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STRENGTHENING BIOTECHNOLOGY STUDENTS' UNDERSTANDING OF GLOBAL SUSTAINABILITY THEMES THROUGH AN ESP BLENDED-LEARNING APPROACH

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Abstract: Sustainability has become a global concern due to its strong impact on the world economically, socially, and environmentally. As higher education increasingly adapts its curricula to the United Nations Sustainable Development Goals (SDGs), universities around the globe are expected to prepare graduates to effectively address contemporary sustainability issues by providing them with knowledge and disciplinary expertise. However, integrating sustainability into English for Specific Purposes (ESP) remains neglected despite the growing emphasis on education for sustainable development. ESP courses usually prioritise discipline-specific teaching materials, limiting students' opportunities to engage with broader global issues such as sustainability. This study explores the effectiveness of a blended ESP course designed to strengthen biotechnology students' English language competence and to enhance their understanding of global sustainability themes. To achieve this, an exploratory mixed-methods research design was employed with 48 second-year students enrolled at the Higher National School of Biotechnology, Constantine, Algeria. The course combined face-to-face instruction with online learning activities through the Moodle platform, incorporating scientific texts, videos, quizzes, and interactive learning activities. Students' language performance was evaluated using a pre-test and a post-test, whereas their awareness and attitudes towards sustainability were examined through a post-course online survey consisting of both closed-ended and open-ended questions. Quantitative data were analysed descriptively and inferentially, whereas qualitative data were analysed thematically. The major findings revealed that integrating several sustainability themes into a blended ESP course has the potential to enhance students' English language performance, particularly in reading comprehension, vocabulary, and grammar, in addition to increasing their knowledge and motivation to adopt more sustainable practices in the future. The study further suggests that integrating sustainability into ESP can promote language proficiency by connecting disciplinary content with real-world global challenges. These findings contribute to the growing body of research on sustainable ESP pedagogy by demonstrating how blended learning can simultaneously support language development and sustainability education. Finally, the study provides practical insights into designing interdisciplinary ESP materials that encourage collaboration between language and subject-matter teachers to prepare learners for increasingly sustainability-oriented professional contexts.

***Keywords**:* Biotechnology; blended learning; English learning; ESP pedagogy; sustainability

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1. Introduction

Sustainability has become increasingly important across sectors, including education, which plays an essential role in equipping 21st-century learners with the skills and knowledge they need to address this global issue. Abo-Khalil (2024) emphasises the crucial role of higher education institutions in preparing future generations to deal efficiently with the complexities of sustainability, as well as the importance of interdisciplinary approaches and strong faculty involvement in developing sustainability education. Teachers, therefore, play a central role in involving their students in discussions related to this issue and training them to become future leaders in sustainability practices. This view is reinforced by Finnegan (2023), who asserts that encouraging young people to be part of collective actions within their schools and communities can significantly strengthen their action competence. Such involvement can, for instance, help them balance hope and distress and become actively engaged in shaping a sustainable future. Additionally, Dibbern and Serafim (2021) highlight the importance of a global mobilisation aimed at forming an epistemic community that supports the Sustainable Development Goals.

One of the challenges of integrating sustainability into higher education is the limited understanding of its concepts and the insufficient number of trained instructors (Abo-Khalil, 2024). Although higher education institutions (HEIs) are expected to participate in sustainable development, integrating sustainability into curricula requires more than treating it as a separate subject. It involves creating more opportunities for learners to engage with sustainability-related issues across various learning areas, in addition to developing the skills, knowledge, and awareness required to meet global challenges. In this respect, integrating sustainability into different disciplines can help learners connect their learning with real-world concerns and understand the relevance of sustainability to their future professional careers. Although science and technology programmes have been introducing sustainability-related content in different fields such as biology and ecology, its integration into language education has received little attention. Language classes can offer an additional area in which learners encounter global issues through authentic materials and communicative activities and simultaneously enhance their language competencies. Nevertheless, sustainability remains largely absent from language classes. This is also the case with ESP classes, which generally focus more on building students' technical vocabulary and improving their technical writing skills. This limits students' exposure to interdisciplinary knowledge and leaves them few opportunities to practise the language with authentic materials and to enhance their skills in relevant, real-world settings.

Biotechnology is a multidisciplinary field in which students study different disciplines related to biology and technology, such as bioinformatics, genetics, microbiology, etc. Because of the field's interdisciplinary nature, biotechnology students are likely to encounter professional and scientific contexts in which sustainability concerns are involved. Yet, sustainability-related content is not adequately integrated into English language instruction, which largely focuses on scientific vocabulary, grammar, and writing but rarely includes sustainability concepts relevant to their field. This study aims to incorporate sustainability themes closely connected to biotechnology into a blended ESP course in order to strengthen both students' language proficiency and sustainability awareness. Instead of treating sustainability as an additional and separate subject, the study embeds it in authentic content through which learners can practise English and explore issues relevant to their interdisciplinary field. In other words, the course deploys asynchronous online materials, including scientific texts, videos, and quizzes, combined with face-to-face sessions to enhance students' English proficiency and promote their understanding of sustainability concepts and issues. In doing so, the study aims to answer the following questions:

1. What are the effects of an ESP blended course on students' awareness and attitudes towards sustainability?
2. How can the integration of sustainability themes into a blended ESP course improve biotechnology students' language skills?
3. What are students' perceptions of learning English through sustainability concepts in a blended course?

It is therefore hypothesised that integrating sustainability-related content into a blended ESP course would improve students' English proficiency and their knowledge and understanding of sustainability. The significance of this study lies in showing that language teaching can simultaneously develop students' language skills and raise their awareness of global concerns. It also contributes to ESP pedagogy and blended learning by offering practical teaching recommendations that target the United Nations' Sustainable Development Goals (SDGs).

2. Literature Review

2.1 Blended Learning and ESP Pedagogy

Blended learning has become an established pedagogical approach in higher education. It combines face-to-face instruction with online learning environments to offer greater flexibility, accessibility, and more opportunities for learner-centred instruction using digital tools and interactive activities (Rao, 2019). Research demonstrates that blended learning enhances students' engagement, autonomy, and academic performance. Fully online learning, on the one hand, provides flexibility, but it is often constrained by technical challenges, insufficient training, limited interaction, and learners' reduced motivation and social isolation. Face-to-face instruction, on the other hand, ensures active interaction, but it may not adequately meet the expectations of today's technology-oriented learners. By integrating the strengths of both approaches, blended learning offers a valuable alternative, as it creates a more interactive and supportive learning atmosphere that encourages participation and independent learning (Islam et al., 2015; Muxtorjonovna, 2020).

