



Group project design for sustainability: Impact on group dynamics, learning experience and competencies development

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ABSTRACT

Education for Sustainable Development (ESD) seeks to develop competencies such as communication, collaboration, critical thinking and self-awareness to prepare learners to address global challenges, which requires effective teamwork. However, group work in higher education often faces persistent challenges, including unequal participation and communication barriers. This study investigates a scaffolded group assessment implemented in an undergraduate Environmental Economics course, designed to foster collaborative learning among students from diverse backgrounds through setting structured milestones and authentic tasks (a podcast and a policy brief), as a pathway for developing key ESD competencies. We designed a two-stage assessment which was scaffolded and accounted for more than two-thirds of the overall course grade. The design aims to encourage sustained group interaction and promotes the perception that individual success depends on group achievements and teamwork. To evaluate the assessment's effectiveness, we analysed responses from a reflective survey focusing on students' learning, group dynamics, conflict resolution and the benefits of collaborative work. Thematic analysis revealed that the scaffolded design strengthened group cohesion, supported the development of core ESD competencies and enriched students' learning experiences.

Keywords: Education for Sustainable Development, group work, reflective learning, collaborative learning, diversity and inclusion

Introduction

Education for Sustainable Development (ESD) is a transformative pedagogical approach that equips learners with the knowledge, skills, values and attitudes necessary to make informed decisions and take responsible actions addressing global sustainability challenges (UNESCO, 2020). Central to ESD is the development of sustainability competencies: systems thinking, anticipatory thinking, normative reasoning, strategic thinking, collaboration, critical thinking, self-awareness and integrated problem-solving (referred to as KC1–KC8; UNESCO, 2017). Collaborative learning, particularly through group work, provides authentic contexts in which students can practice and develop these competencies, making it directly aligned with the goals of ESD (Zhou et al., 2025).

A large body of literature highlights the benefits of group work in higher education, such as peer collaboration, workload sharing, enhanced productivity, mutual support, conflict resolution, effective communication, teamwork skills and learning from diverse perspectives (Cheng & Selvaretnam, 2022; Fatmi et al., 2013; Jang et al., 2017; Knierim et al., 2015; Koles et al., 2010; Litchfield et al., 2010; Marangell 2018; Michaelsen et al., 2004; Tholen et al., 2016). In the context of ESD, research shows that group engagement enhances students' sense of responsibility and prepares them to navigate complex, real-world problems, fostering values such as equity, democracy and sustainability (Barth et al., 2007; Keeley & Benton-Short, 2020; Mitakidou & Tamoutseli, 2011). Group work also enables the development of a dialogic learning culture where negotiation, shared meaning-making and problem-solving become

opportunities for personal and social transformation—core processes for achieving the competencies and mindset shifts central to ESD (Baena-Morales et al., 2020; Colomer et al., 2021; Lozano et al., 2022; Zhou et al., 2025).

However, group work in higher education presents challenges such as unequal participation, communication barriers and differing work ethics, all of which can hinder group outcomes and negatively impact the student learning experience (Chang & Brickman, 2018; Davies, 2009; De Vita, 2005; Francis et al., 2022; Ippolito, 2007; Ledwith & Seymour, 2001; Meijer et al., 2020; Summers & Volet, 2008; Volet & Ang, 2012; Wilson & Brookes, 2017). Students also often cluster with peers from similar cultural background either when self-selecting team members or by forming sub-groups within their assigned team, limiting their opportunities to develop skills through interaction, collaboration and shared learning with peers with diverse skill sets and from different backgrounds (Arkoudis & Baik, 2014; Glass & Westmont, 2014; Moore & Hampton, 2015; Rienties et al., 2014; Rienties & Nolan, 2014). Such clustering is observed across all ethnic groups and appear to stem from students' desire to be in a homogeneous group, as well as to manage the risk of working with a member who may have limited ability to contribute (Payne & Monk-Turner, 2006).

To address these issues, several strategies have been proposed. These include the use of peer rating systems to assess individual performance (Oakley et al., 2004), allowing students to self-select themselves into groups (Chapman et al., 2006), reducing group sizes (Bertucci et al., 2010; Davies, 2009; Francis et al., 2022; Karau & Williams, 1993; Race, 2025) and designing low-stakes group tasks to minimise the perceived consequences of unequal effort and anxiety (Aggarwal & O'Brien, 2008; Selvaretnam, 2024).

While low-stakes tasks may have advantages, they can also reduce student motivation and engagement (Musekamp & Pearce, 2016). Karau and Williams' (1993) meta-analysis on social loafing, through the Collective Effort Model, suggests that individuals are less likely to exert effort in group tasks when the outcomes are not personally valued. When group work accounts for only a small proportion of a student's final grade, its perceived valence may be low, likely reducing motivation to contribute and increasing the likelihood of unequal effort. In such contexts, students may also feel less accountable and less inclined to monitor or support underperforming peers. Freeman and Greenacre (2010) highlight that for collaboration to be meaningful, students must depend on and feel a sense of obligation to their peers, which is described as "the quintessential quality that defines collaboration and transforms group work into teamwork" (p. 6), and essential for fostering shared responsibility and active engagement. This aligns with cooperative learning theory, which emphasises positive interdependence and individual accountability as essential conditions for shared responsibility and active engagement (Johnson et al., 2007; Johnson & Johnson, 2008).

Furthermore, Freeman and Greenacre (2010) point out the importance of distinguishing between those who make less contribution and struggling group members. Without this distinction, students may respond negatively to both, limiting struggling peers' opportunities to improve. When supported appropriately, however, struggling students can develop and contribute meaningfully, highlighting the importance of a design that allows time and space for the development of group dynamics and instructor's timely intervention. Morgan et al. (1993) suggest that group dynamics improve as team members mature and gain experience, implying that longer, more sustained engagement in group tasks can enhance collaboration. There is research that argues that long-term, scaffolded group work supports deeper engagement and learning (Cheng & Selvaretnam, 2022; Cruickshank et al., 2012; Davies, 2009). This type of sustained collaboration also promotes a shared sense of purpose, which is fundamental to achieving the mindset shifts and competencies central to ESD.

Drawing on these insights, this study implements a high-stakes, long-duration, scaffolded group project within an undergraduate Environmental Economics course, designed to support the development of key ESD competencies. The project included structured milestones such as peer and self-evaluations and culminated in two authentic summative outputs: a podcast and a policy brief. Spanning the entire course and supported by ongoing in-class activities, the design aimed to foster sustained collaboration and

strengthen group cohesion. With 80% of the final grade allocated to the group assessment, the project intentionally linked individual success to collective achievement. This study examines how such an assessment design may address common challenges in group work while supporting the development of competencies central to sustainability education. Although situated within Environmental Economics, the model offers potential applicability to other disciplinary contexts where similar competencies are valued.

