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Generative AI-Supported Project-Based Learning in EFL: Impacts on Student Engagement and Learner Agency

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ABSTRACT

The growing integration of Generative AI (GenAI) tools in language education presents new opportunities for enhancing learner engagement. However, empirical evidence on their effectiveness remains limited, particularly in project-based and collaborative contexts. This study examined the impact of integrating GenAI tools into collaborative Project-Based Language Learning (PBLL) on EFL undergraduates' engagement and agency. Using a quasi-experimental pre-/post-test control group design and a sequential mixed-methods approach, the study combined quantitative questionnaire data with qualitative reflections. Results showed significant improvements across emotional, behavioural, cognitive, and agentic engagement dimensions, with the most substantial gains in emotional and agentic domains. Student reflections supported these findings, revealing increased motivation, confidence, participation, and a stronger sense of autonomy. Emotional responses evolved from initial uncertainty to enthusiasm, while students demonstrated leadership and self-directed learning. Participants valued the combination of GenAI with peer collaboration and teacher support, highlighting the importance of balancing technology with human interaction. The study underscores the potential of GenAI-driven PBLL to create engaging, learner-centred environments and offers practical insights for educators seeking to integrate AI meaningfully. It calls for inclusive, autonomy-supportive learning conditions that scaffold the use of GenAI while fostering reflective, active, and personalized language learning experiences.

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1. Introduction

The evolving landscape of English as a Foreign Language (EFL) teaching is being driven, in part, by online learning environments and the potential integration of AI [1]. These innovations are flexible, resource-rich, and student-directed approaches for immersive language learning. In particular, generative AI (GenAI) is transforming how learners engage with and acquire languages [2]. Tools such as ChatGPT— a large language model (LLM) from OpenAI—deliver personalised learning, allow for asynchronous learning, and have the potential to transform higher education [3]. This transformation points to the importance of examining how these current EFL technologies shape learners' experiences.

The increase of GenAI adoption, as noted by Wang et al. [4], is a reaction to continuing challenges with the L2, large class time, and limited speaking and listening practice time in a low-stress environment [5]. Teachers also face difficulties in providing a meaningful level of personalised feedback to their large classes [6]. As AI becomes commonplace in students' lives, educators must integrate it in a meaningful manner into their instruction [7]. However, concerns persist about overreliance and ethical issues such as plagiarism [8].

Interest in Generative Artificial Intelligence (GenAI) as part of language learning is on the rise. Studies have outlined the potential usefulness of these tools for both L2 acquisition and learning motivation [1,3,4,9]. However, to date, there is still a clear empirical, design-based gap in research. It seems most of the literature has been focused on the earlier adoption of AI tools that are not generative, while overlooking the later and developing nature of GenAI tools/assistance [10–12]. In addition, studies of other AI-oriented learning interventions have included a small number of learners in their studies [7,13,14], and they have largely focused on the perceived benefits of the interventions rather than how GenAI assists in deeply (cognitive, affective, and behavioral) enhancing or improving the learning processes. See also Wang et al. [4]. Likewise, many studies used descriptive rather than interventionist or experiment-like approaches to research design, which contributed to uncertainty and the ability to improve actual learning processes [15–17]. This all together raises questions about the ability of the existing research to support learning improvement and effectiveness. What is required to ensure the validity of using GenAI tools as part of L2 learning is substantial empirical research using effectiveness frameworks to assess GenAI to support measurable performance in real-world language learning experiences and in a variety of education contexts that have their challenges and needs for planning and teaching.

Heutagogy, or self-determined learning, is a fundamental part of effective L2 learning, as proposed by Hase and Kenyon [17]. Heutagogy is characterized by an emphasis on autonomy, reflective practice, and the development of independence and capability. The definitions of double-loop learning and self-assessment, where learners can assess their assumptions, beliefs, and effectiveness and seek the feedback of others in order to overcome new situations, are paramount in evaluation.

In a similar spirit, Kukulska-Hulme and Viberg [18] has urged researchers to make learning that relates to learners' needs, beliefs, and contexts more important than research on technological features, reinforcing the importance of understanding how people engage with digital tools in ways that are meaningful to them. Linked to this, Vanderplank [19] argued that it is better to study the "effects with" and "effects through" technology rather than the "effects of" technology, as learners used tools to take agency to shape their learning and pursue personal goals. This perspective on technology reiterates the potential that technology has to continue to transform language learning, which can be leveraged to provide learners with personalized, autonomous, and context-sensitive experiences that are not accommodated by traditional approaches.

Therefore, the current research suggests that employing GenAI-enabled collaborative Project-Based Learning (PBL) projects could accelerate the integration of technology within the curriculum and likewise might support learners in developing heutagogy that aligns with their focused learning objectives. These technologies may offer opportunities that

we have not yet considered, allow for non-linear learning for both active participation and individual/group stages, enable real-time tracking and visualization of language acquisition progress, provide responsive feedback to individuals on how to improve, and more [1]. Similarly, GenAI-enabled collaborative projects consolidate the benefits of collaborative learning and GenAI tools, adding AI assistance to human-to-human collaborative activity while advancing collaborative practice in second language acquisition and foreign language learning.

Building on the identified research gaps, the present study investigates how GenAI-driven collaborative projects impact language learning engagement and learner agency among EFL undergraduates. By examining interactions within human-AI collaborative contexts, this research aims to illuminate the transformative potential of such engagements. Furthermore, it seeks to offer insights into how human and GenAI interactions enhance learning outcomes, bridging the divide between perceived benefits and tangible educational advancements in language learning. In essence, this research addresses two primary research questions:

RQ1: What is the impact of GenAI-driven collaborative Projects on enhancing language learning engagement and learner agency among EFL undergraduates?
RQ2: What benefits, challenges, and implications do EFL undergraduates link to implementing these projects for boosting language learning engagement and nurturing learner agency?