Within ESP, blended learning enables the integration of authentic materials and collaborative learning activities that reflect disciplinary contexts. Previous studies have shown that blended ESP instruction contributes to significant improvements in students' language skills, technical vocabulary, learner autonomy, critical thinking, and teamwork (Boudinar, 2023; Susanto, 2022). This highlights the potential of blended learning as a flexible environment capable of supporting innovative instructional practices. Despite the advantages of blended learning, it presents several pedagogical and technical challenges. Designing effective ESP courses requires ESP teachers to integrate language instruction with specialised disciplinary content, a demanding task that often exceeds their subject expertise. Many studies have also reported difficulties related to learners' engagement and online interaction (Prihatmi, 2022). The effectiveness of blended ESP instruction depends not only on technological infrastructure but also on appropriate pedagogical design and collaboration between language teachers and subject specialists. Simply adopting a blended approach does not guarantee improved learning outcomes.

Challenges of implementing blended ESP courses are particularly evident in the Algerian context. National policy-makers continue to encourage the integration of digital technologies to modernise teaching and learning, recognising their contribution to educational quality, creativity, and innovation (Hoadjli & Mehiri, 2015). Nevertheless, ESP instructors usually work under demanding conditions characterised by limited training in syllabus design, insufficient teaching resources and time, unclear objectives and institutional expectations, as well as learners' low English proficiency and large, heterogeneous classes (Missoum, 2023).

These conditions often lead to students' poor engagement and low motivation. Although recent studies have shown a growing use of digital resources in Algerian ESP classes, technology integration remains modest (Boukersoul & Sadoune, 2024).

Existing research demonstrates that blended learning represents a promising approach for enhancing ESP pedagogy. This approach offers opportunities to rethink ESP course design and delivery to address students' professional needs. To date, previous studies have primarily examined its effectiveness in improving language proficiency and learner engagement. Nonetheless, little attention has been paid to how blended ESP courses can serve as an educational platform for fostering disciplinary language skills and an understanding of global concerns such as sustainability. With the growing interest in sustainability goals and impacts around the globe, exploring how sustainability themes can be meaningfully integrated into blended ESP instruction is crucial, yet it remains an underexplored area of research.

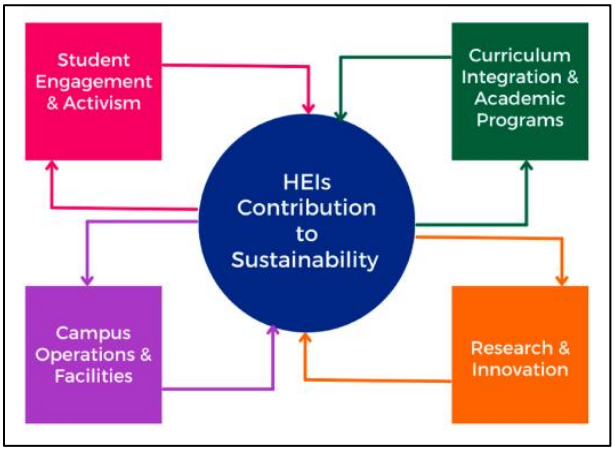
2.2 Sustainability in Higher Education

Universities play an important role in advancing sustainability because they shape students' knowledge and understanding, preparing them to contribute meaningfully to the achievement of the United Nations' Sustainable Development Goals (SDGs). In 2015, the United Nations (UN) adopted the 17 SDGs to serve as a universal framework, mainly aiming to support global economic, social, and environmental sustainability by 2030. The SDGs cover a set of interconnected issues such as poverty, hunger, education, gender equality, climate action, etc. (United Nations, 2025a). They serve as a strategic framework to guide different institutions in improving sustainability and global well-being. Higher education institutions, for instance, play a central role in implementing strategies that support the SDGs in education, research, and innovation (Urbano et al., 2025).

In this regard, Tasdemir and Gazo (2020) emphasise the role of universities in promoting sustainability through modern management techniques and hands-on activities. Integrating sustainability concepts into academic curricula can therefore contribute positively to global transformation in different areas such as public health, economic growth, and sustainable production (Žalėnienė & Pereira, 2021). Effective sustainability education needs to be addressed holistically, targeting societal, ethical, and environmental aspects, whereas interdisciplinary collaboration helps manage SDG trade-offs, as illustrated in Figure 1. Such interdisciplinary integration and the deployment of a wide range of innovative teaching methods ensure productive sustainability education and enable students to develop critical thinking, problem-solving abilities, ethical awareness, and responsible decision-making (Ankareddy et al., 2025; Seatter & Ceulemans, 2017).

Figure 1:

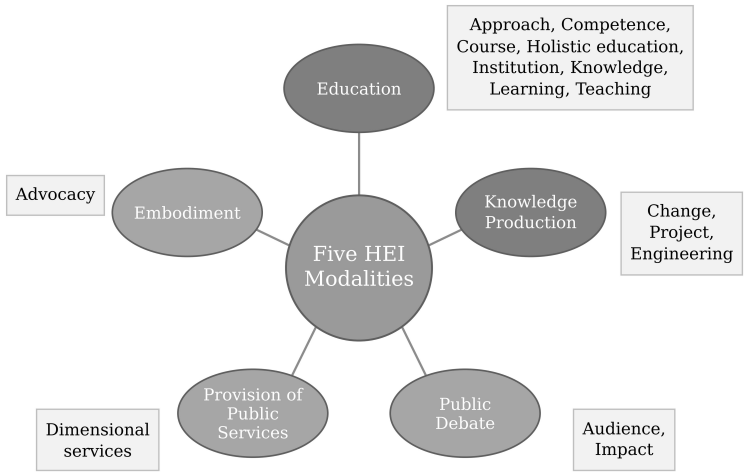
Interdisciplinary Approaches to Sustainability in HEIs (Ankareddy et al., 2025, p. 6)



Even with its recognised value, the integration of sustainability in higher education remains uneven across institutions and academic disciplines. Previous studies have identified several barriers, such as limited funding, stakeholders' resistance, lack of professional vision, curriculum constraints, and inadequate teacher preparation (Sebire & Flores, 2023; Žalėnienė & Pereira, 2021). Likewise, McCowan (2023) argues that universities often struggle to maximise their contribution to sustainable development because of limited resources and recognition, market pressure, status competition, difficulties in measuring impact, and a lack of imagination and of connections with the labour market. Building on McCowan's work, Alfathy et al. (2024) propose a framework of higher education modalities, shown in Figure 2, which focuses on education such as active learning and project-based activities, institutional policies targeting teacher training and campus adaptation to sustainability, and, finally, community engagement across social, economic, and environmental dimensions. This highlights that achieving sustainability requires innovative pedagogical approaches and institutional policies (Galán-Muros, 2023).

Figure 2:

Higher Education Modality Framework (Alfathy et al., 2024, p. 35)



Integrating sustainability into English Language Teaching (ELT) has begun to gain recognition due to its potential in equipping students with the necessary skills to face global challenges. Research reveals that this approach can boost critical thinking, problem-solving skills, students' sense of agency, and active participation in sustainability issues. In other words, it is not merely an educational trend, but a crucial step towards fostering students' linguistic abilities and awareness needed to be proactive global citizens (Yu et al., 2024). A similar view is shared by Huot and Em (2024), who believe that sustainability-oriented ELT can effectively combine language development with experiential activities, community-based projects, and partnerships with different organisations, thereby connecting classroom learning with real-world challenges. Nevertheless, the incorporation of sustainability into language education remains at an early stage and is highly context-dependent. In most studies, it is realised through a variety of activities, such as project-based and inquiry-based activities, the use of literary texts, and other interdisciplinary methods, which enhance critical thinking, empathy, motivation, teachers' pedagogical knowledge, and global citizenship (Azizah et al., 2025). However, teachers' readiness, institutional policy constraints, and some disparities in research and implementation hinder its effective integration (Xuan & Lindqvist, 2025).