Group assessment design

Course Context

Two group assessments were introduced in the undergraduate optional course, Environmental Economics. The teaching semester ran from weeks 1 to 11. The class was diverse with students from various countries, bringing valuable lived experience, skills, knowledge and perspectives. Of the 33 groups formed, 31 were multinational and all included mixed genders. The diversity within heterogeneous teams fosters awareness and deeper understanding of global sustainability challenges while building essential social and cross-cultural communication skills, cultivating responsibility, and preparing students for sustainable leadership (Zhou et al., 2025).

Collaborative learning design

To support these assessments and promote collaborative learning, the class regularly incorporated various group-based tasks. These included formative assessment exercises like rubric discussions, exemplar reviews, and training sessions for podcasts and policy briefs; and 'learn together' sessions that featured structured questions related to the week's topics. These strategies are known to enhance student engagement, clarify expectations and strengthen group work skills through structured peer interactions (Laal & Ghodsi, 2012). In assessment design, insights from a scoping literature review by Zhou et al. (2025) about reflective learning and collaborative learning about sustainability were influential. They state that "to genuinely contribute to sustainable development, students must not only possess the necessary knowledge, but also embody values and global awareness, thus enabling them to reflect on and evaluate their practical experiences within complex contexts" (p. 1).

Group allocation and design principles

In the second week of teaching, after the end of the add/drop period when students finalise their course enrolment, students were randomly assigned to groups of four and met their group members during class. This random allocation was intended to address the earlier concerns about self-selection by increasing the likelihood of forming diverse groups, thereby fostering a learning environment conducive to transformative collaboration (Wals, 2011), while also helping students appreciate the importance of embracing differences among group members in an informed way (Freeman & Greenacre, 2010).

Group size was chosen as optimal for encouraging idea generation, discussion, conflict resolution and effective action, while minimising the risk of free-riding or member obscurity (Bertucci et al., 2010; Davies, 2009; Francis et al., 2022; Race, 2025). The group tasks were designed with assigned individual roles and responsibilities to foster positive interdependence, supporting fair participation and shared accountability (Boud et al., 2014; Freeman & Greenacre, 2010; Oakley et al., 2004) and reflected the five principles proposed by Meyers and Nulty (2009, p. 4): authenticity, constructive sequencing, cognitive challenge, alignment with outcomes, and motivational engagement. This assessment aimed to promote students' awareness of their individual contributions and behavioural dynamics within teams.

Assessment tasks and timelines

The first group assessment task, worth 30% of the total grade, was to create an interview podcast to identify an urgent environmental problem in a particular country and convince a hypothetical ‘Minister-in-charge’ of the urgency to act. The second task, worth 50% of the total grade, required students to write a policy brief to address the problem. Both assignment tasks were designed to be divisible among group members, allowing for individual accountability. Assessment details were available from week 1, with group allocations finalised by week 2. The podcast deadline was set for week 6, while the policy brief was due in week 10. Finally, in week 11, students completed an individual structured reflection on their experiences and insights from the course; a key component of collaborative learning that encourages critical evaluation of one’s behaviours and contributions (Zhou et al., 2025).

Table 1 Timeline of group activities

Week(s)	Activity
1	Course kick-off & getting-to-know-you
2	Group formation & meet your peers in class
3	Podcast formative activity & training
4	Learn together activities
5	Policy brief formative activity & training
6	Podcast submission
6-10	Ongoing learn together activities
10	Policy brief submission
11	Individual reflection submission & course conclusion

Peer evaluation and individual accountability

To address the common challenge of free riding, the instructor implemented a peer evaluation system in which students assessed each group member’s contribution, including their own, for both the podcast and the policy brief. These evaluations aimed to help students recognise how individual attitudes and efforts directly affect overall team outcomes (Kazlauskienė et al., 2021). They also enabled the instructor to identify instances of non-participation and assign individual grades accordingly, after follow-up discussions with the groups. This approach reflects Freeman and Greenacre’s (2010) emphasis on the importance of distinguishing between those who make less contribution and struggling group members, who face genuine challenges. Without allowing time for both students and instructors to make this distinction, there is a risk that all low participation is viewed negatively, which can discourage those students from trying to improve. Implementing a two-stage evaluation process after each project submission can help overcome this issue.

Summary and distinctive features of the assessment design

Below, we highlight and summarise the key distinctive features of the assessment design, which are relatively rare or rarely combined in existing group work literature:

1. Long-term interaction: Students collaborated with the same group members from Week 2 to Week 10. Although sustained team interaction is a feature of established collaborative approaches such as team-based learning and project-based learning, in this design it was deliberately combined with high assessment weighting and scaffolded tasks to reinforce accountability and deepen collaboration over time.

2. Two-stage scaffolding tasks: The second assessment task (policy brief) was built directly on the first (podcast), promoting deeper, higher-level learning and integration of knowledge.
3. High weighting: The group assessment accounted for 80% of the final grade, substantially higher than the typical 30–40% weighting in other courses within the programme, to encourage commitment and responsibility.
4. Real-world task relevance: Each group selected and addressed authentic sustainability challenges from around the world, increasing the authenticity and engagement of the learning process, increasing task valence. Issues selected included desertification in China, air pollution in Nigeria, water pollution in India, deforestation in the Brazilian Amazon, drought in Madagascar, water scarcity in Egypt, floods in the Philippines, glacial melting in Kyrgyzstan, and rising sea levels in the Maldives.
5. Collaborative classroom learning: Regular in-class group activities supported ongoing group work and fostered a collaborative learning environment and mindset. These sessions also provided dedicated time for coordination and progress review.
6. Two-stage peer evaluation: A structured peer evaluation process was used for both tasks to identify and address disparities in group member contributions.

Methodology

In Week 11, students submitted an individual structured reflection on their group work experience, accounting for 20% of the final grade. All 86 students completed the reflection. This study analyses one section of these responses, while other dimensions are explored in companion papers (Kushwah et al., 2024; Navrouzoglou et al., 2024). As the analysis draws on students' reflective accounts, the findings represent perceived rather than directly measured competency development. Ethics approval was granted by the ethics committee of the College of Social Science where the research took place (No. 400170120).

Students' responses were analysed using thematic analysis, with emergent themes identified and organised following established procedures (Braun & Clarke, 2006; Maguire & Delahaut, 2017).

