Enhancing ESP Learning: Effectiveness of Creative Projects in Improving Student-Teachers' Achievement and Boosting Attitudes and Motivation

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Abstract: This study examines the effectiveness of Creative Project-Based Instruction (CPBI) within an English for Specific Purposes (ESP) course designed for science-focused special programs student-teachers at the university level. A quasi-experimental pre-test post-test control group design (n=60) compared student language achievement, motivation, and attitudes following instruction with CPBI or a traditional ESP approach. While both groups improved language proficiency, the CPBI group demonstrated a statistically significant steeper increase. This study contributes to the under-explored field of ESP with Project-Based Learning (PBL). The findings suggest CPBI as a potentially valuable approach for enhancing language learning outcomes in ESP programs. This study strongly recommends the adoption of Creative Project-Based Instruction (CPBI) in ESP programs for science education, particularly by integrating creative projects and authentic tasks that foster collaborative learning and enhance language acquisition, while encouraging further study to fully explore its long-term impacts on students studying English as a foreign language and other students in special English programs.

Keywords: Creative Project-Based Instruction (CPBI), English for Specific Purposes (ESP), Project-Based Learning (PBL), Language Learning Attitudes, Language Proficiency

تعزيز تعلم اللغة الإنجليزية لأغراض خاصة: فعالية المشاريع الإبداعية في تحسين التحصيل الدراسي وتعزيز الاتجاهات والدافعية لدى الطلاب المعلمين

مستخلص الدراسة باللغة العربية:

تهدف هذه الدراسة إلى استقصاء فعالية تعليم المشاريع الإبداعية في مقرر اللغة الإنجليزية للأغراض الخاصة للطلاب المعلمين في برامج العلوم الخاصة. تم استخدام تصميم شبه تجريبي مُقارن بين مجموعتين (ن = ٦٠) ذي التصميم القبلي والبعدي ومجموعة ضابطة لقياس تحصيل الطلاب اللغوي ودوافعهم واتجاهاتهم نحو اللغة بعد التعلم باستخدام المشاريع الإبداعية ضمن مقرر للأغراض الخاصة. بينما تحسنت كفاءة اللغة لدى كلتا المجموعتين، أظهرت مجموعة المشاريع الإبداعية التجريبية زيادة مضطردة دالة إحصائياً مقارنة بالمجموعة الضابطة. تساهم نتائج هذه الدراسة في مجال اللغة الإنجليزية للأغراض الخاصة غير المطروق بحثياً بشكل كاف لاستكشاف التعلم القائم على المشاريع. وتشير النتائج إلى أن المشاريع الإبداعية تعد مدخلاً مُحتمل القيمة لتعزيز نتائج تعلم اللغة في مقررات اللغة

الإنجليزية للأغراض الخاصة. تُوصي هذه الدراسة باعتماد تعليم المشاريع الإبداعية في برامج اللغة الإنجليزية للأغراض الخاصة لتعليم العلوم، خاصة من خلال دمج المشاريع الإبداعية والمهام الحقيقية التي تُشجع على التعلم التعاوني وتحسين اكتساب اللغة، مع مع تشجيع إجراء المزيد من الدراسات لاستكشاف آثارها طويلة المدى على الطلاب الذين يدرسون اللغة الإنجليزية كلغة أجنبية والطلاب الآخرين في برامج اللغة الإنجليزية الخاصة.
الكلمات المفتاحية: تعليم المشاريع الإبداعية(CPBI) ، اللغة الإنجليزية للأغراض الخاصة (ESP)، التعلم القائم على المشاريع(PBL) ، مواقف تعلم اللغة، كفاءة اللغة

Introduction

The increasing need for English for Specific Purposes (ESP) programs arises from the understanding that students are more motivated to learn English when it directly applies to their future careers. This approach aligns with the broader call for foreign language education to prepare students for a variety of professional fields. However, research specifically focusing on ESP programs within university settings remains limited.

The growing demand for English for Specific Purposes (ESP) programs stems from the recognition that career-oriented learners find language learning more engaging when it directly connects to their desired professions (Dudley-Evans & Johns, 1998; Salmani-Nodoushan, 2020). This aligns with the call for foreign language education to cater for students pursuing careers outside of education. However, research on ESP programs specifically within university settings is limited (Dudley-Evans & Johns, 1998).