In short, integrating sustainability into higher education is widely recognised as influencing students' critical thinking and social behaviours. It enhances their skills and attitudes. However, many challenges remain, such as teachers' readiness, students' engagement, the lack of materials and resources, and the misalignment of language teaching objectives with the SDGs. These challenges are particularly relevant in ESP pedagogy, in which teaching materials are traditionally designed for specific disciplines. Hence, global themes, including sustainability, usually receive little attention despite their importance for students' future professional contexts. This issue is especially pertinent for students in interdisciplinary fields such as biotechnology, whose future careers are closely related to sustainability challenges and concerns in many areas, such as agriculture, the environment, healthcare, etc. Yet, empirical studies examining how sustainability can be systematically integrated into blended ESP courses to promote language learning remain limited, particularly in the Algerian context. In other words, previous studies have independently demonstrated the advantages of blended learning in ESP and the importance of sustainability in higher education, but limited research has examined the intersection of these two concepts. Accordingly, the present study examines how sustainability can be embedded in ESP for biotechnology classes to improve students' English performance and strengthen their sustainability awareness.

3. Methodology

3.1.Research Design

To investigate the effects of implementing sustainability-related content in a blended ESP course for biotechnology students, the study opted for an exploratory mixed-methods research design within a pragmatic research paradigm. Pragmatism was considered the most appropriate because it allows research methods to be selected based on the research questions and the type of data required to address the research problem, allowing the combination of measurable evidence of students' English performance with insights into their perceptions and experiences of the course. Quantitative data were collected through a pre-test and a post-test to assess students' English language performance and progress, whereas qualitative data, supported by descriptive quantitative components from the post-course survey, explored students' sustainability awareness and their general perceptions of the designed course.

Within the mixed-methods framework, the quantitative component followed a one-group pre-test/post-test quasi-experimental design (O1 → X → O2). In this design, the same group of participants is assessed before and after exposure to a planned instructional intervention, allowing the examination of changes in their performance. In the present study, the sample consisted of 48 students who completed the pre-test (O1) before the intervention, participated in a 12-week blended ESP course (X), and completed the post-test (O2) immediately after the intervention. A post-course survey was subsequently administered to provide complementary quantitative and qualitative data about students' sustainability awareness, attitudes, and perceptions of the blended learning experience.

The study did not involve separate experimental and control groups. The one-group design was selected because the research was conducted within pre-existing institutional groups, making random assignment to separate experimental and control conditions administratively infeasible. Moreover, the primary purpose was to examine changes in students' English language performance using sustainability-related content following the implementation of the designed ESP course, rather than to compare different instructional conditions and techniques.

3.2.Participants and Research Setting

This study was conducted at the Higher National School of Biotechnology (ENSB), in Constantine, Algeria, during the second semester of the academic year 2024–2025, and lasted 12 weeks, from February to May 2025. The target population consisted of second-year students enrolled in the preparatory cycle. The whole population comprised twelve groups formed randomly by the institution. Three groups were selected through convenience sampling based on accessibility and the fact that their timetables allowed them to participate in the face-to-face sessions required by the blended course. Together, these three groups included the 48 students who participated in the study and were treated as a single sample since they received the same intervention under identical conditions. The participants had a pre-intermediate level of English and, as they were still enrolled in the preparatory cycle, they had been exposed only to basic concepts of biotechnology. Therefore, their familiarity with sustainability themes and goals was also limited. These characteristics made the selected participants suitable to examine the extent to which the designed course could influence their understanding of different sustainability concepts and their awareness of global sustainability issues and concerns.

3.3.Course Design

The blended ESP course was specifically designed to expose students to different sustainability themes relevant to their field of study and language level. The course was delivered in two modes: online and onsite. The online asynchronous resources mainly included scientific texts with vocabulary activities and comprehension questions. These texts were shared with the students as PDF files on the Moodle platform. Videos related to sustainability themes were also shared on the platform with interactive H5P activities. Quizzes with instant feedback and discussion forums were created to increase students' motivation and learner autonomy.

It is worth mentioning that AI tools such as ChatGPT, Gemini, Magic School, and Napkin were used to facilitate the creation of the course, for instance, by preparing some questions and activities and generating illustrations, sustainability-related concept images, and diagrams. Other technological tools, such as Canva, VUE, puzzle generators, and video editors, were also used to provide an engaging online learning environment.

Following a flipped classroom model, the onsite sessions were devoted to practice. Students worked through the asynchronous online resources at home and then took part in classroom activities designed primarily to check their answers and understanding. Part of the onsite sessions was devoted to discussions to improve students' communicative skills and to writing workshops to develop their writing techniques.

Given the duration of the investigation, the course focused on four SDGs that were closely aligned with biotechnology and the learning objectives of the ESP course, as shown in Table 1.

Table 1:

SDGs and Teaching Topics Covered in the Course

SDGs	**Sustainability topics covered**
SDG 3: Good health and well-being	Food nutrition
	Antibiotics
	Vaccine development
	The immune system
SDG 6: Clean water and sanitation	Environmental pollution
	Wastewater treatment
	Biodegradable plastics
SDG 7: Affordable and clean energy	Renewable energy
	Electric vehicles and smart houses
SDG 13: Climate action	Global warming

(Source: created by the author)

3.4.Data Collection

Three research tools were used to collect data: a pre-test, a post-test, and a post-course survey. As previously mentioned, the pre-test and post-test were used to examine the participants' performance in English and check their progress after the treatment. Both tests were self-designed by the researcher, with AI assistance, to align with the learning objectives of the blended ESP course (see Appendices A and B). The tests targeted students' language competencies, particularly reading comprehension and text analysis, scientific vocabulary, and grammatical aspects such as tenses, reported speech, and the passive voice, all presented in sustainability-related contexts. To ensure comparability, both tests followed a similar structure and degree of difficulty.

To obtain reliable results, the tests were administered in the classroom under identical conditions. Both tests were completed individually within one hour. Participants were not allowed to use any assistance tools such as dictionaries, electronic devices, or any AI tools during the assessment. The training extended over twelve weeks, during which students completed both the online and face-to-face activities of the course. Both tests consisted of different types of questions, such as multiple-choice, gap-filling, and short-answer questions, focusing on the lessons covered in the training, particularly reading comprehension, vocabulary and grammar.