The data with the responses to the open-ended questions by each participant was organised in an Excel spreadsheet. All participants who took part in this study provided informed consent, thus their data were included in the final analysis. We conducted an inductive thematic analysis, following Braun and Clarke's (2006) approach. Initial codes were generated from the data rather than pre-determined. First, one author conducted the initial reading of the dataset, and generated preliminary codes, capturing relevant phrases under each code. The research team then reviewed, refined, and merged codes through discussion, identifying emerging patterns and developing candidate themes. All authors independently revisited the dataset to ensure that the coding captured the breadth of responses and to identify any additional codes. Through iterative discussion, they agreed on the final themes and sub-themes, and recorded the frequency of the comments within themes. It is important to note that the analysis moved beyond counting, to interpret the underlying meanings and patterns in participants' reflections.

The dataset included 86 participants' reflections. To ensure confidentiality, each participant was assigned a unique identification number (g1–g86) during data organisation, and these codes were used throughout the analysis and reporting.

The four guided, open-ended questions used for this study were: How did the two group assessments help you to:

1. learn more,
2. improve the dynamics of working in team,
3. resolve issues with team members due to long-term interaction, and

4. overcome challenges of working individually?

Results

Figure 1 presents a visual summary of students’ responses to the four core reflective questions regarding the group work experience. The total number of coded comments for each question appears at the centre of each segment, with subthemes and their frequencies shown as outer bands. The results of the thematic analysis, along with examples of students’ quotes, are presented in Tables 2-5 in the Appendix.

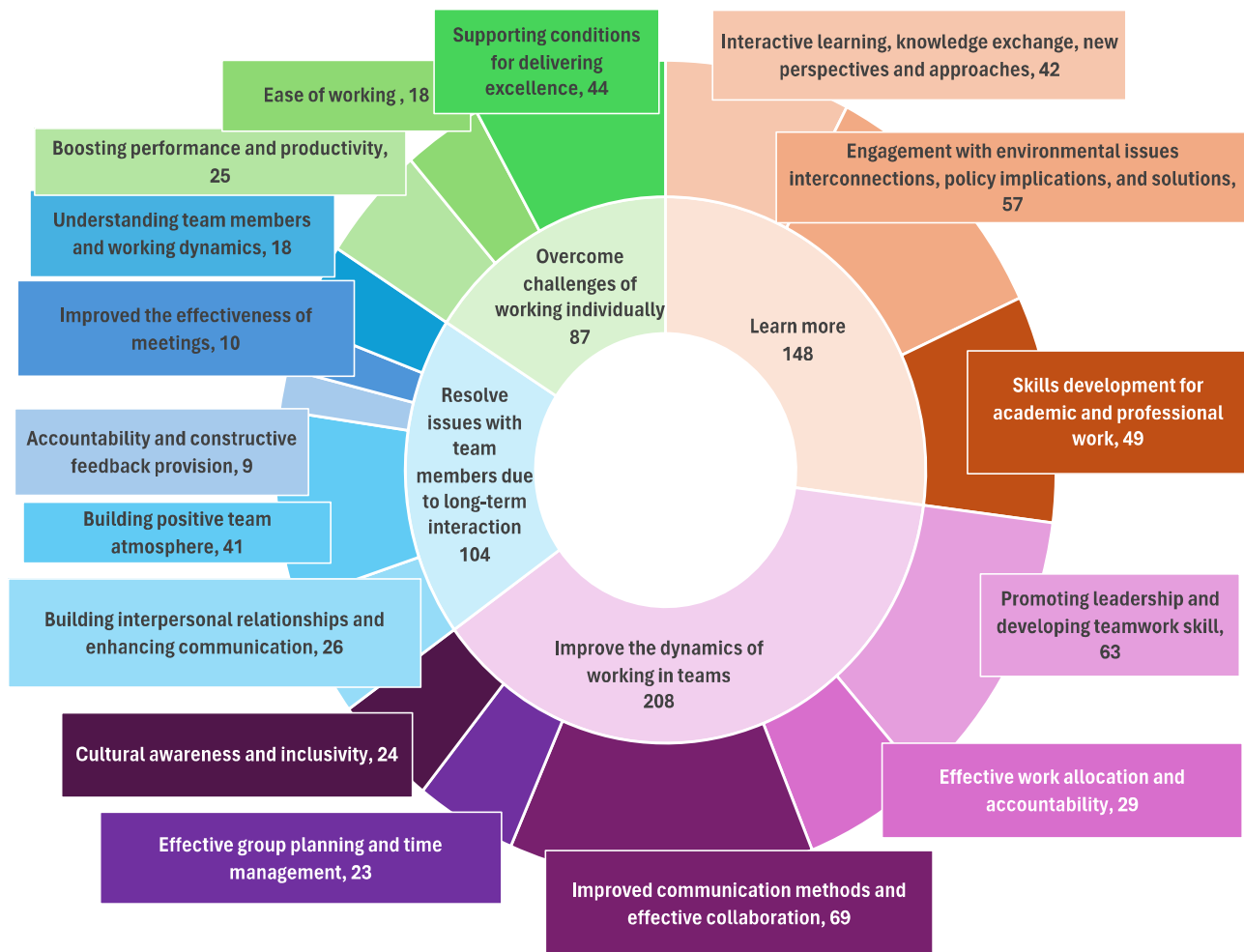


Figure 1 Overview of thematic analysis: Themes and sub-themes.

The results presented in Figure 1 are discussed below.

Learning more (n=148)

This theme captures how group work deepened students’ learning. A key driver of these gains was engagement with real-world issues (n=57), where authentic, self-selected sustainability problems increased motivation and helped contextualise complex policy implications. As one student reflected:

I was able to learn and find out about different environmental issues, some of which I had never heard of before due to the diverse thinking and suggestions. (g37)

Students also highlighted academic and professional skill development (n=49), including research, argumentation and digital production skills. One student noted:

The group work allowed me to try my hand at producing my own podcast for the first time and gave me the opportunity to learn skills such as recording and post-editing. (g62)

Finally, interactive learning and exposure to new perspectives (n=42) enabled students to deepen their conceptual understanding in ways individual work often does not. This is reflected in the following comment:

By dividing research between team members, it allowed me access to more information on our chosen topic than if I had been alone [...] which led me to a more well-rounded view. (g71)

Improving team dynamics (n=208)

Students identified a range of teamwork skills that contributed to stronger group cohesion. The most frequently mentioned theme was enhanced communication and collaboration (n=69), reflecting how structured interaction protocols and regular peer feedback supported more effective coordination. For example, one student shared:

Setting group deadlines helped improve our teamwork and taking minutes at our meetings helped everyone understand their role. (g59)

Themes of leadership and shared accountability (n=63), as well as clear work allocation (n=29), highlighted the importance of defined roles and mutual responsibility. This was exemplified in comments such as:

We have selected the team leader before work begins, making sure we each have our roles and responsibilities. (g8)