The findings of this research will profoundly influence English as a second language (ESL)/EFL learners, combining technology and language learning with projects driven by GenAI. The research contributes to teachers' pedagogical practices by demonstrating practical possibilities of implementing project-based language learning (PBLL). A significant objective is to change second language (L2)/EFL approaches to learning by emphasizing the importance of generative technologies. There are implications for language learning in terms of student engagement and agency for all stakeholders, course instructors, developers, and policy decision-makers. Focusing on finding ways to help EFL university students build important 21st-century skills is important in empowering learners to deal with contemporary technology.

2. Literature Review

2.1. Generative AI in Language Learning: Transformative Potential and Applications

Generative AI (GenAI) denotes a suite of AI technologies that can create original content, including text, images, and audio, at scale, based on patterns identified in large data sets. Many GenAI tools are based on large language models (LLMs), including OpenAI's GPT series, that leverage transformer-based deep learning to analyse, learn, and produce linguistic data at scale. Rather than generating text based on rules or instructions, LLMs can produce fluent and relevant writing either via deploying prompt instructions or in response to user prompts, because they are trained across diverse language patterns. It is also important to understand that LLMs do not have to understand language or context, they emulate human-like output by predicting the most likely next word based on context. In educational contexts, enabling these generative activities allows for ChatGPT to facilitate conversations in ways that simulate students chatting with a peer or instructor, receive personalized learning feedback to initially scaffold language practice in interactive and responsive manners, and receive timely dialogic supports with natural poses and focus away from their devices.

GenAI is expanding on these capabilities to change Second Language Acquisition (SLA) through a more adaptive, personal, and learner-centered design. When utilized in Intelligent Computer-Assisted Language Learning (ICALL) environments, GenAI provides on-time feedback, matched to context, and helps in providing low-stress, motivation-increasing conditions for learners [20–22]. GenAI tools are capable of providing real-world language experience, while closely following lead learners' proficiency levels and contextual challenges/goals [23]. These affordances would provide timely scaffolding in line with Vygotsky's Zone of Proximal Development [24] to enhance meaningful language learning [7].

Empirical studies increasingly illuminate both the strengths and limitations of GenAI in language learning. For example, Lee et al. [25] examined AI chatbots in English as a Lingua Franca (ELF) contexts and found that although AI chatbots did enhance learners' awareness of different Global Englishes and their confidence, learners risked relying so heavily on chatbots that they were missing out on the

essential human interaction that is a hallmark of language practice involving the nuances necessary in interpersonal communication. Similarly, Wang et al.[4] investigated an AI-based coach in primary EFL contexts - they reported that learners' enjoyment and cognitive presence increased, but learning outcomes substantially decreased because of diminished teacher presence—suggesting that AI cannot replace the socio-emotional presence of teachers. Recent research in Saudi Arabia explored EFL teachers' perceptions of ChatGPT, found it useful for lesson-planning, assessment design, and student engagement, yet concern remained about over-reliance on ChatGPT as less critical thinking occurred[26].

In the context of higher education, Yuen and Schlote[1] explored students' experiences with AI-powered mobile apps, highlighting their effectiveness in supporting vocabulary and grammar acquisition in the early stages of learning. However, participants reported that these tools lacked the complexity needed for higher-order language skills, such as argumentative writing or discourse negotiation. Complementing this, Liu et al.[27] introduced the CALLA-LLM model, integrating GenAI into a cognitive academic language learning framework. Their study showed improvements in EFL learners' writing proficiency and self-regulated learning. Notably, the researchers emphasized that the success of the intervention depended heavily on teacher facilitation, again affirming the irreplaceable role of human educators.

These findings consequently highlight a consistent message: GenAI tools have advantages (e.g., outward accessibility, personalization, and engagement), but AI cannot replicate the socio-cognitive aspects of human social interaction. Studies have been clear and consistent that applying AI in ways that substitute, and not complement, the contribution of a human, has the potential to undermine important emotional and pedagogical support required for learner development over an extended period[28,29].

This study takes a step in response to this body of work by taking a balanced approach that utilizes the affordances of GenAI technology, while also combining the strengths of PBLL as a socially constructed collaborative process. This study does not represent a singular contribution of GenAI, but rather the contribution of GenAI and PBLL as complementary to teacher scaffolding and peer collaboration aimed at maximizing their pedagogical use and capitalizing on their limitations. By contextualizing GenAI within a human-centered, collaboratively constructed learning framework, this study addresses the need for empirical research to understand better how GenAI can impact not only isolated language skills, but also learner engagement and agency—research areas we know we are not yet fully exploring in the literature.

2.2. Learner Engagement and Agency in EFL Contexts

Engagement is a key feature of the language learning process. Engagement is frequently considered one of the strongest influences on successful educational outcomes[30]. Unlike motivation, which refers to learners' hopes and aspirational states, engagement indicates the movement between motivation and action[31]. Engagement can be considered a multidimensional process, influenced by various individual processes (cognitive, emotional, and behavioural), as well as the learning environment and sociocultural variables that influence wider social aspects of individuals' lives[32,33]. Cognitive engagement refers to learners' intellectual effort, including focusing attention and using deep learning strategies, like critical thinking or problem-solving. Emotional engagement refers to the affective states learners experience when engaging with language tasks (e.g., enjoyment, interest, and motivation) and positively informs students' relationships with their learning tasks and peers. However, negative emotions such as frustration or boredom may signal students' disengagement and inhibit their learning experience and performance. Behavioural engagement refers to observable behaviours in learning situations (like classroom engagement and persistence) and is often indicative of learners' cognitive and emotional engagement[34]. While these emotional, cognitive, and behavioural facets can be thought of as interrelated constructs, they function in concert, with behavioural engagement being observable evidence of emotional and cognitive engagement[35].