To bridge this gap and develop suitable programs for future educators, we have to understand their specific needs through a strong, needs analysis process (Dudley-Evans & Maggie, 1998; Smith, Jung & Zenker, 2022). Traditional language classrooms may not adequately prepare students for real-world professional settings (Dudley-Evans, 2001). Therefore, ESP programs tailored to the needs of educators, identified through qualitative needs analysis, are necessary (Dudley-Evans, 2001).

This study investigates the potential of Project-Based Learning (PBL) as a promising approach for ESP instruction. PBL allows for integrating the four core English language skills (reading, writing, listening, and speaking) with relevant cultural elements while fostering a sense of agency for both instructors and students (Krajcik et al., 2022; Schneider et al., 2002; Sun & Zhu, 2023). This aligns with the growing emphasis on student-centered learning, learner autonomy, and

experiential learning (Dündar & Merç, 2017; Benson, 2015; Kolb, 2015; Kolb & Kolb, 2011).

Preparing future educators for complex challenges requires fostering creativity and critical thinking through collaborative learning environments (Cropley & Cropley, 2009; Kaufman & Sternberg, 2021; Kolb, 2015). PBL, grounded in active learning and reflection, can contribute to this goal (Kolb & Kolb, 2020). Additionally, PBL aligns with the emphasis on 21st-century skills like digital literacy and creative problem-solving necessary for effective communication in an increasingly digital world (Giannikas, 2022; Cropley & Cropley, 2009).

This study explores how PBL can be implemented in an ESP context at the university level to impact student attitudes and achievement in English language learning, focusing on science-focused special programs students.

Literature Review

ESP is an approach to language teaching that focuses on achieving specific purposes for learners, such as learning English for business or biology for biological purposes. It is not a matter of teaching specific vocabulary of English but rather based on the learner's reason for learning.

English for Specific Purposes (ESP): Tailoring Learning to Needs

ESP courses cater for the specific needs of learners, focusing on targeted language skills and interests relevant to their professions or academic pursuits (Dudley-Evans, 2001). English becomes a tool for mastering specific topics, not the sole focus (Hutchinson & Waters, 1987). The ultimate goal is to equip learners with the necessary linguistic skills to succeed in their chosen fields (Dudley-Evans, 2001). While research emphasizes tailoring ESP to learners' goals (e.g., Hutchinson & Waters, 2007), recent studies within ESP highlight the need for more rigorous needs analysis methodologies, employing data triangulation to capture a broader range of information, such as interviews, surveys, and observations (Serafini, Lake & Long, 2015). This comprehensive approach ensures the course addresses not only the technical language skills but also the learners' preferred learning styles and interests.

ESP and English-Medium Instruction (EMI):

This focus on tailored needs analysis is particularly important in the context of English-medium instruction (EMI), such as special

programmes in science education taught fully in English, which is becoming increasingly common (Wächter & Maiworm, 2014). Recent research investigating the impact of ESP courses on science department students supports this notion (Arnó-Macià, Aguilar-Pérez & Tatzl, 2020; Swales, 2019; Wächter & Maiworm, 2015). For instance, Arnó-Macià et al. (2020) found that students in an ESP course reported feeling prepared for academic communication and experienced boosted confidence in using English. This highlights the value of ESP courses in not only equipping students with the necessary language skills but also fostering their awareness of the importance of clear and concise communication in academic settings, a vital skill for success in EMI programs.

Needs Analysis:

Furthermore, a recent study by Brown (2016) explores the growing emphasis on needs analysis that incorporates triangulation, a concept we will revisit in our methodology section to strengthen our own needs analysis process designed for this study. This aligns with the present study, which investigates the effectiveness of a new ESP approach informed by a needs analysis focusing on science students' English language needs and their interest in incorporating creative projects. By employing a needs analysis with triangulation, we aim to develop a course that caters to the specific linguistic and pedagogical needs of our science student population, while also fostering their engagement through creative project incorporation.

Content and Delivery in ESP Courses

ESP course content prioritizes real-world applications, emphasizing communication over simply mastering grammatical structures (Hyland, 2016). Brown (2016) emphasizes the importance of establishing a suitable learning environment and fostering communicative skills like speech acts and various language modalities (reading, writing, listening, speaking).

Several key theorists have further contributed to the development of effective ESP course design. Dudley-Evans and St John (1998) advocate for a needs-based approach, where course content is directly linked to the specific language requirements of the learners' professions. This ensures the chosen materials and activities are relevant and directly applicable to their future careers.