At the end of the course, the participants were invited to complete an anonymous online survey to evaluate their perceptions of learning about sustainability through a blended approach. The survey was self-designed by the researcher to complement the quantitative findings obtained from the tests (Appendix C). It was developed in accordance with the aims of the study. To ensure survey completion, the created questions were specific and straightforward, allowing participants to complete the survey within a few minutes. The

survey consisted of four sections: the first explored students' prior knowledge of sustainability and their perceived learning gains, the second section examined their attitudes towards sustainability, the third identified participants' perceptions of the blended ESP course, and the fourth focused on students' suggestions for possible improvements. The survey was created on Google Forms and delivered through the online learning platform. To gather both quantitative and qualitative data, the survey included multiple-choice and open-ended questions.

3.5.Data Analysis

The quantitative data collected from the tests were analysed using the statistical tool IBM SPSS (version 27). Descriptive statistics were first computed to analyse students' performance, followed by a paired-samples t-test to determine whether the observed difference in the participants' performance between the two tests was statistically significant. The paired-samples t-test was used as it is the most appropriate test for comparing the performance of the same participants before and after the course. To determine the participants' attitudes towards sustainability themes and learning online, the quantitative data collected from the post-course survey were analysed descriptively, while responses to the open-ended questions were analysed thematically to identify recurring themes regarding students' awareness of sustainability and their perceptions of the blended learning experience.

3.6.Ethical Considerations

Participation in the study was entirely voluntary. All students were informed about the purpose of the study at the beginning of the course. Participants were also informed that their responses in the tests and survey would be treated anonymously, kept confidential, and used only for research purposes.

4. Results

This section reports the results of the study. The first part focuses on the participants' English language outcomes, while the second part focuses on their views regarding blended learning and sustainability.

4.1.Students' English Performance in the Pre-test and the Post-test

The effectiveness of the blended ESP course was first examined by comparing the participants' performance before and after the training. Table 2 displays the participants' results in the pre-test and the post-test. All the participants completed both tests (100%). It is worth mentioning that students' assessment in the Algerian higher education system is typically based on a 20-point grading scale. This means that obtaining a score of 10/20 represents the average level. Scores above the average reflect good performance, strong understanding of the concepts and great mastery of the language. Scores below the average, however, reflect insufficient mastery of the language and a need for further improvement in understanding the covered concepts. The pre-test and post-test were designed to assess students' performance in particular language aspects, including reading comprehension, vocabulary, and grammar. These aspects, however, were not analysed separately. Therefore, Table 2 displays students' overall achievement considering these aspects.

***Table 2**:*

Pre-test and Post-test Results

Participant	Pre-test	Post-test	Participant	Pre-test	Post-test
1	10	11	25	18	18
2	12	14	26	17	14
3	9	9	27	11	9
4	8	12	28	16	15
5	14	16	29	17	18
6	15	16	30	12	14
7	10	12	31	11	12
8	17	17	32	10	16
9	10	14	33	12	13
10	8	11	34	9	14
11	7	10	35	7	10
12	7	9	36	6	8
13	10	15	37	5	9
14	12	12	38	5	7
15	15	17	39	9	13
16	13	15	40	7	10
17	11	12	41	13	12
18	11	14	42	14	14
19	11	11	43	10	11
20	9	10	44	10	10
21	10	10	45	9	13
22	9	13	46	7	15
23	9	11	47	17	16
24	15	17	48	15	18

Note. Scores are expressed on the 20-point scale used in Algerian higher education.

Table 3 displays the statistical results obtained using SPSS. It shows the means and standard deviations for the pre-test and the post-test, together with the significance of the paired-samples t-test.

Table 3:

Descriptive Statistics

Measure	*N*	*M*	*SD*	*p* (two-tailed)
Pre-test	48	11.02	3.40	—
Post-test	48	12.85	2.87	—
Pre-test − Post-test	48	−1.83	2.10	< .001

Note. N = number of participants; *M* = mean; *SD* = standard deviation. Paired-samples *t*-test: $t(47) = -6.06$, $p < .001$, Cohen's $d = 0.87$.

A glance at Table 3 highlights the difference between the participants' scores in the pre-test and the post-test, showing an improvement in their average scores in the post-test (*M* = 12.85). This means that the participants' performance was better after the course. Although students had achieved a satisfactory average score before the training (*M* = 11.02), the higher post-test mean indicates further improvement in the language competencies targeted throughout the course, particularly reading comprehension, vocabulary building, and grammar. Since the study focused on the participants' overall test scores instead of focusing on each language component separately, the obtained results reflect an overall improvement in

English competencies. In statistical terms, the paired-samples t-test showed that this difference was significant, $t(47) = -6.06$, $p < .001$, with a large effect size ($d = 0.87$), indicating that the participants' English performance improved significantly. Moreover, the standard deviation of the score differences (SD = 2.10) indicates some variation in students' performance, which suggests that the course did not influence all the participants to the same extent. This usually happens in heterogeneous groups, where students differ in their initial language proficiency, engagement, and cultural background. Such variability is common in national schools where enrolled students come from diverse cultural and social backgrounds.

The observed improvement was recorded right after the implementation of the blended ESP course and suggests a positive association between participation in the course and better English performance. Nevertheless, because the study employed a single-group design, findings cannot be interpreted as evidence of causation. Although participants were also enrolled in their regular English course and other biotechnology subjects, the sustainability-focused blended ESP course offered additional exposure to sustainability via reading activities and interactive online learning. Thus, the observed improvements are attributed partly to the course, without discounting the influence of students' overall academic learning during the semester.

These findings suggest that integrating sustainability-related content into a blended ESP learning environment is associated with significant improvement in students' English performance. Although the statistical analysis shows a statistically significant increase in students' overall achievement on the tests following the course, the post-course survey, presented in the next section, provides further insights into their perceptions of the course and their sustainability awareness and attitudes.

4.2.Students' Perceptions of Sustainability and the Blended ESP Course

The results presented in this section reflect the participants' insights into their overall experience of the integration of sustainability themes into the blended ESP course, and most importantly, its effects on the participants' awareness regarding global sustainability issues.

4.2.1. Sustainability Awareness and Learning Outcomes

The survey first examined students' prior familiarity with sustainability before participating in the course. The majority reported having minimal knowledge of sustainability (60%), while only a few (4%) believed they had strong knowledge of sustainability. The remaining participants either claimed they had some knowledge of sustainability (25%) or none at all (11%). These findings suggest that most participants entered the course with limited awareness of sustainability-related concepts despite studying biotechnology, a discipline that is closely related to various sustainable practices and areas. This indicates that the course addressed an educational need rather than simply reinforcing students' prior knowledge.

The second question of the survey sought to determine whether the participants had improved their understanding and knowledge of sustainability after the course. The obtained results show that the overwhelming majority of the participants (71%) responded that they had improved their knowledge considerably. Of the remaining participants, 23% reported some improvement, while a few (6%) indicated that the course helped them a little. No participant reported a lack of improvement, suggesting the effectiveness of the course in increasing students' knowledge of sustainability themes. Although these results are based on students' self-perceptions rather than an assessment of sustainability knowledge, they indicate that integrating sustainability themes into the ESP course was perceived positively as an effective means of increasing students' awareness of global sustainability issues. Moreover,

the complete absence of negative responses further suggests that the selected themes were appropriate for the participants' academic background and successfully introduced sustainability concepts within the ESP learning context.