In their comprehensive systematic review, Hiver et al.[33] outlined five essential characteristics of language learning engagement that serve as a foundation for understanding this complex construct. First, they emphasized the central role of action, asserting that active participation is fundamental to meaningful learning involvement. Second, they highlighted the context-dependent nature of engagement, demonstrating how cultural, social, and educational settings

shape and influence the degree of learner engagement. Third, they introduced the concept of engagement's object-centred nature, where engagement revolves around a specific focus—whether it be a topic, activity, or interaction. Fourth, they discussed the dynamic and adaptable quality of engagement, noting how it evolves and responds to various internal and external factors. Finally, they stressed the pivotal role of educators, who, through deliberate strategies and supportive environments, can significantly enhance learner engagement, enriching the overall educational experience.

Reeve and Tseng[36] critiqued the traditional tripartite model of engagement, which predominantly focuses on the behavioural, emotional, and cognitive aspects, often neglecting the crucial role of students actively shaping their own learning experiences. They contended that the conventional model oversimplifies the student-teacher interaction by failing to consider students' agentic involvement in the learning process. To bridge this gap, drawing from the self-determination theory framework, Reeve and Tseng[36] proposed a fourth dimension to student engagement—agentic engagement. Unlike the three engagement dimensions, agentic engagement stands out due to its proactive nature, empowering students to take the lead in interacting and influencing the learning process, shaping their environment to be more personally relevant and challenging[36].

An agent, as defined by Bandura[37], is an individual who consciously influences their own functioning and life circumstances. In the realm of education, agency embodies both motivation—the desire to impact one's learning—and action—the behaviours reflecting this desire. In the classroom setting, student agency is closely linked to the capacity to influence and reshape interactive learning practices[38]. Matusov von Duyke, and Kayumova[39] delineate two facets of student agency: responsive or domesticated agency, where students comply with the teacher's directives, and self-generated or free-range agency (also termed agentic engagement), where students autonomously take charge, adopt viewpoints, and express their ideas.

Agentic engagement has been integrated into models of engagement alongside behavioural, cognitive, and emotional dimensions[40,41]. Dincer et al.[40] study demonstrated a positive correlation between increased emotional and agentic engagement and higher grades, emphasizing the importance of fostering agentic engagement, particularly in project-based learning environments where students actively collaborate and contribute to shaping their educational experiences.

Engagement in language learning is increasingly shaped by educational technology, offering students avenues to personalize their learning experiences and engage with content in innovative ways[42]. However, the integration of technology also brings challenges, such as the risk of isolation in online learning environments[43]. In this context, agentic engagement emerges as a pivotal element capable of addressing these obstacles by empowering students to actively shape their learning encounters through the utilization of digital tools. This proactive approach not only enhances their learning experiences but also fosters a sense of ownership and autonomy in their educational journey.

3. Method

3.1. Study Design

This study employed a quasi-experimental, two-group pre/post-test design to investigate the impact of GenAI-driven collaborative projects on student engagement and learner agency in EFL education. A sequential mixed-methods approach was used, combining quantitative data from structured questionnaires with qualitative insights drawn from students' reflective journals. This design enabled a comprehensive analysis of both measurable changes across groups and the lived experiences of participants, thereby strengthening the depth and validity of the findings.

3.2. Participants

The participants were 58 female EFL undergraduates, all enrolled in a first-year computer science program at a Saudi university. The students came from two parallel classes, which were taking the same English course (ENG140: English Language), a 2-credit-hour course, which took place during a 12-week semester, or 24 hours of instruction. Both of the classes used the same content in common coursework that covered practical communication in everyday situations, in accordance with a standardized curriculum using Step Forward 4: Language for Everyday Life, which is by Denman and Adelson-Goldstein[44]. This study used a quasi-experimental design and randomly assigned the two intact classes into either a control group or an experimental

group (experimental: n = 30; control: n = 28). Random group assignment was performed on a class level in order to maintain continuity of instruction and not disrupt the existing course schedule. The participants ranged in age from 17 to 24 years old, with an average age of 18.20 (SD = 0.96). The participants were given the Oxford Placement Test to assess English proficiency. The OPT is considered to be a reliable and useful measure of English proficiency, which is appropriate for use as is aligned with the Common European Framework of Reference (CEFR). Most students were A2 (pre-intermediate) (65%) and the next most common were B1 (intermediate) (25%), which suggests there was a need for ongoing language development. Although students indicated they had a modest amount of familiarity with artificial intelligence (AI) tools (mean rating = 3.13, SD = 0.78 on a 5-point Likert scale), none had previously used AI to assist them in completing project-based work.