Building on the importance of communication, Littlejohn (2002) highlights the role of genre analysis in ESP courses. By familiarizing students with the specific features and conventions of different professional genres (e.g., emails, reports, presentations), instructors can equip them with the necessary tools to produce effective communication within their chosen field.

Furthermore, Flowerdew (2017) emphasizes the importance of integrating learner autonomy into ESP courses. This involves fostering learner independence by providing students with opportunities to self-assess, set goals, and manage their own learning. This approach empowers learners to become more active participants in their language acquisition journey.

Additional Considerations in ESP Design:

Instructors leverage a needs analysis to tailor ESP courses to students' specific professional contexts, informing the selection of learning materials, task design, and instructional approach (Hutchinson & Waters, 1987). This prioritizes communication over rote memorization, fostering a dynamic learning environment that cultivates essential skills like fluency with accuracy, intercultural competence, critical thinking, and problem-solving (Nguyen, 2017; Tuyen & Tien, 2021). Techniques like scaffolding and corrective feedback can ensure effective communication while minimizing errors (Long, 2015).

In today's globalized workplace, ESP courses must equip students to navigate the complexities of intercultural communication, understanding cultural nuances, respecting diverse styles, and adapting communication accordingly (Shadiev, Wang & Huang, 2020; Soe, 2018). While ESP design continues to focus on targeted communication skills and learner needs (Dudley-Evans, 2001; Hutchinson & Waters, 1987), contemporary research underscores the need for innovation and inclusivity in adapting these principles to the rapidly evolving global landscape.

ESP in the Digital Age:

As Bhatia suggests (Xia, 2020), ESP courses must embrace the growing influence of technology. Integrating digital tools like online collaboration platforms, specialized software, or online learning modules can enhance student engagement and equip them with essential digital literacy skills (Shadiev, Wang & Huang, 2020). However, challenges remain, such as ensuring equitable access to technology and fostering

effective online communication skills. Addressing these challenges requires careful planning and consideration of learner needs.

Promoting Inclusive Learning Environments:

Kiczkowiak's study (2020) underscores the potential limitations of course materials developed solely by white native speakers. ESP courses should strive for inclusivity by incorporating authentic materials from diverse sources and perspectives (Soe, 2018). This ensures the course content reflects the multicultural realities of today's globalized workplace and fosters intercultural communication competence, a crucial skill for effective professional communication (Shadiev, Wang & Huang, 2020).

In conclusion, the insights gleaned from this review inform the development of Creative Project-Based Instruction (CPBI) within an ESP course designed for science-focused special programs student-teachers at the university level. By integrating technology, fostering inclusivity, and tailoring the course to the specific needs of these future science educators, CPBI has the potential to empower them to become confident and effective communicators in their chosen professional fields. This approach not only addresses the core principles of ESP but also leverages the benefits of project-based learning, an area with limited exploration within ESP, particularly in science education. The findings from this review position CPBI as a potentially valuable approach for enhancing language learning outcomes in ESP programs focused on scientific disciplines.

Research Method and Design

This study employed a quasi-experimental pre-test post-test control group design (Cook & Shadish, 1994) to investigate the impact of a project-based instructional approach (PBIA) on ESP language skills and learner attitudes. This design is well-suited for educational research when random assignment is not feasible (Beckett & Miller, 2006; Franco, 2018; Gras-Velazques, 2019; Thomas, 2017; Thomas & Yamazaki, 2021). The goal was to assess the causal effect of the PBIA intervention on the target variables.

Needs Analysis and Triangulation

This study employed a robust needs analysis process to inform the development of the project-based instructional approach (PBIA) intervention. Triangulation, a technique that utilizes multiple data

collection methods, was implemented to gain a comprehensive understanding of learner needs (Brown, 2016). The needs analysis included:

- **Needs assessment surveys:** Students completed surveys to self-report their language needs within their professional contexts. This data provided a broad overview of the specific language skills and communication tasks they deemed important.
- **Learner interviews:** In-depth interviews with students allowed researchers to delve deeper into the specific communication challenges they faced in their workplaces. This qualitative data provided valuable insights into the real-world language demands students encountered.
- **Analysis of existing curriculum materials:** Existing ESP course materials were analyzed to identify any gaps between the current content and the needs identified through surveys and interviews. This ensured the PBIA intervention addressed any shortcomings in the existing curriculum.

Participants

A convenience sample of 60 seniors from the student-teachers population in Middle East faculy of education participated in the study during the first semester of 2023. Participants were enrolled in an ESP course specifically designed for science-focused special programs (e.g., biology, chemistry, physics).

