinowsky and Robinson (1997). Enhancing Civil Engineering Education Through Case Studies. Journal of Engineering Education, 45-49

Fitzgerald, N., (1995). Teaching with Cases. ASEE Prism, 4(7), 16-20.

Georgallis, P. and Bruijn, K. (2021). Sustainability teaching using case-based debates. Journal of International Education in Business, 15(1), 147-163. https://doi.org/10.1108/JIEB-03-2021-0039

Martin, D.A., Conlon, E. and Bowe, B. (2021). Using case studies in engineering ethics education: the case for immersive scenarios through stakeholder engagement and real-life data. Australasian Journal of Engineering Education, 26(1), 47-63. https://doi.org/10.1080/22054952.2021.1914297

McLoughlin, C. and Lee, M. J. W. (2008). The three P's of pedagogy for the networked society: Personalization, participation and productivity. International Journal of Teaching and Learning in Higher Education, 20, 10 – 27

M-Gibes (2023). 28 Student-Centered Learning Strategies. https://mgibes.co.uk/student-centered-learning-strategies/ [accessed 30-06-2024]

Myszka, D. (2002). Implementing 'Student-Centered' Case Studies. Proceedings of the 2002 American Society for Engineering Education Annual Conference and Exposition, June 16-19, Montreal, Canada

Nazirah, Z. A., and Ijias, S. (2006). Involvement of Sustainability Issues in Value Management: Requisite Factors. ICCI

Newson, T. A., and Delatte, N. J. (2011). Case methods in civil engineering teaching. Canadian Journal of Civil Engineering, 38(9), 1016-1030.

Russ, A., and Taggart, M. (2018). Learning Through Case Studies. Available at: https://thegeep.org/sites/default/files/files/GEEP.eBOOK_.Learning%20Through%20Case%20Studies.pdf

Schweisfurth, M. (2019). Is student-centred education' best practice'? Education Think Piece Series, UNICEF Eastern and Southern Africa Regional Office, Nairobi. Available at: https://www.unicef.org/esa/sites/unicef.org.esa/files/2019-08/ThinkPiece_9_LearnerCentredEducation.pdf [accessed 30-06-2024]

Seatter, C.A., and Ceulemans, K. (2017). Teaching Sustainability in Higher Education: Pedagogical Styles that Make a Difference. Canadian Journal of Higher Education, 47(2), 47-70. https://doi.org/10.47678/cjhe.v47i2.186284

UNESCO. (2009). UNESCO World Conference on Education for Sustainable Development. Available at: http://unesdoc.unesco.org/images/0018/001887/188799e.pdf

University of Plymouth (2024). What is Education for Sustainable Development? https://www.plymouth.ac.uk/students-and-family/sustainability/sustainability-education/esd

Vanderbilt University (2024). Teaching Sustainability. Available at: https://cft.vanderbilt.edu/guides-sub-pages/teaching-sustainability/ [accessed 30-06-2024]

Vashist, N. (2022). Why is case study learning important in Construction? Available at: https://www.linkedin.com/pulse/why-case-study-learning-important-construction-niyanth-vashist/ [accessed 30-06-2024]

Wakefield, A., Pike, R., and Amici-Dargan, S. (2023). Learner-generated podcasts: an authentic and enjoyable assessment for student working in pairs. Assessment and Evaluation in Higher Education, 48(7), 1025-1037. https://doi.org/10.1080/02602938.2022.2152426

Wood, B. (2005). Sustainable Building Strategy: Assessing Existing Building Stock. The Queensland University of Technology Research Week International Conference, Brisbane, Australia, 4-8 July 2005

Zhou, L., Keivani, R., and Kurul, E., (2013). Sustainability performance measurement framework for PFI projects in the UK. Journal of Financial Management of Property and Construction. 18(3), 232 – 250. https://doi.org/10.1108/JFMPC-08-2012-0032