3.3. Research Instruments

3.3.1. The Study Questionnaire

A self-report questionnaire was used to assess changes in students' learning engagement and agency before and after the intervention (**Appendix A**). The instrument consisted of two sections: the first gathered demographic information, including age, perceived technology proficiency, and frequency of AI tool use for general and project-based English learning. The second section measured student engagement across four dimensions—behavioral, emotional, cognitive, and agentic—using items adapted from two validated scales: the Language Learning Engagement Scale [35,37] and the Agentic Engagement Scale [45]. A total of 27 items were included: 5 for behavioral, 4 for emotional, 8 for cognitive, and 10 for agentic engagement, each rated on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). Minor wording adjustments were made to tailor the items to the specific context of English language learning and GenAI-supported project work. These adaptations involved rephrasing generic academic terms (e.g., "class," "schoolwork") to directly reference "English language class" or "English assignments," thereby improving contextual relevance while maintaining construct integrity. The questionnaire showed strong reliability, with Cronbach's alpha values of 0.78 (Behavioral), 0.80 (Emotional), 0.80 (Cognitive), and 0.80 (Agentic).

3.3.2. Reflection Journals

To complement the quantitative data and capture nuanced learner experiences, participants maintained bi-weekly reflective journals throughout the 10-week GenAI-driven collaborative projects. These journals were designed to document students' evolving engagement, decision-making, challenges, and sense of agency as they navigated the project tasks and interacted with GenAI tools. A structured reflection template (**Appendix B**) was provided to encourage depth and balance in responses. Prompts guided students to critically examine both successes and setbacks, including moments of disconnection, confusion, or shifts in motivation and autonomy. The goal was to facilitate genuine introspection—not to elicit only positive feedback—by asking students to reflect on the complexity of their language learning experience. A final cumulative entry was submitted at the project's conclusion, allowing students to synthesize their journey across the intervention.

3.4. Data Collection Procedures

The data collection process spanned 12 weeks and followed a three-phase structure (**Figure 1**). The study was conducted with two intact classes of first-year EFL students, randomly assigned to either an experimental or a control group. Both groups completed pre- and post-intervention questionnaires, while only the experimental group participated in the GenAI-enhanced collaborative intervention.

Phase 1 (Week 1) focused on preparation and baseline data collection. Ethical approval was obtained from the university's Institutional Review Board (IRB), and written informed consent was secured from all participants. Students were informed that participation was voluntary, confidential, and would not affect their academic standing. No incentives were provided. During this phase, students completed the Oxford Placement Test and the pre-intervention engagement and agency questionnaire. The experimental group also attended an orientation session introducing the study's purpose and procedures. As part of this session, students completed a collaborative project planning worksheet (**Appendix C**), guiding them to select a theme aligned with Saudi Vision 2030, determine the type of GenAI-supported product to develop and assign team responsibilities.

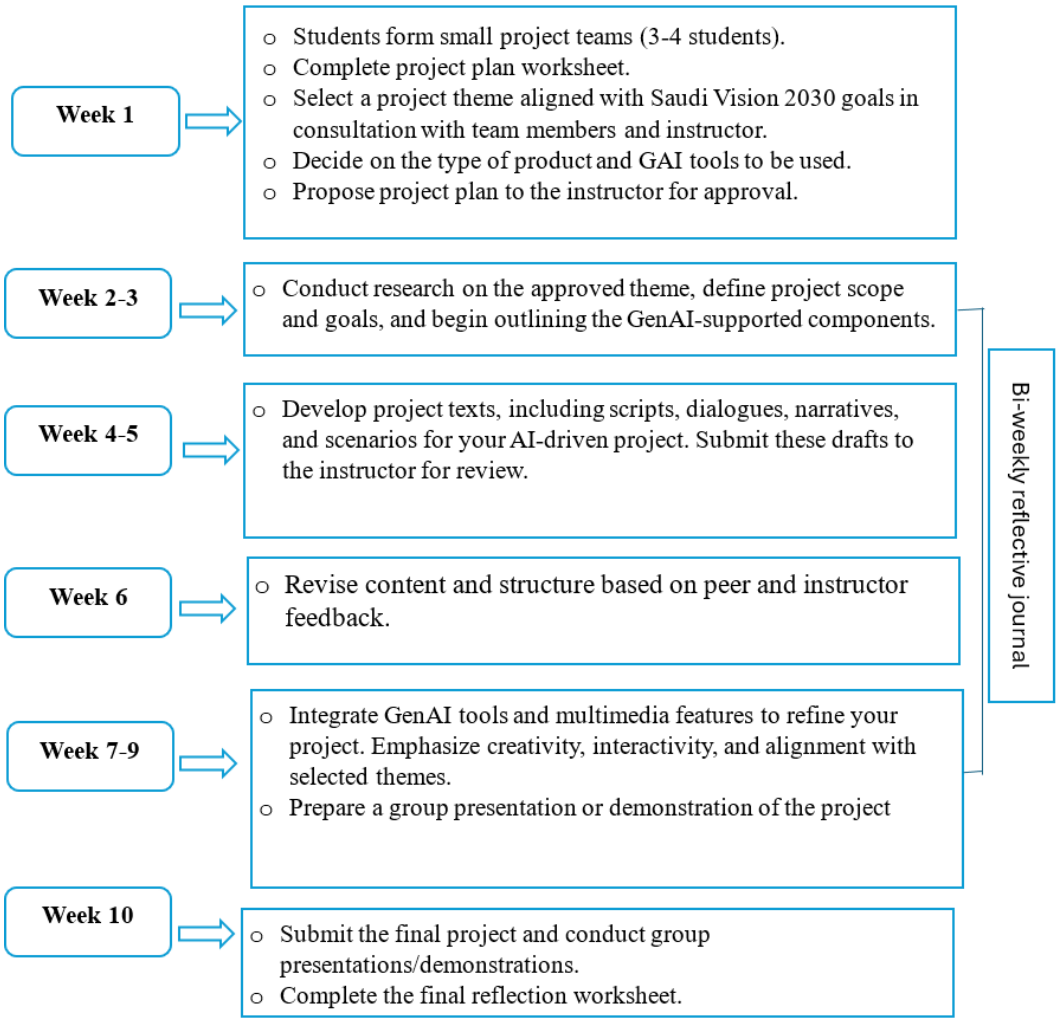

Figure 1. Project timeline followed by the experimental group during the 10-week GenAI-driven collaborative project.