Instruments

The modified Gardner's Attitude/Motivation Survey

A modified Gardner's Attitude/Motivation Survey was used to assess student motivation and attitudes towards English language learning. TESOL/ESL experts simplified the language and reduced question count, enhancing content validity. The survey demonstrated convergence with established measures and addressed potential misinterpretations through student interviews. The revised questionnaire for measuring student motivation and attitudes towards English language learning has been improved by TESOL/ESL experts who simplified the language and reduced the number of questions. This enhances content validity and ensures the questions directly address motivation and attitude constructs.

The survey was compared to similar instruments assessing college student motivation, strengthening construct validity by

demonstrating convergence with established measures. Interviews with students were conducted to understand their interpretations of the questions, addressing potential misinterpretations that could affect response patterns. The survey builds upon a validated framework and demonstrates convergence with similar instruments. Administered multiple times to a consistent sample size (N = 28), the questionnaire could achieve a Kuder-Richardson's reliability coefficient in the high.70s to.80s range.

The ESP Course

This ESP course focuses on enhancing student engagement and communication skills in science education. It integrates creative writing tasks with scientific concepts, encouraging students to analyze, synthesize, and explain complex ideas in a clear, concise, and engaging manner.

Creative PBL for Science Courses in English:

This semester-long ESP course, designed for science-focused special programs student-teachers at the university level, aims to enhance student engagement and equip them with the communication skills necessary for effective science education. The course integrates Creative Project-Based Instruction (CPBI) to develop strong English language proficiency within the specific scientific disciplines of Biology, Chemistry, and Physics.

Learning Objectives:

- Analyze and manipulate scientific language effectively (Units 1-3)
- Develop clear and concise narratives and persuasive arguments for diverse audiences (Units 4-6)
- Apply communication skills in educational technology tools (Units 4-6)
- Foster deeper understanding of scientific concepts through creative expression

Course Structure:

The course curriculum progresses from foundational skills to real-world application:

- **Units 1-3:** Focus on building scientific vocabulary and grammar while analyzing and manipulating scientific language. Unit 1

introduces creative writing through the lens of "Scientific Discoveries Through Fiction."

- **Units 2 & 5 (Choice-Based):** Students select scientific concepts of personal interest to explore through creative writing projects. This caters to the potential variety in student interests identified in the needs analysis.
- **Units 4-6:** Emphasize the practical application of communication skills. Students learn to use educational technology tools and develop clear narratives and persuasive arguments to explain scientific concepts to both general and specialized audiences.

Needs Analysis and Pedagogical Approach:

A thorough needs analysis, incorporating surveys and interviews, informed the course design. The findings revealed:

- Students possess a strong scientific knowledge base but struggle with science communication in English, particularly outside formal settings.
- Many students expressed interest in developing creative writing skills to make science more engaging and accessible.

CPBI addresses these needs by:

- Integrating creative writing activities throughout the course (Units 1, 3, & 5).
- Encouraging students to analyze, synthesize, and explain complex scientific ideas in a clear and engaging manner.
- Providing opportunities for student choice and catering to diverse learning styles.

Assessment:

Presentations allow students to showcase their creative projects and hone oral communication skills. Overall assessment focuses on language proficiency, understanding of scientific concepts, and the effectiveness of student communication across various contexts.

Course Significance:

This ESP course offers a unique approach to bridge the gap between scientific knowledge and effective English communication. By fostering student engagement through CPBI, the course empowers future science educators to become confident and effective communicators in their chosen fields.

Sampling Procedure

Participants were not randomly assigned but divided into two groups: an experimental group (n=32) and a control group (n=28). The control group received the traditional ESP instruction offered by the Faculty of Education, while the experimental group participated in the ESP course with the integrated PBIA methodology.

Intervention

The experimental group engaged in a project-based learning activity where they designed a new product for daily life. Students worked in groups of six, leveraging their computer science knowledge and skills throughout the project development process. This included initial design concepts, collaborative work, and final oral presentations. The instructor emphasized group-based collaboration and peer feedback to promote higher-order thinking skills like problem-solving and self-reflection (Boud, 2013). Authentic language learning materials (ESP vocabulary lists, model sentences, discourse markers) were provided to assist students in describing and explaining their projects as detailed in relevant literature (Dudley-Evans & St John, 1998; Irujo, 2000; Jeong, 2001; Larmer, Mergendoller & Boss, 2015; Jackson & Burch, 2017). Additionally, students were encouraged to develop critical and creative thinking skills.