The survey also investigated whether the course increased students' confidence in discussing sustainability-related topics in English. The obtained results reveal that more than half of the participants (52%) reported feeling more confident communicating about sustainability after completing the course. Nevertheless, 29% indicated that they remained only slightly confident, while 15% reported that they still lacked confidence. The reported responses may be explained by the limited opportunities available for the participants to practise speaking. Although the course successfully expanded students' sustainability knowledge, developing enough confidence in oral communication requires additional instructional support. Since this course primarily focused on reading comprehension, vocabulary development, and grammar, participants were unable to improve their speaking skills considerably. Therefore, incorporating more speaking activities, debates, presentations, and collaborative discussions about sustainability could strengthen students' communicative confidence.

The participants' positive perceptions were also reflected in their opinions regarding the inclusion of sustainability topics in ESP instruction. The vast majority (81%) supported incorporating sustainability into English classes, whereas only 4% disagreed and 15% remained uncertain. This strong level of acceptance suggests that students viewed sustainability as content worth studying that complemented both their language and discipline learning.

4.2.2. Attitudes towards Sustainability

One of the main objectives of this study was to raise students' awareness about sustainability in real-world situations. The survey examined whether the course had influenced students' attitudes towards sustainability and their willingness to adopt sustainable behaviours in their daily lives. The majority of the participants (83%) reported that the course had positively influenced their attitudes towards sustainability, while 13% indicated that their attitudes had become somewhat more positive. Only 4% perceived no noticeable change, and none of the participants reported a negative impact. One possible explanation for this percentage is that these participants may have been those who were already aware of sustainability issues and who reported having a strong knowledge of sustainability in the first question of the survey. This indicates that implementing sustainability themes into language instruction can positively affect students' attitudes and practices. The findings suggest that embedding sustainability themes within ESP instruction can extend beyond language learning by encouraging students to reflect on sustainability issues from both personal and professional perspectives. The high proportion of positive responses may be due to the close connection between the selected sustainability themes and biotechnology, which allowed students to connect classroom learning with real-world challenges.

To identify whether changes in sustainability awareness and attitudes could translate into future actions, participants were also asked about their willingness to adopt more sustainable behaviours after completing the course. Most participants reported that they intended to adopt more sustainable practices, whereas only a small proportion expressed uncertainty or indicated that they were unlikely to change their behaviours. It should be noted that these responses represent behavioural intentions rather than observed behaviours. They nevertheless suggest that the course encouraged students to consider applying sustainability principles beyond the classroom. Consequently, the course appears to have promoted not only

students' awareness of sustainability but also a stronger personal commitment to environmentally and socially responsible behaviours.

4.2.3. Students' Evaluation of the Blended ESP Course

Participants were also requested to evaluate different aspects of the course through closed-ended and open-ended questions. Their responses offer valuable insights into the content they found most beneficial, in addition to their suggestions for future improvement.

As indicated in the methodology, it was not possible to cover topics addressing all 17 SDGs. Therefore, only a few topics, mainly related to biotechnology, were selected. The participants were requested to select the topics they considered interesting and were allowed to choose multiple options for this question. Their feedback would also help determine which topics should be addressed in more depth and which need to be improved or even replaced. The participants' interest was distributed across different sustainability topics. Yet, some topics received more attention than others. For instance, topics such as vaccine development and biodegradable plastics were the most frequently selected. Other topics such as electric vehicles and smart houses, food nutrition, the immune system, antibiotics, environmental pollution, and global warming also received considerable attention. Nevertheless, renewable energy and wastewater treatment were not often selected and received comparatively less interest. This suggests that the majority of the selected themes matched the learners' interests and suitable to their scientific background. The popularity of biotechnology-related topics suggests that students were particularly engaged when sustainability themes were closely related to their academic discipline and future professional careers. This shows the importance of contextualising sustainability within learners' disciplinary backgrounds rather than presenting it in isolation.

The survey ended with two open-ended questions that explored the participants' preferences and suggestions to improve the course. The purpose of the first question was to gather qualitative data about the most useful part of the course. The participants' responses varied. They frequently mentioned the texts, discussions, and online activities as the most useful ones. Many of them appreciated the relevance of the selected texts to their field of study. For example, one of the respondents stated: "*I appreciate that we are given the opportunity to learn English through a scientific content*." A similar view was shared by another respondent, who said: "*I liked reading activities the most because they helped me improve my vocabulary, specially scientific words*". As regards sustainability, some of the respondents expressed their positive perception of this aspect of the course. To illustrate, one of the students said that combining English lessons and sustainability-related themes made the course more engaging and motivating. The students who identified the online activities as the most useful part of the course believed that these activities allowed them to learn at their own pace. They liked the asynchronous nature of these activities, as it allowed them to access the activities anywhere and at any time. This indicates that students valued the close alignment between ESP teaching materials and their field of study, reinforcing the importance of using appropriate authentic materials in ESP course design.

The second open-ended question sought to elicit the participants' suggestions to improve the course. One notable suggestion that frequently appeared in the students' answers was adding more videos and interactive activities. One of the students, for instance, said: "*I suggest giving us more videos with activities on them, like in pollution."* In the previous comment, the student is referring to a particular activity in Moodle that uses the H5P plug-in Interactive Video. In this activity, the students had to watch a video and answer some questions directly on the video while watching it. This type of activity is useful when teachers want to engage their students through pop-up information, buttons and questions to enable

them to interact with videos, instead of watching them passively. Other students, however, requested having more interactive activities in the face-to-face sessions. Some students also suggested including more speaking activities and reducing grammar lessons. These students want to improve their speaking skills because they have few opportunities to use English outside the classroom. These suggestions indicate that students would welcome a stronger emphasis on communicative activities to enable them to apply their language skills more actively in sustainability-related contexts.

5. Discussion of Findings

The major findings of this study show that introducing different sustainability themes in ESP courses is beneficial. As reported by the majority of the students, learning about sustainability in English classes is very useful. This course helped them learn English, and most importantly, raised their awareness of sustainability. Thus, the course appears to have had a positive effect on the students, particularly in raising their awareness about different global issues, and strengthening their intention to adopt more responsible practices in the future. As far as the language skills are concerned, the results obtained in the pre-test and the post-test demonstrated the strength of the course. The students improved their English level significantly at the end of the course. These findings answer the research questions, which sought to examine the effects of implementing sustainability themes in an ESP course.