The two group assignments gave us the freedom to discuss and divide the work on our own, with everyone trying to contribute to the group in order to get high marks. (g62)

Smaller but meaningful subthemes also emerged. Students described how group work contributed to building interpersonal relationships (n=26) and fostering cultural awareness (n=24), illustrating the social value of extended collaboration in supporting both the academic and social integration of international students. This approach also enabled students to identify variable efforts, allowing them to offer appropriate support to group members who were genuinely struggling:

The random allocation of groups allowed us to experience working with different cultures and backgrounds. Not everyone spoke English as their first language, so the podcast helped these individuals boost their confidence in presenting, with the support of encouraging teammates. (g2)

Resolving issues through long-term interaction (n=104)

This theme highlights the benefits of sustained group engagement across multiple assessments. The most frequently cited benefit was building a positive team atmosphere (n=41), suggesting that extended collaboration helped pre-empt interpersonal tensions and foster mutual respect. As one student reflected:

Because we knew we would be spending more time together, we put more effort into making more personal connections with each other. (g85)

Students also reported a better understanding of team dynamics (n=18) and greater ease of collaboration (n=18), indicating that familiarity and continuity led to smoother interactions and more empathetic working relationships. One student shared:

The long-term nature of the assignments allowed us to build relationships and become familiar with one another's working preferences, enabling us to cooperate more effectively and contribute as a team. (g39)

The theme also captured improved performance and productivity (n=25), as well as the effective use of constructive feedback (n=9), both of which were linked to clearer expectations and iterative improvements. For example, one student explained:

We were able to figure out what worked and what didn't after the podcast and improve the structure of our meetings/divisions of work for the brief [...] This was a much more efficient way to work. (g10)

Overcoming individual challenges (n=87)

Students reported that group processes alleviated personal task-related difficulties when working on individual tasks alone. The most frequently mentioned benefit was the creation of supportive conditions for excellence (n=44), emphasising the important role of teamwork in motivating students to perform at their best. Additional comments on enhanced performance (n=25) and increased ease of working (n=18) further illustrate how well-structured group processes make individual challenges more manageable. For example, students shared:

I believe working as a group made us more productive compared to working individually, as we were pushing each other to meet deadlines. (g2)

Whenever I needed clarification on something, I would seek help from course mates, and that was always sufficient given the collaborative nature of the module. This meant I avoided significant challenges. (g19)

Although relatively few students explicitly referred to the 80% weighting of the assessment, one participant highlighted its perceived influence on group commitment:

The 80% allocation to group work meant that teammates were more involved and willing to get to know each other than in lower-weighted assessments. I have struggled to build a similar relationship with peers in shorter coursework. Informality helped to create honesty about our strengths and weaknesses for work distribution. (g9)

This comment suggests that the high weighting may have strengthened relational investment and accountability within groups.

While many students emphasised the supportive nature of collaboration, peer evaluation mechanisms also revealed instances where individual engagement remained uneven. During the podcast project, seven cases of low engagement were identified through peer evaluations, decreasing to three during the subsequent policy brief. In four groups, lower-engaged members demonstrated improvement over time, indicating that sustained collaboration combined with structured feedback enabled corrective adjustment. However, in three groups, engagement issues persisted despite multiple instructor interventions. In these cases, individual grades were adjusted following peer evaluations and follow-up discussions, illustrating how structured accountability mechanisms complemented supportive group processes in addressing individual challenges and behaviours.

Discussion and conclusion

This study explored the impact of an intentionally designed and scaffolded group assessment implemented in an undergraduate Environmental Economics course to develop key ESD competencies. The assessment combined structured milestones with two authentic tasks to promote effective, sustained collaboration among diverse student groups. Drawing on data from students' summative individual reflections, the study

examined how students experienced and made sense of their group work. The findings indicate that a carefully structured group assessment can mitigate common challenges such as unequal participation and communication barriers, while simultaneously fostering the development of key ESD competencies.

The extended nine-week group interaction fostered a strong sense of shared purpose, enhancing team cohesion, role clarity, and sustained engagement. Sequencing two interrelated tasks for the same group encouraged deeper collaboration, and more effective problem-solving over time. Clearly defined roles, peer and self-evaluation mechanisms, and ongoing scaffolding supported students in overcoming common group work challenges, including communication barriers and interpersonal tensions. Additionally, the diverse composition of groups broadened students’ understanding of real-world sustainability issues and promoted their ability to engage with varied perspectives and backgrounds.

Figure 2 presents a conceptual model illustrating how the integrated group assessment design supported the development of ESD competencies. The tree metaphor depicts the assessment design as the trunk, scaffolding, authentic tasks, significant assessment weighting, two-stage peer and self-evaluation, and a collaborative classroom environment. Emerging from the trunk are eight leaves, representing the core ESD competencies developed through the group project experience. The colour differentiation highlights the key assessment dimensions underpinning each competency, including enhanced learning, strengthened teamwork, sustained interaction, and the overcoming of individual and group challenges. Collectively, these elements demonstrate how the integrated design fostered competency development while addressing common challenges associated with collaborative work.