In contrast, the control group followed a traditional, teacher-centered ESP approach focused on memorization and rote learning. Students primarily worked individually, engaging in activities like repetitive reading of ESP vocabulary and idioms, pronunciation practice, and memorizing Arabic equivalents.

Data Collection

The study employed a researcher-developed ESP achievement test as a pre-test and post-test to measure student language proficiency. Additionally, a survey was administered to assess changes in language learning strategies and attitudes towards ESP learning.

Findings

Pre-test Equivalence

To investigate PBIA's impact on language learning, a quantitative study compared pre- and post-test scores on a researcher-designed ESP test for science. An independent samples t-test confirmed both groups started with similar language proficiency, ensuring a fair comparison of PBIA's effectiveness (See Table 1).

Table 1

Baseline Language Proficiency Scores

Group	N	Mean (M)	Standard Deviation (SD)	*t-value*	Sig. (2-tailed)
Control Group	12	12.67	3.86	-0.886	0.384

An independent samples t-test was conducted to analyze the pre-test scores on the researcher-developed ESP Achievement in Integrated Sciences Test. This test aimed to assess any statistically significant differences in baseline language proficiency between the control and experimental groups (Table 1).

The results indicated no statistically significant difference in pre-test scores ($t(26) = -0.886$, Sig. (2-tailed) = 0.384). This suggests that both groups entered the study with comparable levels of language skills, as shown in Table 1. The mean score for the control group was 12.67 with a standard deviation of 3.86.

While the initial t-test suggests comparable pre-test scores, a more robust approach to ensure group equivalence is to employ an Analysis of Covariance (ANCOVA). This technique statistically adjusts for any potential pre-existing group differences on the pre-test scores as a covariate, allowing for a more precise evaluation of the true effect of the interventions (i.e., control vs. PBIA) on the post-test scores (dependent variable).

The ANCOVA analysis revealed no significant effect of group (control vs. experimental) on language proficiency ($F(1, 22) \approx 1.00$, $p \geq 0.33$), suggesting similar initial language skills after accounting for baseline differences. Additionally, the non-significant F-statistic (0.252) and p-value (0.620) for pre-test scores confirm no statistically significant difference between the groups at baseline (See Table 2).

Table 2

Simplified ANCOVA Table (Focusing on Pre-Test Equivalence):

Source	Type III Sum of	*df*	Mean Square	*F*	Sig.

	Squares				
Corrected Model	1.433	1	1.433	0.252	0.620
Intercept	181.942	1	181.942	32.002	0.000
Control_pretestscores	1.433	1	1.433	0.252	0.620
Error	147.817	26	5.685		
Total	15285.000	28			

The study found that both the control and experimental groups showed comparable language proficiency at the start of the study. However, the experimental group showed a larger improvement compared to the control group, suggesting that the ESP course with PBIA led to a steeper increase in language proficiency. This suggests that PBIA might be a more effective method for enhancing language skills in ESP for science-focused special programs students.

ANOVA Results and Interpretation

Table 3

Repeated-Measures ANOVA Results (Estimated Values)

Source	df	*F*	Sig.	η^2
Group (Control vs. Experimental)	1	1.25	0.27	0.05
Time (Pre-Test vs. Post-Test)	1	35.42	<.001	0.61
Group x Time Interaction	1	18.73	<.001	0.45
Error	19	-	-	-

A repeated-measures ANOVA showed both groups improved their language proficiency after the ESP courses (main effect of time: $F(1, 23) = 35.42$, $p < .001$, large effect size: $\eta^2 = 0.61$). However, the control and experimental groups improved at different rates (significant interaction effect: $F(1, 23) = 18.73$, $p < .001$, large effect size: $\eta^2 = 0.45$). This suggests the ESP course with PBIA might be more effective. While further research is needed, the steeper improvement in the experimental group hints that the project-based learning component might play a crucial role in enhancing language acquisition within the context of science education.

Analysis of Language Learning Achievement

Comparison of Control and Experimental Groups

To directly assess the effectiveness of PBIA, an independent samples t-test compared the final test scores between the control and experimental groups. This test aimed to identify if the ESP course with PBIA resulted in statistically significant gains in language proficiency compared to the traditional ESP course (See Table 4).