The improvement observed in students' English performance is likely associated with the specific design of the course. Even though the participants were simultaneously enrolled in a regular English course for biotechnology during the semester, that course focused mainly on technical writing, unlike the blended ESP course that emphasised reading comprehension, grammar, vocabulary development, and the integration of authentic sustainability-related teaching materials. Therefore, the significant gains recorded in the pre-test and post-test are more likely to reflect the learning outcomes of the intervention, although the contribution of students' overall language improvement throughout the year cannot be completely excluded. These findings serve as preliminary evidence of the effectiveness of adopting blended ESP pedagogy. These findings are also consistent with previous research studies that highlight the efficiency of blended learning, which depends on proper pedagogical design and digital literacy (Rao, 2019). In this study, the integrated course intentionally combined online resources with face-to-face learning activities to increase flexibility and broaden access to learning resources. This increased students' engagement and sense of collaboration, particularly in doing online activities. Similarly, Susanto (2022) highlights that blended learning can foster language development, collaboration, and critical thinking if learning activities are meaningfully incorporated into curricula.

The current study also examined the students' perceptions of the designed course. The vast majority reported positive feedback, showing more confidence in using English and motivation to adopt more sustainable lifestyles. However, they suggested integrating more videos and interactive activities, particularly online. This indicates the positive impact of multimedia and cooperative learning. The students usually feel more engaged when online interactive resources are used. These results are in accordance with many studies that identified the advantages of using blended learning in ESP classes. Blended learning not only helps students develop their language skills but also raises their motivation and engagement much better than the classical face-to-face teaching mode. Moreover, the students' positive insights can also be attributed to the nature of blended learning that is flexible, inclusive, and widely accessible. This aligns with the studies conducted by Muxtorjonovna (2020) and Boudinar (2023), which demonstrate numerous advantages of blended learning, mostly in promoting learner autonomy, engagement, and enthusiasm. Accordingly, the students' feedback in this study reinforces the importance of designing blended ESP courses that

combine interactive digital resources with more opportunities for active participation in the classroom.

The positive attitudes reported by the participants should also be interpreted in light of the educational context. As previously mentioned, the students were enrolled in the second year of the preparatory cycle, in which sustainability is not yet explicitly addressed in the curriculum. Moreover, the other biotechnology subjects were delivered predominantly in French, as English-Medium of Instruction (EMI) had only recently begun to be introduced for first-year cohorts. Consequently, the blended ESP course represented the participants' main structured opportunity to explore sustainability concepts through English. This may explain the increase in students' perceived knowledge of sustainability and their confidence in discussing sustainability themes in English. The findings also reflect the necessity of contextualising sustainability themes within learners' disciplinary backgrounds. In other words, instead of presenting sustainability as an abstract global concept, the blended ESP course connected it with biotechnology-related topics such as renewable energy, biodegradable plastics, food nutrition, etc. This interdisciplinary approach corresponds with Ankareddy et al. (2025), who argue that successful sustainability education requires interdisciplinary collaboration. Students' positive responses likewise suggest that sustainability becomes more meaningful if embedded within authentic disciplinary contexts.

Connecting sustainability-related content with ESP instruction reflects a global trend. Many studies nowadays try to investigate how to incorporate sustainability into curricula to keep pace with global reforms. In this regard, Yun (2023) recommends strengthening digital learning systems and ensuring that educational innovations remain sustainable and aligned with the SDGs. This course attempted to address sustainability through a variety of activities involving digital interactive learning. Following Tasdemir and Gazo (2020), several activities like management techniques, project-based activities, and hands-on activities, were incorporated into the course. With regard to language teaching, which seems to have been neglected, including real-world situations into the content can improve the quality of the content to support sustainability and boost students' language mastery and critical thinking (Yu et al., 2024). The findings also support recent developments in sustainability-oriented language education. They align with Huot and Em's (2024) findings regarding students' improvement in linguistic competencies and sustainable attitudes. Integrating authentic sustainability themes into the blended ESP course appears to have promoted similar educational outcomes by raising students' interest in English learning and sustainability.

Further support comes from another study that focused on energy in engineering classes. The obtained results align with this study's major findings, highlighting the impact of integrating sustainability-related content, covering the SDGs, in enhancing students' sustainability understanding and stimulating their critical thinking and engagement. The authors concluded that the university plays a crucial role in preparing future generations and promoting sustainable communities and also identified the role of sustainable communities in higher education institutions (Biancardi et al., 2023). Nevertheless, the reported changes in students' awareness and behavioural intentions were derived from self-reported responses and can only reflect participants' perceptions rather than objectively observed behaviours. Moreover, the observed improvements cannot entirely be attributed to the treatment due to the absence of a control group. Thus, the current study provides exploratory evidence that integrating sustainability into ESP courses represents a promising pedagogical approach. In other words, the overall findings suggest that sustainability should be viewed as authentic disciplinary content that enriches ESP pedagogy by enhancing students' linguistic competence, disciplinary knowledge, and awareness of global sustainability challenges. The

study also supports strong collaboration between language teachers and subject specialists in designing effective ESP courses.

6. Limitations of the Study

Despite the promising findings obtained in this study, several limitations were unavoidable. First, the sample size was relatively small due to the institution's grouping policy, which made selecting larger groups hard to achieve. The 48 students, forming three groups, were drawn from a second-year population composed of 12 groups. The participants were selected through convenience sampling because they were available to attend the additional sessions required for the study and voluntarily agreed to participate. The selection was primarily determined by timetable feasibility rather than students' motivation. In other words, the three groups were selected because their schedules allowed the implementation of the additional face-to-face sessions, which are essential in the blended course. Yet, the relatively small sample compared to the target population reduces generalisability.

Second, the study focused exclusively on biotechnology students. Since ESP courses differ considerably across academic disciplines, the effectiveness of integrating sustainability themes may vary depending on students' needs, discipline, and language proficiency. Consequently, it is not possible to generalise the results until the study is replicated in other disciplines, such as engineering, medicine, agriculture, and economics, to check whether students in these disciplines express similar feedback and attitudes, and to gain a broader understanding of the applicability of this approach. Besides, biotechnology represents a field in which sustainability is naturally connected to professional issues related to environmental protection, renewable resources, healthcare, and other forms of sustainable production. In this case, students may have perceived the relevance of the selected materials more readily than learners from other ESP disciplines. Future comparative studies across different academic fields would help determine whether the observed positive effects in this study are equally applicable in other disciplinary contexts.

It is worth mentioning that the duration of the treatment was limited. The experiment took place in the second semester, which is usually short. Besides, second-year students in the preparatory cycle sit a national competitive examination at the end of the year. This explains why the treatment had to be completed within only 12 weeks. This also restricted the opportunity to examine the long-term retention of language gains and the sustainability of students' behaviours. Additionally, the short duration of the treatment may partly explain the nature of the reported outcomes. A statistically significant improvement was observed in overall test scores covering reading, vocabulary, and grammar. Students also showed greater confidence in discussing sustainability topics in English. Nevertheless, twelve weeks may not be sufficient to produce lasting changes in language skills or deeply embedded sustainable practices. Longer interventions, therefore, would offer more opportunities to investigate whether these short-term gains are maintained over time.