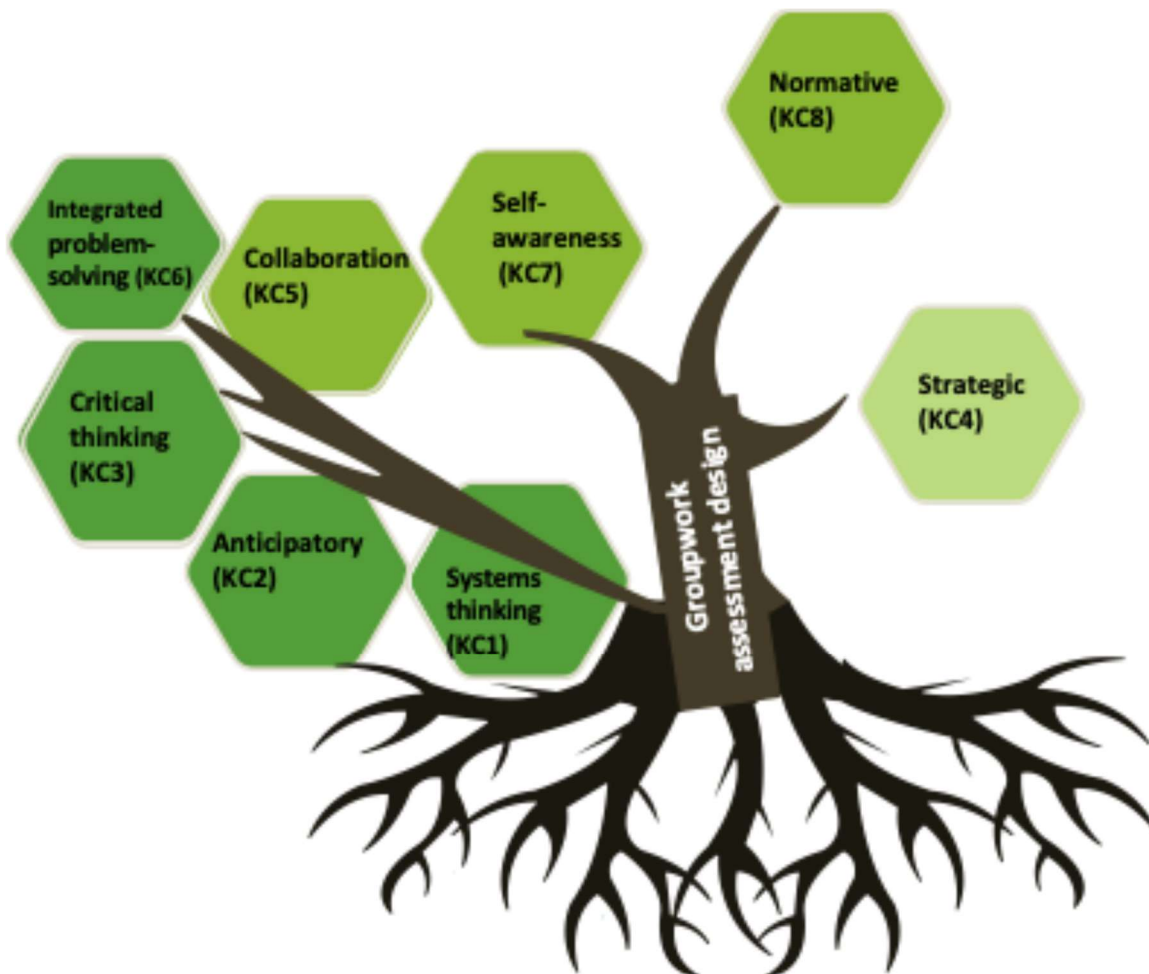


Figure 2 “Tree” of groupwork assessment design and key ESD competencies

Systems thinking (KC1), anticipatory thinking (KC2), critical thinking (KC3) and integrated problem solving (KC6) were embedded through design principles emphasising authenticity, constructive sequencing, cognitive challenge, alignment with learning outcomes and motivational engagement (Meyers & Nulty, 2009), and diverse groups. This approach broadened and deepened students' comprehension of complex sustainability issues and potential solution pathways.

Collaboration (KC5), normative competence (KC8), and self-awareness (KC7) were cultivated through sustained group interaction, supported by diverse group composition (Wals, 2011), manageable group size (Bertucci et al., 2010; Davies, 2009; Francis et al., 2022; Karau & Williams, 1993), and tasks designed to promote positive interdependence and clear allocation (Boud et al., 2014; Feigh & Pritchett, 2014; Freeman & Greenacre, 2010; Oakley et al., 2004; Wageman, 1995). These factors enhanced interpersonal relationships, strengthened team cohesion, and encouraged shared responsibility, enabling students to distinguish between those who make less contribution and struggling group members (Freeman & Greenacre, 2010). Furthermore, peer and self-evaluation mechanisms contributed to clearer expectations and heightened self-awareness by clarifying the impact of individual attitudes and efforts on overall team outcomes (Kazlauskienė et al., 2021).

Strategic decision-making (KC4) emerged as students collectively negotiated and selected topics and devised solutions. The substantial weighting of this group assessment, accounting for 80% of the final grade, likely reinforced the importance of collaborative engagement by leveraging the diverse perspectives, knowledge, experiences and skills of all members. Roles were adjusted as students developed a deeper understanding of one another, thereby enhancing teamwork. This finding deviates from the practice of reducing the grade weight of group work to address fairness concerns related to underperforming members (Selvaretnam, 2024), suggesting that high weighting, when combined with structured accountability and supported mechanisms, may instead reinforce engagement.

A seemingly questionable aspect of our design is the high weight of 80% for this group project, but in fact this is a useful novelty for this design. In order to get round the challenge of students' dislike/suspicion of group work and to reduce the risk of the grade being affected by under-performing group members, there is a tendency to reduce the weight of the group work element and increase the individual element (Selvaretnam, 2024). Group tasks that are over a long time, authentic and project based would be justified to be awarded a high grade. The high weighting likely increased perceived importance and reinforced accountability, aligning with established motivation and cooperative learning research discussed earlier.

Overall, this study contributes to the literature by providing practical guidance on how an intentional and scaffolded group assessment design can enhance collaborative learning and foster the development of key ESD competencies, while effectively leveraging the diversity within higher education settings. While situated within a specific course context, the design principles identified here may offer transferable insights for other disciplines where collaborative competencies are central to learning. The findings highlight the value of group work as a powerful pedagogical tool in ESD, preparing students to engage meaningfully, confidently and collaboratively with real-world sustainability challenges.

Biographies

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Appendix A

Table A-1 Thematic analysis of responses for question 1 'Learn more'

Themes	No. of comments	Example quotes
Interactive learning, knowledge exchange, new perspectives and approaches		
Enhancing understanding through peer interactions	13	<p>"The group assessments have greatly assisted my understanding of the course content." (g70)</p> <p>"We helped each other to understand course material ...I found great value in explaining the material to others since it forced me to truly understand the topic enough to teach it and be able to communicate my understanding clearly." (g52)</p>
Cultivating diverse perspectives and approaches	10	<p>"I learned from my teammates not to rush into assignments at the beginning of the assignment but to take more time to analyse the questions and marking criteria. This gives us a better idea of what we are trying to do, and which parts need to be analysed in depth." (g40)</p> <p>"I have also been exposed to the unique and excellent way of thinking of my group members, and it has given me new reflections." (g43)</p> <p>"Furthermore, the podcast allowed me to experience different perspectives when looking at issues from different roles and exercised dialectical thinking." (g51)</p>
Generating new ideas through discussions	13	<p>"Groupwork allowed us to 'bounce' ideas off of each other and think differently about issues. For example, one group member was very interested to also look at the socioeconomic impact of closing down pollutant textile-factories in Bangladesh, which was an area that I hadn't thought of considering." (g35)</p> <p>"Providing discussions and explanations as to what is causing the problems and what can be done to reduce the pollution." (g44)</p> <p>"By dividing research between team members, it allowed me access to more information on our chosen topic than if I had been alone. In particular the podcast was good because we were more inclined to question each other's findings and discuss opinions which lead me to a more well-rounded view." (g71)</p>
Expanding/Growing knowledge through peer interactions	9	<p>"We thereby approached the subject from several angles through which we got a wider knowledge of the topic. Moreover, getting more perspectives on the area we were studying benefitted my learning as everyone had something new to contribute with." (g61)</p> <p>"Both assignments helped me learn more; this was mainly from our team discussions." (g82)</p>
Engagement with environmental issues: Interconnections, Policy Implications, and Solutions		
Enhancing the understanding of environmental issues and challenges	15	<p>"I acquired a knowledge of the severity of environmental issues through investigating the threat air pollution poses to human life, damages the ecological environment." (g30)</p> <p>"The two group assignments I completed in environmental economics helped me attain a greater understanding of India's water pollution crisis." (g44)</p> <p>"For example, after researching around our chosen topic of overfishing in UK waters, I realised that there were examples of negative production</p>