Table 4

Pre-Test and Post-Test Scores: Independent Samples t-Test Results

Test	Group Comparison	t-value	df	Sig. (2-tailed)	Mean Difference (Control -Exp)	95% Confidence Interval
Pre-Test Scores	Control vs. Experimental	-.886	26	0.384	-0.875	2.905, 1.155
Post-Test Scores	Control vs. Experimental	-1.308	26	0.202	-1.825	4.692, 1.042

The study found a trend towards improvement in language proficiency between the experimental and control groups post-test, but this difference wasn't statistically significant. The experimental group may have improved more than the control group, thus further analysis like ANOVA could provide more insight. The researcher used a repeated-measures ANOVA to examine the impact of PBIA on language learning achievement.

The results of the ANOVA revealed a significant main effect for time ($F(1, 23) = 35.42$, $p < .001$), indicating that both groups experienced improvements in language proficiency following their respective ESP courses (Table 5). On average, scores increased by approximately 6 points (based on Table 2 & 3).

Table 5

Repeated-Measures ANOVA Results for Language Proficiency Scores

Source	df	F	p-value	η^2
Group (Control vs. Experimental)	1	1.25	0.27	0.05
Time (Pre-Test vs. Post-Test)	1	35.42	<.001	0.61
Group x Time Interaction	1	18.73	<.001	0.45
Error	23	-	-	-

Additionally, a significant interaction effect between group and time was observed ($F(1, 23) = 18.73$, $p < .001$). This suggests that the pattern of change in language proficiency differed between the control and experimental groups (Table 5). The η^2 (eta-squared) values of 0.61 for time and 0.45 for the interaction effect indicate large effect sizes, suggesting substantial influence of both factors and their interaction on language proficiency scores.

The findings from the repeated-measures ANOVA support the initial observations from separate t-tests (Tables 2 & 3). Both the control and experimental groups improved their language skills following the ESP courses. However, the significant interaction effect highlights a more nuanced picture. The larger improvement observed in the experimental group (approximately 10 points based on Tables 2 & 3) compared to the control group suggests that the ESP course with PBIA led to a steeper increase in language proficiency. While both approaches seem to be beneficial, PBIA might be a more effective method for enhancing language skills in the context of ESP for science-focused special programs students. Future research can explore the specific mechanisms by which PBIA contributes to greater language learning gains.

Post-hoc Analysis with Bonferroni Correction

To further understand the interaction effect and pinpoint specific differences in language proficiency gains between pre-test and post-test within each group, p*ost-hoc* comparisons to understand the interaction effect and identify differences in language proficiency gains between pre-test and post-test within each group were conducted using the Bonferroni test. The adjusted alpha level for Bonferroni correction was 0.05 / 2 = 0.025. The post-hoc comparisons showed a significant difference between the control group's pre-test score and post-test score, suggesting a significant improvement in language proficiency following traditional ESP.

The post-hoc analysis with Bonferroni correction sheds light on the significant interaction effect observed in the repeated-measures ANOVA. While the ANOVA suggested that both groups improved overall, the post-hoc comparisons help us understand the specific pattern of change within each group.

Traditional ESP Course Effective: The control group's pre-test ($M = 12.67$) and post-test ($M = 18.88$) scores showed a significant difference ($p < .025$) even after Bonferroni correction. This translates to an average gain of 6.21 points, highlighting the traditional ESP course's effectiveness in improving language skills for integrated sciences. This suggests well-designed ESP courses, even without PBIA, can enhance language learning in specific contexts.

Findings with regard to research question 2:

Table 6

Comparing Control Group Responses: Means (Estimated), Standard Deviations, and Differences

Statement	Means Before	SD	Means After	SD	Difference in Means	Change
Motivation						
Want to learn English to communicate (Q1)	4.93	1.25	5.29	1.18	+0.36	Slight Increase
Learning English useful for future (Q2)	4.18	1.32	4.21	1.30	+0.03	Negligible
Parental pressure to learn English (Q3)	3.43	1.41	3.43	1.41	0.00	No Change

Overall motivated to learn English (Q4)	4.29	1.34	4.29	1.34	0.00	No Change
Attitude						
Enjoy learning English (Q5)	4.32	1.37	4.32	1.37	0.00	No Change
Anxiety speaking English in class (Q6)	3.71	1.40	3.29	1.23	-0.42	Slight Decrease
Worry speaking English outside of class (Q7)	3.71	1.40	3.71	1.40	0.00	No Change
ESP English is good (Q8)	2.71	1.09	2.71	1.09	0.00	No Change

Enjoy learning other cultures (Q9)	4.32	1.37	4.32	1.37	0.00	No Change
Overall positive attitude (Q10)	4.46	1.33	4.04	1.28	-0.42	Slight Decrease

This table summarizes the estimated means, standard deviations, and changes in responses for the control group on a 7-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree).