Gathering qualitative data from the respondents is useful in studies tackling students' attitudes and perceptions. However, the participants' responses may be biased and may not reflect their real behaviours since there is no structured follow-up to this study. Even though they were informed that their answers were completely anonymous and would be used only for research purposes, they might still provide answers that do not match their behaviours in their daily life. Another methodological concern is the absence of a control group. Although the pre-test/post-test experiment revealed considerable improvement in students' performance, comparing the experimental group with students following a traditional ESP course would have provided stronger evidence of the course's effectiveness. Moreover, other educational

experiences, such as the regular English course, students' self-study, and the learning of scientific concepts in other subjects, cannot be completely excluded as contributing factors. Yet, the training represented the students' principal structured exposure to sustainability themes through English.

Consequently, future studies are encouraged to consider larger and more diverse groups and longer treatment periods to examine students' attitudes towards sustainability more accurately. More interactive activities can be used, targeting speaking skills. For instance, artificial intelligence tools, games, and interactive videos can be useful in sustainability-focused courses.

7. Implications

The present study has several implications for ESP and sustainability education. It contributes to research exploring the connection between blended learning, ESP pedagogy, and sustainability. Previous studies have mainly examined the effectiveness of blended learning in developing students' language skills or discussed sustainability in higher education separately. This study, however, demonstrates that sustainability can serve as authentic disciplinary content in ESP instruction. The study showed that the SDGs can be taught in ESP classes in ways that enhance students' language skills and global awareness. The study implies that ESP pedagogy can address both discipline-specific language content and broader educational goals related to sustainability concerns.

The study also has important pedagogical implications for ESP teachers and syllabus designers. First, training teachers in sustainability and ESP pedagogy is important to successfully provide effective courses. Collaboration between subject-matter teachers and language teachers is key to the successful integration of sustainability into course content. In this context, educators complement each other and bridge the gap between content expertise and language mastery to create fruitful courses. Another key to the effective inclusion of sustainability is the use of multimodal resources such as interactive videos and project-based activities. Likewise, different authentic materials, discussion forums, quizzes, and other interactive activities can provide meaningful contexts, enabling students to improve their language proficiency and sustainability awareness. Moreover, open educational resources (OER) should be used in designing SDGs-focused programmes and creating a supportive and friendly learning atmosphere.

Finally, the study further suggests several institutional and policy implications. Higher education institutions should encourage interdisciplinary collaboration and provide institutional support for the development of sustainability-related ESP content. This includes providing professional development programmes, technological infrastructure and technical support, sufficient time for course design and delivery, and the creation of high-quality teaching resources. In addition, institutional policies should promote the production and dissemination of OER that facilitate integrating sustainability themes into language classrooms. These implications would contribute to the appropriate implementation of the SDGs within higher education and prepare future graduates for sustainability-related professional contexts.

8. Conclusion

This study has shed light on sustainability and the role of universities in preparing future generations to become professional leaders. It examined the integration of sustainability themes into a blended ESP course for biotechnology students. The obtained results demonstrated the effectiveness of incorporating sustainability-focused content in the biotechnology curriculum. The major findings revealed that integrating sustainability themes

into blended ESP instruction contributed to improving students' performance in reading comprehension, technical vocabulary, and grammar in scientific contexts, and strengthening their understanding of global sustainability issues. This suggests that sustainability can provide suitable content that promotes language learning and education for sustainable development.

One might think that sustainability is closely related to scientific and technical fields like biology, biotechnology, or engineering. This makes the inclusion of sustainability themes particularly suitable for ESP pedagogy. Nonetheless, sustainability can go beyond ESP pedagogy and fit well within EFL classes, offering valuable insights to teachers and students. For example, teachers of writing can address sustainability themes through texts and essay-writing tasks. Teachers of speaking can include global issues in discussion activities, while teachers of study skills can integrate them into note-taking and summarising strategies. This enables EFL learners to learn English using authentic materials. Consequently, the integration of sustainability into language education is a flexible approach that can be adapted to various teaching objectives and contexts.

Future studies should build upon these findings by conducting longitudinal and controlled studies that involve larger and more diverse samples across different levels and disciplines. These studies would provide stronger evidence on the effects of the course on students' long-term language retention and behavioural changes. Such effects could be examined by incorporating objective assessments of sustainability knowledge, longitudinal follow-up measures and classroom observations. Using sustainability as authentic content would help educators support students' language skills and preparing them to address global challenges in their future academic and professional lives. To conclude, sustainability is a global concern that should be addressed at the university, regardless of the field or discipline of study.

Declaration on Generative AI Use. During the preparation of this manuscript, the author used ChatGPT (OpenAI) only to assist with language refinement and to improve the clarity of a few passages. No AI tool was used to generate original content, review literature, conduct data analysis, or develop arguments.

Ethical Declaration. No ethical issues were identified in relation to the conduct of the study. Participation was voluntary, and the collected data were treated anonymously and confidentially.

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Data availability. Data are available from the author upon reasonable request.

Author Contributions. The author was responsible for the conceptualisation and design of the study, the review of the literature and identification of the research gap, the development and implementation of the blended ESP course, data collection and analysis, and the discussion of the findings and pedagogical implications.

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Appendices

Appendix A: Pre-test

A) Reading Comprehension: Read carefully the following text and answer the questions

Food and Nutrition

Nutrition is the process by which the body nourishes itself by transforming food into energy and body tissues. Food provides essential substances called nutrients. It is needed to keep the body running smoothly and to provide energy for different activities. The building material for muscles, bones, and blood comes from food. You cannot have a healthy body without healthy eating and drinking. The term nutrition can also refer to the quality of someone's food choices or diet. A balanced diet is one in which foods eaten on a regular basis provide all the nutrients needed in the right amounts. A balanced diet has many benefits. It can help people feel and look their best. It can also help them stay energetic and healthy, both in the short term and later in life.

Not enough of some foods, or too much of others, can lead to illness. The body needs many different nutrients necessary to provide energy and the materials for growth, body-building, and body maintenance. Not all foods contain all nutrients. So it is not just the quantity of food eaten that is important, but also the variety. The nutrients are divided into six major types: carbohydrates, proteins, fats, vitamins, minerals, and water. Each nutrient performs specific functions to keep the body healthy.

All the nutrients work together to contribute to good health. Malnutrition is an imbalance between the body's demand for nutrients and its available supply of nutrients. It can result from an unsatisfactory diet or from a disorder that interferes with the body's use of food. In other words, good nutrition is a well-balanced diet combined with regular physical activity; however, poor nutrition can lead to reduced immunity and increased susceptibility to various diseases.

The United States Department of Agriculture (USDA) has come up with a picture of a plate to help us make sure we get all the nutrients we need each meal. Notice that the vegetables and grains portions are slightly larger than the fruit and protein portions. This gives you an idea of what foods you need to eat and how much of each.

1. ***Identify whether the following statements are true or false.***
   a) The building material for muscles, bones, and blood comes from fluid. .....
   b) People who have enough food available may still become ill because they are eating too much of a different kind of food. .....
   c) Plenty of protein can be obtained from nuts, seeds, tofu, and eggs. .....
   d) A vegetarian diet is short of protein. .....
2. ***Answer the following questions***
   a) What is a food pyramid?
   b) People try all sorts of crazy diets to lose weight. In your opinion, which is the best way to lose weight?
   c) What is the reason for anemia?