		externalities being produced by fishing companies and this was the reason for fish produce being under-priced." (g22)
Applying theoretical knowledge learned in class to real-world situations	11	"Helped me to better understand the environmental landscape within economics." (g2) "It really helped me to understand how the concepts and theory taught in class worked in real life in a particular country, and it also helped me to understand how I am able to help to create a sustainable economy as well." (g31)
Learning about existing environmental policies, government interventions and their effects	6	"I learnt about the impact of environmental policies and government interventions on welfare and possible barriers to these changes." (g2) "The podcast helped me to learn more as I had to research a specific environmental issue within a country, this allowed me to gain a greater understanding of how some policies currently are not sufficient and how this is impacting the local environment." (g55) "I gained a greater insight into the impact of increased electric vehicle us" (g59)
Designing environmental policy and solutions	8	"I have been able to research about the excessive use of coal and cars and I have been able to develop a clear idea about possible policies to solve it, such as investing in public transportation infrastructure or renewable energy." (g5) "We also recommend to the government to transform Scotland's new energy infrastructure through podcasts to help transition from fossil energy to new energy industries." (g72) "I learned about shorter-term grid-scale battery technology and longer-term storage like pumped hydro storage." (g60)
Discovering new environmental issues	17	"I was able to learn and find out about different environmental issues, some of which I had never heard of before due to the diverse thinking and suggestions." (g37) "Our research topic is the melting of the Greenland ice sheet. This is an environmental issue that I have never paid attention to before. It is through these two assessments that I have delved into this issue and realised the seriousness of the current global environmental problems." (g8)
Skills development for academic and professional work		
Digital skills through podcast production	17	"The group work allowed me to try my hand at producing my own podcast for the first time and gave me the opportunity to learn skills such as recording and post-editing." (g62) "Podcast is a new form of coursework for me, from topic selection, data collection, to audio completion." (g81)
Effective policy brief writing	21	"With the policy brief, I learnt how to better structure a policy brief and do so in a very concise manner, something I have transferred to other courses already." (g55) "Similarly, the policy brief helped me enhance my research skills and to understand how to translate my research findings to a non-specialist audience." (g77) "In the more creative policy brief, we focused on problem-solving. As I had never written a policy brief before, I thought that it was very interesting to adapt the layout and the writing style, which is significantly different from the classic academic essay, yet at least as important for later life." (g69)

Strengthening research skills	11	<p>“It taught me the importance of using empirical evidence/studies to help strengthen my policy recommendation.” (g59)</p> <p>“It improved my independent research and sparked interest beyond the course theory.” (g79)</p> <p>“For example, when researching the negative externalities of Japan's imported coal, I took more care to ensure I only included data found from more reputable sources as I knew it would potentially be used multiple times.” (g85)</p>
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Table A-2 Thematic analysis of responses for question 2 ‘Improve the dynamics of working in teams’

Themes	No. of comments	Example quotes
Promoting leadership and developing teamwork skills		
Recognising the need for leadership	11	<p>“I have also learned how to solve possible conflicts.” (g5)</p> <p>“We have selected the team leader before work begins, making sure we each have our roles and responsibilities.” (g8)</p>
Motivating, challenging and encouraging each other	11	<p>“In podcast, because my language level was limited, the team members gave me great help and patience to record,” (g29)</p> <p>“Whilst also still ensuring we all challenged ourselves”. (g45)</p> <p>“If anyone was stuck, we could work together to help them.” (g82)</p>
Team play to accomplish shared goals	41	<p>“In this way, the second activity has also given us a good opportunity to enhance dynamics of working as a team.” (g3)</p> <p>“The group projects helped improve dynamics when working in a team as the briefs were equally split, which meant that each person had a significant role in the end result being achieved. (g18)</p>
Effective work allocation and accountability		
Recognising and leveraging individual strengths	26	<p>“Recognise everyone’s strength and weaknesses during the first assessment and were thereby able to overcome challenges. It also allowed us to put each strength to the best use when allocating tasks.” (g61)</p> <p>“The two group assignments gave us the freedom to discuss and divide the work on our own, with everyone trying to contribute to the group in order to get high marks.” (g62)</p> <p>“These assessments also improved my teamwork dynamics by teaching me how to delegate and share work.” (g79)</p>
Cultivating a strong sense of responsibility	3	<p>“We were generally more active in the group work than we would have been if we had done our own individual work.” (g62)</p> <p>“I believe that I have been very conscientious and motivated to do my part in the group and to assist my fellow group members in any way I can.” (g70)</p>
Improved communication methods and effective collaboration		
Encouraging open discussions and active participation	28	<p>“There will be an exchange of ideas and a clash of ideas. The Podcast assessment required us to choose the country and the environment, I felt important when I shared my ideas and get agreement..... When we have different opinions and cannot choose one of them, we will explain the reasons for the opinion and search the literature together to prove the</p>