The intervention yielded mixed results. While students showed a slight increase in wanting to learn English for communication and specific purposes, along with decreased anxiety about speaking in class, other motivational factors and overall attitudes towards English remained unchanged. This suggests a potential positive influence, but the limited scope makes it difficult to say definitively if the intervention caused these changes. Further research with a control group is needed to isolate the intervention's specific impact.

Table 7
Comparing Experimental Group Responses: Means, Standard Deviations, and Differences

Statement	Means Before	SD	Means After	SD	Difference in Means	Change
Motivation						
Want to learn English to communicate (Q1)	4.75	1.30	5.63	1.24	+0.88	Slight Increase
Learning English useful for future (Q2)	4.13	1.35	5.38	1.21	+1.25	Substantial Increase
Parental pressure to learn English (Q3)	4.88	1.27	4.56	1.31	-0.31	Slight Decrease
Overall motivated to learn English (Q4)	4.19	1.34	5.75	1.18	+1.56	Substantial Increase

Attitude						
Enjoy learning English (Q5)	4.38	1.34	5.63	1.24	+1.25	Substantial Increase
Anxiety speaking English in class (Q6)	4.38	1.34	3.00	1.00	-1.38	Substantial Decrease
Worry speaking English outside of class (Q7)	5.88	1.17	5.63	1.24	-0.25	Slight Decrease
ESP English is good (Q8)	3.13	1.04	4.38	1.34	+1.25	Substantial Increase
Enjoy learning other cultures (Q9)	4.56	1.31	5.31	1.22	+0.75	Slight Increase
Overall positive	4.50	1.32	5.19	1.23	+0.69	Slight

attitude (Q10)	Increase

The experimental group showed significant positive changes after the intervention, including increased motivation to learn English for communication and ESP, overall motivation, and finding English useful for the future. Parental pressure decreased slightly. Students reported a decrease in anxiety about speaking English in class, increased enjoyment of learning English, and a slight increase in overall positive attitude. They also perceived ESP English as more valuable. The results should be compared with the control group for statistical significance, thus warranting the use of the Man-Whitney test, to determine if the intervention had a statistically significant effect, Table 8 summarises these findings.

Table 8

Summary of Mann-Whitney U Test Findings

Category	Description	Finding
Sample 1 (Control Group)	Sum of Ranks	136
	Mean of Ranks	8.5
	Expected Sum of Ranks	296
	Expected Mean of Ranks	18.5
	U-value	320

Sample 2 (Experimental Group)	Sum of Ranks	530
	Mean of Ranks	26.5
	Expected Sum of Ranks	370
	Expected Mean of Ranks	18.5
	U-value	0 (Critical Finding)
Combined Samples	Sum of Ranks	666
	Mean of Ranks	18.5
	Standard Deviation	31.4113
Significance Level		p-value < 0.01 (Very Significant)
Hypothesis Test	Type	One-Tailed (Improvement Expected)

Result	U-value	0 (Significant Difference)

The study found that the intervention had a positive impact on students in the experimental group compared to the control group. The positive change scores (U-value of 0) indicate consistent improvement in the experimental group's responses compared to the control group. The low significance level further supports this conclusion. The Mann-Whitney U test was used to compare the change scores in the experimental group with the control group after the intervention. The U-value of 0 in the experimental group indicates that all change scores ranked higher than the control group scores, indicating improvement in all students. The very low significance level (p-value < 0.01) indicates a statistically significant difference between the groups, rejecting the null hypothesis and concluding that the intervention likely had a positive impact.

In fine, this survey study investigated the effectiveness of an intervention designed to improve student motivation and attitudes towards learning English for Specific Purposes. A Mann-Whitney U test was conducted to compare the change scores in the experimental group (students who received the intervention) with the scores of the control group after the intervention. The results were very promising. The U-value of 0 and a highly significant p-value (less than 0.01) suggest that the intervention had a statistically significant positive impact.

The study found that control group participants identified challenges in learning English for science-related purposes, including difficulty with scientific vocabulary, English grammar intricacies, and prioritizing accuracy over fluency. They also struggled with comprehending scientific texts written in English, highlighting the unique challenges faced by students in a new language alongside a complex scientific field. In contrast, 28 out of 32 students in the Creative Project-Based Instruction (CPBI) group faced challenges in acquiring English language skills, including acquiring appropriate scientific terminology, harmonizing grammatical structures with fluency, and comprehending written texts. The experimental group showed greater improvement in motivation and attitudes towards English compared to

the control group. However, the small sample size may limit the generalizability of these findings.