B) Vocabulary

3. ***Define briefly the following terms***

Sustainability Pollution Renewable energy Recycling Climate change

4. ***Fill in the gaps in the following using the appropriate word from the box***

renewable, solar energy, antibiotics, global warming, food safety, biodiversity, sustainable, wastewater, recycling, water pollution

a. Proper …….. helps prevent several diseases and protects public health.
b. ……. is one of the cleanest sources of electricity because it uses sunlight to generate power.
c. Industrial waste discharged into rivers is a major cause of …….
d. Before being released into rivers, ……..should be treated to remove harmful chemicals and microorganisms.
e. The unnecessary use of ……. contributes to the development of resistant bacteria.

C) Grammar

5. ***Put the verbs between brackets into the right tense***

a. Scientists (to develop) new vaccines every year to protect people from infectious diseases.
b. If the current research is successful, scientists (to produce) a more effective vaccine next year.
c. In recent years, many countries (to introduce) vaccination programmes to reduce the spread of infectious diseases.
d. While the laboratory technician (to analyse) the blood samples, the teacher explained the procedure.

6. ***Turn the following sentences into the passive form***

a. Researchers are studying the effects of genetically modified food on human health.
b. Scientists discovered the structure of DNA in 1953
c. The technician has extracted the DNA from the blood samples.
d. Hospitals use antibiotics to prevent infections after surgery.

7. Change the following into reported speech

a. The teacher said: "Don't touch the sample without protection."
b. The researcher said: "If I had more time, I would repeat the test."
c. The doctor said: "You should take the antibiotic twice a day."
d. She said: "Is the experiment ready?"

Appendix B: Post-test

A) Reading Comprehension: Read carefully the following text and answer the questions

The Immune System and the Growing Threat of Antibiotic Resistance

The immune system is the body's natural defense against harmful microorganisms such as bacteria, viruses, fungi, and parasites. It is made up of different organs, cells, and proteins that work together to protect the body from infection and disease. White blood cells play a major role in identifying and destroying pathogens before they can spread. The immune system is divided into two main parts: the innate immune system, which provides immediate but general protection, and the adaptive immune system, which develops specific responses and memory against particular pathogens. When the body detects an infection, the immune system activates a series of responses to fight the invading organisms and restore health.

Antibiotics are medicines used to treat bacterial infections by killing bacteria or stopping their growth. They have saved millions of lives since their discovery and are essential in modern medicine. However, the misuse and overuse of antibiotics have led to a serious global problem known as antibiotic resistance. Antibiotic resistance occurs when bacteria change and become strong enough to survive the effects of antibiotics. As a result, infections become harder to treat, leading to longer illnesses, higher medical costs, and increased risk of death. One major cause of antibiotic resistance is taking antibiotics without medical advice or not completing the prescribed treatment.

The immune system and antibiotics work together to protect the body. While antibiotics help eliminate harmful bacteria, the immune system continues fighting the infection and prevents future illnesses. To reduce antibiotic resistance, people should only use antibiotics when prescribed by healthcare professionals, follow the correct dosage, and avoid sharing medications with others. Improving hygiene, vaccination, and public awareness are also important ways to prevent infections and reduce the need for antibiotics.

1. Identify whether the following statements are true or false

a) The immune system protects the body from harmful microorganisms. ……....
b) Antibiotics are effective against all viral infections. …….
c) Antibiotic resistance can make infections more difficult to treat. ……..
d) Sharing antibiotics with others is recommended by healthcare professionals. ……

2. Answer the following questions

a) What is the main function of the immune system?
b) What is antibiotic resistance?
c) Mention two ways to reduce antibiotic resistance.
d) Why can the misuse of antibiotics become dangerous for public health?

B) Vocabulary

3. Define briefly the following terms

Global warming Sustainability Biofuel Ecosystem Biodiversity

4. Fill in the gaps in the following using the appropriate word from the box

renewable energy, composting, global warming, electricity, biodiversity, sustainable, wastewater, recycling, biodegradable plastics, greenhouse gases.

a. Wind and solar power are examples of ……..that reduce dependence on fossil fuels.

b. ……. are produced to decompose naturally and reduce environmental pollution.
c. Fruits and vegetable wastes can be turned into natural fertilisers through ……
d. Burning fossil fuels increases the amount of …… in the atmosphere.
e. Wind turbines generate …… without producing carbon emissions.

C) Grammar

5. Put the verbs between brackets into the right tense

a. Last year, a scientist (to discover) a new way to boost plant growth.
b. Currently, many researchers (to study) new viruses and their mutations.
c. Antibiotics ..... (become) less effective over the past years.
d. The government (to introduce) new regulations on genetically modified food next month.

6. ***Turn the following sentences into the passive voice***

a. Farmers grow genetically modified crops in many countries.
b. Researchers are studying the effects of junk food on human health.
c. The research team had completed the bioethics form before the experiment began.
d. The liver processes nutrients absorbed from the intestines.

7. Rewrite the following dialogue into reported speech

Student: *"What is the Coronavirus?"*
Researcher: *"It is a virus that affects the respiratory system."*
Student: *"Can the immune system fight it?"*
Researcher*: "Yes, but it sometimes needs medical support."*

Appendix C: Post-course Survey

Dear student,

This survey aims to evaluate your experience with the blended ESP course and to explore your perceptions of learning about sustainability in English. Your participation is voluntary, and all responses are anonymous and confidential. The collected data will be used for research purposes only. There are no right or wrong answers. Please answer each question honestly and freely based on your own experience.

The survey takes approximately 2-3 minutes to complete.

Thank you for your valuable participation.

Section A: Sustainability Knowledge and Awareness

1. Before this course, how much did you know about sustainability?
   A lot
   Some
   A little
   Nothing
2. How much do you feel your knowledge about sustainability has improved after this course?
   A lot
   Some
   A little
   Not at all
3. Which sustainability topic(s) did you find most interesting? (select all that apply)
   Food nutrition
   Antibiotics
   Vaccine Development

Immune System
Environmental Pollution
Wastewater Treatment
Biodegradable Plastics
Renewable Energy
Electric Vehicles and Smart Houses
Global Warming

Section B: Attitudes towards Sustainability

4. Compared to before the course, how has your attitude towards sustainability changed?
   Very positive
   Somewhat positive
   No change
   Negative
5. After this course, how likely are you to practise sustainable behaviours in your daily life?
   Very likely
   Likely
   Neutral
   Unlikely
   Very Unlikely

Section C: Learning Experience

6. How confident do you feel discussing sustainability topics in English now?
   Very confident
   Confident
   Neutral
   Less confident
   Not confident
7. Do you think sustainability topics should be regularly included in your English classes?
   Yes
   Maybe
   No

Section D: Feedback and Suggestions

8. What was the most useful part of the course for you?
9. What would you improve or add to the course?