		<p>possibility of it. The exchange and collision of ideas will provide plenty of topics for discussion at our group meetings". (g14)</p> <p>"Groupwork helped us to work on negotiation skills, as a significant amount of EI are 'wicked problems', and so we had to listen and adapt our approach to the viewpoints of all members." (g35)</p>
Cultivating a culture of mutual respect to enable clear communication	17	<p>"In a group meeting, although I messily expressed my words, the group members would still stop and listen to my opinions carefully. The group member who understood would also help me to relay them to the group members who did not understand." (g11)</p> <p>"Sometimes it is difficult to unify ideas when making decisions, but we respect each other." (g29)</p>
Recognising the importance of getting to know each other	10	<p>"We first explained where we were coming from through Moodle, briefly introduced ourselves, said we were looking forward to working together." (g4)</p> <p>"By communicating with members and being reflective, we were able to talk openly about each other's strengths and weaknesses to ensure the best outcome." (g19)</p>
Providing feedback to each other	14	<p>"When recording the podcast, I was worried that my speaking would make it unattractive, so I kept practising after completing the script and with corrections from my native English speaking group members, we got a podcast that sounded amazing, and I gained different skills as well as a sense of achievement from both group collaborations." (g28)</p> <p>"The constant exchange of constructive criticism helped us to make good progress as a group." (g69)</p>
Effective group planning and time management		
Meeting and group work planning	15	<p>"Set up a WhatsApp group to get to know each other and prepare for future discussions. In addition, we created a Google Share document to update each person's progress in real time and to add individual comments." (g4)</p> <p>"We booked rooms in advance on campus to accommodate everybody's tight schedules and guarantee attendance." (g36)</p> <p>"In addition to regular face-to-face communication, we also timely shared the progress and new ideas through WhatsApp." (g74)</p>
Effective time management	8	<p>"Setting group deadlines helped improve our teamwork and taking minutes at our meetings helped everyone understand their role." (g59)</p> <p>"Teamwork also makes prompts me to make a timeline for the completion of the task". (g30)</p>
Cultural awareness and inclusivity		
Multicultural skills development for international students	11	<p>"The fact that four people from three completely different areas of the world managed to produce two decent pieces of work, through communication and groupwork gives me confidence to embark on new projects with people outside my network." (g6)</p> <p>"Meanwhile, through these two group assessments, I also improved my skills and experiences in working with peers with different culture and education backgrounds." (g13)</p> <p>"In these jobs, as a group of international students, there will be certain resistance in terms of communication and culture. I also improved my ability to communicate more effectively." (g72)</p>

Multicultural skills development for Western students	13	<p>“The random allocation of groups allowed us to experience working with different cultures and backgrounds. Not everyone spoke English as their first language, so the podcast helped these individuals boost their confidence in presenting, with the support of encouraging teammates.” (g2)</p> <p>“Gained much from working with a new group of individuals. English was not the first language of some of our group members which made parts of the assignment challenging, particularly recording the podcast. Economics is a field which is truly international, and I am sure I will encounter regular situations where I am faced with working alongside colleagues who I do not share a common language with.” (g25)</p> <p>“This group work really helped me to work with people from other countries, specifically from China.” (g31)</p>
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Table A-3 Thematic analysis of responses for question 3 ‘Resolve issues with team members due to long-term interaction’

Themes	No. of comments	Example quotes
Building interpersonal relationships and enhancing communication		
Investing in (building) relationship	4	<p>“As this was an ongoing assignment, by the end of the semester we became friends, and our team dynamic had dramatically changed.” (g50)</p> <p>“In the process of group cooperation, I found that everyone will feel tired. Therefore, after each meeting, I will invite everyone to do other activities together to improve fatigue. For example, during the break, we will watch the competitions together.” (g83)</p> <p>“Because we knew we would be spending more time together meaning we put more effort into making more personal connections with each other.” (g85)</p>
Improved communication	8	<p>“For the policy brief assignment, there have been a number of disagreements within our group. For example, I completely disagreed with the initial version of the structure developed by our group. I expressed my disagreement but was rejected by them, but I did not give up, gathered information and patiently explained my views to them, and eventually they accepted my views and decided to use the structure I had developed. I was really happy when I got the approval of all the group members!” (g38)</p> <p>“This also made me realise the value of communication when working in a team, which can also improve the dynamics of the whole team.” (g43)</p> <p>“The main issues that arose from this group podcast were. I should have spent more time at the meeting to understand my ideas about the problem in advance, rather than just finding the article and providing it to the group members. I then realised that I should have explained to the group why I was using this and provided literature to support my ideas. For example, when I chose “Environmental issues and countries in need of urgent solutions”, I brought up the issue of air pollution in India and gave the relevant literature to convince my group members.” (g67)</p> <p>“Let me know that the best way to resolve differences is to make a suitable point of view and provide enough evidence to support this point of view.” (g72)</p>

Efficient communication to find solutions	5	<p>“Using Teams to create shared documents in file processing to ensure that each member can understand the progress of the team's work and make modifications and additions at any time.” (g51)</p> <p>“Any issues that occurred were solved very quickly. Because the group was consistent throughout the whole semester, it meant that we had a reserved time every week that allowed for meeting and resolving issues. We remained active on the group chat throughout both projects e.g. member's not having access to certain shared documents was resolved immediately via the group chat.” (g17)</p>
Increased willingness to accommodate	3	<p>“Also, each of us, at different times, could not attend a group meeting due to ill health or other commitments. However, as we were in the group for almost two months, we always found time to reschedule.” (g20)</p> <p>“This meant that when a group member missed two meetings due to illness, we weren't angry as we knew his style and trusted he'd complete his sections. In the end, he completed his sections and offered important insight into the policy brief that we'd missed.” (g32)</p>
Adaptability and flexibility to group working	3	<p>“One of the aspects that I liked the most is that the group was the same for both assignments. I have never had the opportunity to work in a team for several months and that has improved my adaptability a lot.” (g5)</p> <p>“As we were given the same group for both assignments, we were able to adapt to each member's style of learning and communication.” (g41)</p>
Ease in seeking help and support	7	<p>“We could understand each other's strengths and use these to our advantage. For example, during the second assignment one group member was falling behind, but as soon as we spoke to him, he explained his reason for being absent and began to put in more work.” (g2)</p> <p>“The group were comfortable with each other to point out the fact they may not get all bits covered which allowed others to jump in and help or for them to communicate to the group their part will take a bit longer.” (g18)</p> <p>“Rely on each other for help if we were struggling on our assigned section.” (g22)</p>
Building positive team atmosphere		
Supportive environment, increased familiarity, and reduced conflict	6	<p>“Familiarity among group members promotes the atmosphere and efficiency of work.” (g23)</p> <p>“Allowed me to develop a good rapport with each team member which helped to establish a more informal environment where we could each be more productive.” (g24)</p> <p>“Due to the long-term nature of the group work it made me feel more comfortable with my group members as I believe I worked up a good rapport with them in the first project. This was very beneficial when we encountered challenges on issues such as choosing the correct policy to be used for our policy brief.” (g55)</p> <p>“As you get to know your team members better over two assessments I feel as though you aren't afraid to give constructive criticism which can be crucial”. (g78)</p>
Ease in communication of concerns	3	<p>“I was more comfortable expressing issues and problems with the group which we could then resolve together” (g18)</p>