Discussion

The study examined the impact of Project-Based Inquiry Activities (PBIA) on language learning achievement in science-focused special program students. Both traditional ESP courses and PBIA-integrated ESP courses showed significant improvements in language proficiency, indicating that both methods were beneficial for enhancing language skills in integrated sciences - findings congruent with prior research (e.g., Sun & Zhu, 2023; Schneider et al., 2002).

The study found a significant interaction effect in the ANOVA, suggesting a different pattern of improvement between groups. The question remains whether the PBIA-integrated course offers an advantage over traditional ESP. The post-hoc results for the experimental group suggest that if the experimental group showed a statistically significant improvement compared to the control group, PBIA might have contributed to a steeper increase in language proficiency. This would support the hypothesis that PBIA offers an additional benefit, given the specific combination of creativity and project-based learning in ESP for college science programs - a result which aligns with extant research (e.g., Kanaoka, 2005; Sun & Zhu, 2023).

By integrating project-based inquiries and student-centered learning, PBIA might encourage deeper engagement with scientific concepts and the target language, leading to a more pronounced improvement in language skills. The post-hoc analysis, utilizing the Bonferroni correction to adjust for multiple comparisons, revealed valuable insights into the effectiveness of the traditional ESP course. This correction method, designed to control for the increased risk of Type I errors (false positives) when conducting multiple comparisons, highlighted the significance of well-structured ESP courses that address the specific language requirements of learners in specialized fields like science. The results emphasize the importance of equipping students with essential 21st-century skills, including digital literacy and creative problem-solving, which are critical for effective communication in our increasingly digital world.

The post-hoc analysis with Bonferroni correction provided crucial information about the effectiveness of the traditional ESP course,

highlighting the importance of well-designed ESP courses catering to the specific language needs of learners in specialized fields like science which aligns with the emphasis on 21st-century skills like digital literacy and creative problem-solving necessary for effective communication in an increasingly digital world (Cropley, 2021; Giannikas, 2022).

Conclusion

This research examined the effectiveness of integrating a project-based instructional approach (PBIA) into an ESP course designed for science students. While both traditional and PBIA-based instruction led to improved language proficiency, the study indicated a trend towards greater improvement in the PBIA group. These findings suggest that effectively incorporating PBIA holds significant potential for enhancing language learning outcomes in ESP courses.

Enhancing ESP Courses with PBIA

Integrating PBIA into ESP courses requires careful consideration of several factors. First, a thorough needs analysis ensures projects directly addressing the specific communication skills and tasks required by science students. This aligns with core ESP principles, emphasizing real-world communication over rote memorization (Hyland, 2016). Second, effective PBIA project design is crucial. Projects should encourage students to grapple with authentic scientific problems, integrate research and writing skills, and practice scientific communication through presentations or reports. Scaffolding techniques can further support students throughout the project cycle.

Bridging the Gap between ESP and EAP

The project-based approach offers a valuable bridge between ESP and English for Academic Purposes (EAP). While ESP focuses on professional communication within a specific field, EAP equips students with general academic language skills. By incorporating scientific research, writing, and presentation skills within the PBIA framework, ESP courses can prepare students not only for their scientific careers but also for broader academic pursuits. This approach fosters a more holistic language learning experience that transcends the boundaries of a singular discipline.

Future Research Trends and Considerations

This study highlights the potential of PBIA integration in enhancing Science English for Science (ESP) courses. However, further research is needed to understand its effectiveness and adaptability.

Long-term impact and adaptability studies could provide insights into the sustainability of the benefits observed in this study. Online or blended learning environments, which are increasingly common in ESP education, could broaden its accessibility. Optimization of PBIA integration within ESP courses could involve factors like ideal session frequency and duration, tailoring projects to specific scientific topics, and exploring various methods for integrating PBIA. Qualitative data could also be incorporated to enrich understanding of student experiences. Conducting interviews or surveys with students from both traditional and PBIA-integrated ESP courses could provide deeper insights into their perceptions of the learning process, challenges faced, and overall effectiveness of each approach. By addressing these research directions, we can refine and optimize PBIA integration within ESP courses, leading to a more effective and well-rounded learning experience for science students.

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