Phase 2 (Weeks 2–11) involved the implementation of the GenAI-supported projects. Experimental group students collaborated in teams to design and deliver final products grounded in Saudi Vision 2030 themes—such as entrepreneurship, sustainability, cultural heritage, digital transformation, and social progress. Their project process included theme selection, goal setting, research, content development, GenAI integration, and final production.

Students exercised autonomy in choosing tools and directing project outcomes, with GenAI integration occurring at multiple stages. For example, ChatGPT was used to generate ideas, outlines, and scripts, particularly for chatbot dialogues and narrative components. DALL·E and Canva AI supported the creation of visual content, while QuillBot and Grammarly assisted with language refinement and multilingual editing. Several groups employed text-to-speech tools (e.g., Narakeet, ElevenLabs) for voice narration, and tools like Synthesia and Pictory were used to create AI-enhanced videos.

This flexible, student-driven approach enabled learners to demonstrate increased agency and creativity, producing outputs such as interactive chatbots, bilingual video presentations, digital brochures, and AI-enhanced slides. One group, for instance, developed a personalized cultural tourism assistant using ChatGPT. Another team created "Smart Heritage: AI Innovations in Saudi Arabia's Cultural Preservation", a bilingual digital presentation that featured narrated visuals, chatbot interactions, and AI-generated illustrations of heritage sites like AlUla, Diriyah, and Hegra. They used ChatGPT to script historical narratives, DALL·E and Canva for visuals, Narakeet for bilingual narration, and Pictory to compile the final AI-enhanced video—demonstrating effective

use of GenAI to promote cultural awareness.

The instructor (second author) facilitated the process through regular check-ins, asynchronous feedback on Google Drive, and real-time support via Telegram. No predefined roles were assigned, allowing teams to delegate responsibilities organically. Meanwhile, the control group followed the same instructional schedule and textbook (Step Forward 4) but did not engage in GenAI-enhanced projects. Their activities were limited to traditional classroom tasks such as textbook exercises, instructor-led discussions, and individual assignments. A comprehensive overview of the GenAI tools and their instructional applications is included in **Appendix D**.

Phase 3 (Week 12) marked the conclusion of the intervention. The experimental group presented their projects in 10–15-min sessions to peers and external raters. Presentations were evaluated based on creativity, collaboration, GenAI integration, and relevance to Saudi Vision 2030. Both groups completed the post-intervention questionnaire during the same week to ensure consistency in data collection.

3.5. Data Analysis

Quantitative data collected through the engagement and agency questionnaire were analyzed using IBM SPSS Statistics (Version 28). Prior to analysis, data were screened for missing values and tested for normality using the Shapiro-Wilk test. The results indicated that all subscale scores were normally distributed, justifying the use of parametric tests.

To assess within-group differences from pre- to post-intervention, paired samples t-tests were conducted for the experimental group. Between-group comparisons on the post-test were analyzed using independent samples t-tests. Levene's test for equality of variances was performed for each subscale; where variances were unequal, Welch's t-test was used. Cohen's d was calculated to assess effect sizes, interpreted using standard benchmarks (small = 0.2, medium = 0.5, large = 0.8). Descriptive statistics (means, standard deviations) were also reported to clarify effect magnitude and direction.

Qualitative data from students' reflective journals were analyzed manually using a deductive content analysis approach to maintain closeness to the data and deepen interpretive insight. A coding framework was developed based on Reeve and Tseng [37] four-dimensional model of engagement: emotional, behavioral, cognitive, and agentic. Additional themes related to perceived benefits, challenges, and implications of GenAI integration were also incorporated. Journal entries were systematically examined for recurring patterns, and representative quotes were used to support interpretive validity. The resulting themes were organized and summarized in **Appendix E**, which presents illustrative excerpts across each dimension of engagement. Inter-rater reliability between two independent coders was established at $\kappa = 0.85$, indicating substantial agreement.

4. Results

4.1. Effects of GenAI-Driven Collaborative Projects on Student Engagement (RQ1)

4.1.1. Quantitative Findings on Engagement Dimensions

To assess the impact of GenAI-driven collaborative projects on student engagement and agency, both within- and between-group comparisons were conducted using parametric tests. Pre-test results confirmed baseline equivalence, with no significant differences between the control and experimental groups on total engagement scores ($p > 0.05$), supporting the study's internal validity.

Post-test comparisons using independent samples t-tests revealed significant differences in favor of the experimental group across all engagement dimensions (**Table 1**). Emotional engagement demonstrated the most substantial effect (d = 1.60), followed by agentic (d = 1.25), behavioural (d = 1.10), and cognitive engagement (d = 1.09). The overall engagement score also showed a significant difference, with a huge effect size (d = 1.54). Levene's test indicated unequal variances for all subscales except agentic engagement; therefore, Welch's t-test was applied where appropriate. These results underscore the positive and substantial impact of the GenAI-supported collaborative projects on student engagement and learner agency.

Table 1. Post-test comparison of engagement and learner agency between control and experimental groups (per-item means).