Sharing of ideas confidently	2	"We benefitted highly from the long-term interaction, as we throughout the process became more comfortable sharing ideas." (g15)
Respectful open discussions	23	"In the last meeting we did not agree on the design of the policy brief but as we had been working together for a while, we knew each other better and we were able to find a good solution for everyone. If we had not been together for several months, the solution to the conflict would have been more difficult or even would not have been possible." (g5) "For the members of the group that worked together we were able to resolve both issues related to the content of our assignments, for example, disagreements about what policy options should be chosen and issues regarding the meeting times through compromising with each other, giving an equal weighting to each individual's opinion." (g16) "Any issues between members were solved diplomatically with the view of quality sustenance for the two projects as the priority outcome." (g36)
Developed conflict resolution strategie	7	"Working with the same group over a long period and meeting once or twice weekly meant we could resolve issues more efficiently as we formed better friendships and relationships." (g1) "My team worked quite well without any significant issues during our long-term interaction. Any issues we did have we solved quickly by discussing as a group and coming to a decision together." (g65) "Continued interaction over the assessments improved my ability to resolve internal team issues." (g78)
Accountability and constructive feedback provision		
Encourages transparency and request better contribution	3	"Working over the long-term allowed us to get to know each other better, making it easier to approach someone if they weren't pulling their weight." (g2) "Unfortunately, we had an issue with one team member failing to contribute to the creation of the podcast. However, due to the long-term nature of the work, we were able to work with the individual to better understand his needs. This was achieved through more frequent group meetings that took place both on zoom and in-person, which allowed him to raise any issues quicker and as they came to him. The individual was significantly more engaged with the policy brief and contributed effectively." (g35)
Ease in providing feedback for improvements	6	"We could ask members to change things without feeling rude, as if they were strangers." (g1) "The long-term interaction meant that we could problem solve well. For example, one of our group members first language was not English, and therefore we learnt as a group to help them with proof reading and grammar related issues." (g21)
Improved the effectiveness of meetings		
Accommodating each other's needs when planning meetings	6	"I liked how there were two separate assignments done with the same group, as we were able to figure out what worked and what didn't after the podcast and improve the structure of our meetings/ divisions of work for the brief. With the podcast, we met probably too frequently at the beginning, and so we didn't have as much to discuss in each meeting - it felt like a waste of time. For the brief we only met twice; once to make decisions about the contents of the paper, and the other to edit/finalise. This was a much more efficient way to work, which we were able to learn thanks to the long-term nature of the group assignments." (g10)

		“Our biggest issue was to work around everyone’s different schedule. We always booked our meetings in advance but were very understanding when someone had to cancel last minute.” (g50)
Setting meeting agenda for (early) issue resolutions	4	“I found that the efficiency of the meeting was reduced, which might be caused by the long discussion. Therefore, I proposed to clarify individual tasks under the reasonable division and discuss the controversial”. (g30) “Before or at the beginning of meetings we made sure to set a rough agenda that was useful to ensure that any queries that group members had could be addressed; therefore, preventing problems in the future.” (g82)
Understanding team members and working dynamics		
Develops a better understanding of each other’s working styles	4	“The long-term nature of the assignments allowed us to build relationships and become familiar with one another’s working preferences, enabling us to cooperate more effectively and contribute as a team.” (g39)
Matching tasks to skills and experience	14	“We learnt a lot about each other and how we liked to work. Therefore, by the end of the policy brief (second project) we understood that the best way to achieve our assignment was to divide the work into manageable sections”. (g22) “The long-term interaction led to knowing each other’s strengths and weaknesses while establishing a shared identity.” (g32) “One issue we initially had was that we did not discuss our strengths fully, so team members did not always fit their roles. We learned from this experience, and by better understanding each other’s skills we made sure that everyone worked more on their specialisation to create an improved finished product.” (g79)

Table A-4 Thematic analysis of responses for question 4: ‘Overcome challenges of working individually’

Themes	No. of comments	Example quotes
Boosting performance and productivity		
Leveraging strengths to be more productive	10	“I believe working as a group made us more productive, compared to working individually, as we were pushing each other to meet deadlines.” (g2) “Groupwork allowed us to work to our strengths and consume significantly more information and research” (g35)
Effective time management and individual discipline	10	“When working individually, the team does not supervise you, but even so, I have known how to fight laziness and I have been disciplined. It helped me to make a schedule and each week I spent a day working on the parts of the assignment that had been assigned to me sharing the progress with the group.” (g5) “It also helped me to manage my time, as we set ourselves deadlines internally, so that we could all come to meetings prepared with adequate research.” (g21)
Better strategic planning	5	“My team had a clear idea of what areas we were going to focus on after working on the podcast”. (g7) “One of my main concerns was the policy brief’s design and layout. Together, the team were able to work together to create an effective design. The use of

		orange as a background colour to symbolise fire was particularly effective.” (g39)
Ease of working		
Could have clarification and support from teammates	9	<p>“Group work meant that even when I was finding some parts hard, I was able to turn to my team for advice and give myself some direction to complete my work.” (g21)</p> <p>“Whenever I needed clarification on something, I would seek help from course mates and that was always sufficient given the most collaborative nature of the module. This meant I avoided significant challenges.” (g19)</p>
Enhanced individual accountability and shared responsibility	6	“The projects helped here as I already had the base knowledge from the first project to help with the second therefore, I felt more confident in fulfilling the role of the individual work.” (g18)
Ease of overcoming individual challenges	3	<p>“Although this group came with significant challenges, I believe it also taught the members of the group who worked hard, a big lesson in working through challenging circumstances and working as a group to overcome obstacles.” (g16)</p> <p>“Being a team can really help you overcome challenges you face when working individual” (g61)</p>
Supporting conditions for delivering excellence		
Enhancing output quality through peer assessment	9	<p>“Another advantage was when team members finished their tasks on the project, we would all look over the work and spot any mistakes or any ways to improve. This led our work to be produced at a higher quality by paying high attention to detail.” (g63)</p> <p>“In the policy brief I was responsible for the policy option and the design brief. At first, I was confused about the policy formulation, however, I was not convinced and had a big conflict of opinion with my team members, but through mutual introductions and explanations I found out my problems and eventually listened to the team members' suggestions. I learnt what I consider to be very valuable from this experience.” (g67)</p>
Enhancing knowledge through sharing	18	<p>“You have people to brainstorm with and everyone have an interested perspective to contribute with, which makes your analysis better.” (g61)</p> <p>“I would have struggled with the assignments due to impulsivity that can, at times, lead to a single-tracked approach to work. When working in teams I had to justify my decisions meaning I took a more considered approach. An example would be the policy choice for the brief, I was keen to use afforestation as I had researched it extensively; upon discussion I realised that other policies could more directly link to content learnt in class such as property rights.” (g68)</p>
Adaptive skill deployment when faced with skill gaps	7	<p>“I am not good at IT and design, so I owe a lot to the members for making podcast and designing the policy brief.” (g74)</p> <p>“Finally, the teamwork format helped me overcome the challenge of working individually by helping me to tap into the strengths and knowledge of other team members to resolve my skill and competency gaps.” (g56)</p>