Variable	Group	N	M	SD	*t*	*df*	*p*	Cohen's d
Behavioural	Control	28	5.01	1.48				
	Experimental	30	6.25	0.61	−4.09	35.4	<0.001	1.10
Emotional	Control	28	4.92	1.35				
	Experimental	30	6.55	0.55	−5.94	35.2	<0.001	1.60
Cognitive	Control	28	4.85	1.27				
	Experimental	30	6.00	0.80	−4.09	45.1	<0.001	1.09
Agentic	Control	28	4.18	1.24				
	Experimental	30	5.60	1.04	−4.74	56.0	<0.001	1.25
Overall Engagement	Control	28	4.74	1.12				
	Experimental	30	6.10	0.58	−5.73	39.9	<0.001	1.54

Note: Welch's t-test used for Behavioural, Emotional, Cognitive, and Overall Engagement due to unequal variances; standard independent samples t-test used for Agentic Engagement.

To examine changes over time within the experimental group, paired samples t-tests were performed. As shown in **Table 2**, all engagement dimensions showed statistically significant improvement. The most substantial gains were in behavioural engagement (d = 1.43) and agentic engagement (d = 1.24), indicating increased autonomy and participation. Emotional engagement and cognitive engagement also improved significantly, with moderate-to-large effect sizes (d = 0.76 and d = 0.63, respectively). Overall engagement increased by 41 points (t = 6.37, $p < 0.001$), with a large effect size (d = 1.16), confirming the substantial impact of the GenAI-driven collaborative projects on learner engagement.

Table 2. Pre- and post-intervention changes in engagement and learner agency (experimental group, N = 30).

Subscale	M (Pre)	SD (Pre)	M (Post)	SD (Post)	t	df	*p*	Cohen's d
Behavioral	4.65	0.88	6.25	0.61	7.84	29	<0.001	1.43
Emotional	5.12	1.80	6.55	0.55	4.17	29	<0.001	0.76
Cognitive	5.04	1.17	6.00	0.80	3.44	29	0.002	0.63
Agentic	3.63	1.15	5.60	1.04	6.80	29	<0.001	1.24
Overall Engagement	4.61	1.11	6.10	0.58	6.22	29	<0.001	1.14

Note: Paired samples t-tests were conducted. Cohen's d was calculated using the standard deviation of the paired differences.

4.1.2. Qualitative Support for Engagement Dimensions

Qualitative data from students' reflective journals reinforced the quantitative findings, offering more profound insight into how GenAI-driven collaborative projects enhanced emotional, behavioral, cognitive, and agentic engagement.

Students consistently described heightened emotional engagement, characterized by increased motivation, confidence, and enjoyment. One participant noted, "The GenAI tools made me love and become more involved in learning English," while another reflected, "The project boosted my interest and excitement towards practicing English." Although some students initially expressed anxiety due to unfamiliarity with AI tools, this was typically replaced by confidence and pride as the project progressed. This emotional transformation aligns with the substantial post-test improvement in emotional engagement (d = 1.60).

Behavioral engagement was evident through proactive participation, collaborative teamwork, and persistent effort. Students described active involvement in setting project goals, researching, and problem-solving. For example, one stated, "We determined the topic and objectives together, then started planning and searching using GenAI." Another added, "During class, I volunteered to explain a concept to help my classmates." These behaviors support the significant gain in behavioral engagement (d = 1.43), reflecting consistent and sustained participation.

Evidence of cognitive engagement included deep learning, problem-solving, and critical thinking. Students engaged in research and applied knowledge to real-world topics, such as digital skills and sustainability. One student shared, "I conducted extensive research on the development of digital skills… I gained a comprehensive understanding of the most relevant skills for today's digital landscape." Another

reflected, "We had to think of alternatives for pop-up tech problems," highlighting their adaptive thinking. These experiences correspond with the measured cognitive improvement (d = 1.9).

Agentic engagement was perhaps the most transformative dimension. Many students described taking the initiative, making choices, and leading their teams. One student reflected, "I felt that I had a choice in how to approach the tasks," while another stated, "I organized extra meetings and motivated my team to stay focused." These reflections align with the significant observed increase in agentic engagement (d = 1.24), illustrating growing autonomy and ownership.

Overall, the qualitative data triangulates and substantiates the statistical gains observed across all engagement dimensions, revealing how students not only participated more actively but also felt more empowered and cognitively invested.

4.2. Perceived Benefits, Challenges, and Implications (RQ2)

Beyond measurable engagement, students' reflections revealed key benefits, challenges, and implications of integrating GenAI tools in project-based learning.

Students reported significant improvements in language skills, particularly vocabulary expansion in fields like technology and business. Many praised GenAI tools such as chatbots and AI-driven content platforms for reducing speaking anxiety and enabling personalized practice. One student remarked, "The repetition feature in chatbots helped me practice English without fear of judgment." Others noted improved confidence, collaboration skills, and digital literacy, with one stating, "I have become proficient in using GenAI tools and apps." Students also valued the creative flexibility and real-world relevance of using GenAI in language learning.

Despite these benefits, students encountered several challenges. Language proficiency issues sometimes hinder the effective use of AI tools. As one student explained, "Our project output could have been enhanced with better English skills." Technical difficulties, such as software limitations and subscription barriers, were also common. One student noted, "Some software demands subscriptions, which made it hard to access needed tools." Group work presented another challenge, particularly in coordinating efforts and ensuring equitable participation.

Students offered several recommendations to improve future GenAI-based projects. Chief among them was the need for early and thorough training on AI tools. Others suggested incorporating more immersive technologies like virtual reality and gamified platforms to boost engagement. Many emphasized maintaining a balance between AI assistance and human creativity to avoid overreliance. Students also called for enhancements in AI tool reliability and accessibility to mitigate technical disruptions.

These insights suggest that while GenAI-driven projects can meaningfully enhance language learning engagement and learner agency, their success depends on adequate training, thoughtful integration, and support for both technical and collaborative challenges.

5. Discussion

This study explored the impact of GenAI-driven collaborative projects on EFL undergraduates' language learning engagement and learner agency, using a mixed-methods approach. Both quantitative and qualitative data strongly supported the intervention's effectiveness in enhancing multiple dimensions of engagement. Students reported heightened excitement and motivation, active participation, and increased critical thinking and problem-solving abilities. A stronger sense of control over their learning also emerged, contributing to greater confidence and agency.

The four dimensions of engagement—emotional, behavioral, cognitive, and agentic—interacted throughout the study. Emotional excitement acted as a catalyst. It reinforced participation (behavioral engagement), persistence in problem-solving (cognitive engagement), and learner initiative (agentic engagement). As Reeve and Tseng [36] noted, emotional engagement often comes before and energizes deeper forms of involvement. Students' reflections confirmed that positive emotions helped them be more active, think creatively, and take on leadership roles. Like Mercer [35] and Henry and Thorsen [46], we found that positive emotional experiences had a strong effect on deeper engagement. However, unlike studies that focus only on emotional responses to traditional instruction, our data suggest that the novelty and interactivity of GenAI tools were especially effective in changing initial apprehension into lasting emo-

tional involvement.

Behavioral and cognitive engagement were supported by collaborative planning and effective use of GenAI tools. Students described their active roles in goal-setting, research, and content creation. Their reflections showed strategic thinking and adaptability, which are signs of cognitive engagement. For instance, one student mentioned that planning presentation content helped them think critically and improved their ability to express ideas in English. These experiences matched the significant gains seen in cognitive and behavioral measures. While studies like Yuen and Schlote [1] and Liu et al. [27] highlighted improvements in language skills with GenAI, our study offers a more detailed view. It shows that cognitive engagement, though present, grew at a slower pace compared to emotional or agentic aspects. This difference might reflect the natural slow pace of cognitive growth in project-based learning settings or a need for more focused support in using GenAI tools.

Agentic engagement emerged as a particularly transformative outcome. Students showed autonomy in choosing tools, designing project content, and managing group dynamics. They talked about making strategic decisions, starting meetings, and motivating their peers; these behaviors reflected growing self-regulation and ownership. These results align with Reeve and Tseng [37] idea of agentic engagement. However, while previous studies described students' theoretical ability to shape learning environments, our study provides evidence of learners actively initiating, leading, and customizing their learning experiences within a GenAI-supported PBL framework. This shows a more transparent and observable form of agency in action. These findings also support Reeve and Shin [47] focus on the importance of responsive learning environments in nurturing agency. The instructor's supportive role, which included providing choices, valuing student input, and encouraging leadership, further promoted this development [48,49].

Prior technological experience also played a role in students' engagement. Familiarity with digital tools helped lower barriers to GenAI adoption. This shift allowed students to concentrate on language learning instead of struggling with new systems. This finding supports the work of Nolen, Horn, and Ward [50], Gardner [51], and Dörnyei [52], who argue that learners' past experiences influence their ability to engage with new educational opportunities. Building on this foundation, the intervention used students' digital skills to enhance engagement and outcomes.

The integration of GenAI with human interaction proved to be a key driver of success. Tools like ChatGPT, Canva, and PicsArt enhanced the multimodal, collaborative nature of the projects, while peer and teacher support grounded the experience in meaningful social interaction. This balance reflects best practices in technology-enhanced language learning, as emphasized by Hiver et al. [33] and Yun et al. [53], who stress the importance of dynamic, responsive, and developmentally appropriate learning environments.

Students' reflective journals revealed a progression in engagement over time. Initial apprehension gave way to confidence and a sense of accomplishment, highlighting the importance of structured support, peer collaboration, and feedback. These findings support Dao [54] and Lyrigkou [55], who link engagement with learners' perceptions of task value and their willingness to invest effort. Emotional growth through challenging tasks was also evident, consistent with Salomon [56] view that productive struggle leads to deeper learning.

While students recognized the benefits of GenAI tools, they also noted limitations, including technical issues, software costs, and reliance on English proficiency. These challenges point to the need for scaffolding and accessible tool design. Importantly, students called for training on GenAI tools at the project's outset and suggested integrating immersive technologies such as VR or gamified platforms to further enhance engagement. Whereas Alruwaili and Kianfar [26] expressed concern over potential student dependency on ChatGPT, our findings suggest that with proper scaffolding, including peer collaboration and teacher mediation, GenAI can promote learner autonomy rather than hinder it. This highlights the importance of guided implementation strategies that empower learners while mitigating the risks of overreliance.

A key insight from this study is the value of a "Humans in the Loop" approach [28], where GenAI augments, but does not replace, human instruction. This model highlights the symbiotic relationship between AI and educators: while GenAI offers real-time feedback and personalized scaffolding, teachers provide emotional, evaluative, and socio-cultural support [29,57,58]. Rather than viewing GenAI and human input as a dichotomy, this study illustrates how their integration can produce a richer, more engaging learning experience.

Unlike earlier studies that raised concerns about relying too much on GenAI, for example Alruwaili and Kianfar[26], our findings suggest that when GenAI is used with structured guidance, such as peer collaboration, teacher support, and scaffolded tasks, learners are more likely to feel empowered instead of dependent. This shows how important good teaching design is in shaping how learners interact with AI.

In summary, the collaborative projects driven by GenAI significantly improved learner engagement and agency. They encouraged emotional investment, active participation, critical thinking, and learner independence. The findings support a well-rounded, interaction-rich model of language learning where human and AI support work together to empower students and personalize their learning experience. This teaching approach offers great potential for future EFL settings looking to integrate new technologies in a meaningful and ethical way.

6. Pedagogical Implications

This study provides practical recommendations for language educators who want to integrate GenAI into project-based learning. First, it shows that using GenAI-supported project-based language learning (PBLL) promotes learner agency and engagement. Tools like ChatGPT, Canva, and PicsArt can boost creativity, personalization, and task ownership, while teachers play a crucial role in offering emotional support, guidance, and facilitating collaboration.

To use GenAI effectively, educators should start with short orientation sessions on key functions and responsible use. Sample prompts, guided tasks, and low-stakes practice can help build confidence and ease cognitive load. Gradually reducing support can encourage student independence and active engagement.

Teachers should also consider how their teaching design affects students' relationships with GenAI tools. While some studies warn against overreliance[26], our findings indicate that structured approaches—like peer collaboration, teacher support, and guided activities—can lessen these concerns. In these situations, GenAI can empower students rather than create dependency.

Moreover, addressing technical barriers is also crucial. Educators should evaluate students' digital readiness and provide tailored support. Institutions can help by ensuring access to devices, reliable internet, and affordable or free GenAI tools. Peer mentors or shared troubleshooting resources can reduce frustration and enhance equity.

The varying effects on engagement dimensions require careful design. While GenAI often boosts emotional and behavioral engagement, fostering cognitive engagement needs additional strategies, such as critical thinking prompts, metacognitive reflection, and guided discussions around AI-generated content.

Finally, emotionally responsive, learner-centered environments are essential to fully leverage GenAI's benefits. This involves offering choices, validating student voices, and mixing human interaction with tech support. When combined with thoughtful teaching practices, GenAI can empower learners to take more control of their language development.

7. Conclusion

This study supported the effectiveness of GenAI-driven collaborative projects in enhancing EFL students' emotional, behavioral, cognitive, and agentic engagement. By integrating GenAI tools within a Project-Based Language Learning (PBLL) framework supported by teacher and peer interaction, students experienced heightened motivation, increased autonomy, and more active participation in language learning tasks. These findings reinforce the value of combining human guidance with technological innovation to create engaging, student-centered learning environments.

Despite its contributions, this study has limitations—the use of a single institutional context with an all-female, pre-intermediate to intermediate sample limits generalizability. While a control group was included, the specific effects of teacher support and peer dynamics were not isolated, though both likely influence engagement. Future studies should explore GenAI-supported PBLL across diverse contexts, proficiency levels, and instructional models.

Practical challenges also emerged. Some students faced technical issues or required more support to engage fully with GenAI tools. The study did not examine how different scaffolding strategies affect outcomes, which is essential to ensure GenAI promotes autonomy rather than dependency. Future research should investigate how teacher guidance, structured tool introduction, and support for digital access

shape learner engagement and inclusion.

Author Contributions

Conceptualization, S.M.A. and M.O.A.; methodology, S.M.A.; software, S.M.A.; validation, S.M.A. and M.O.A.; formal analysis, S.M.A.; investigation, M.O.A.; resources, S.M.A.; data curation, S.M.A.; writing—original draft preparation, S.M.A.; writing—review and editing, S.M.A. and M.O.A.; visualization, S.M.A.; supervision, S.M.A.; project administration, S.M.A.; funding acquisition, S.M.A. and M.O.A. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Imam Mohammad Ibn Saud Islamic University (IMSIU) (protocol code 1354 and date of approval: 22 January 2025).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data collected for this research will be made available upon request and will be shared in accordance with applicable data protection and privacy regulations.

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Conflicts of Interest

The authors declare no conflict of interest.

Appendix A

The Study Questionnaire

Section one: Demographic Information

- Gender: _____
- Age: _____
- Major: _____
- Study year: _____
- study level: _____
- How often do you use AI tools to support your English language learning in general? (*Never, Rarely, Sometimes, Often, Always*)
- How often do you use AI tools specifically to assist with project-based tasks or collaborative assignments in your English language course? *(Never, Rarely, Sometimes, Often, Always)*

Section Two:

First: Language Learning Engagement Scale

Scale 1–7 agreement- ranged from "strongly disagree" to "strongly agree"

Strongly disagree ---------- Strongly agree

Behavioural Engagement
1. I listen carefully in my English language class
2. I try hard to do well in my English language class.
3. I participate in my English language class discussions.
4. I work hard when we start something new in my English language class.
5. I pay attention in my English language class.
Emotional Engagement
1. I enjoy learning new things in my English language class
2. When we work on something in my English language class, I feel interested
3. When I am in my English language class, I feel curious about what we are learning.
4. English language class is fun
Cognitive Engagement
1. When working on assignments for my English language class, I try to relate what I'm learning to what I already know.
2. When I study for my English class, I try to connect what I am learning with my own experiences in English language class.
3. When I study for my English class, I try to make all the different ideas fit together and make sense.
4. I make up my own examples to help me understand the important concepts I study in my English class.
5. Before I begin to study for my English language class, I think about what I want to get done
6. When I'm working on my English class assignments, I stop once in a while and go over what I have been doing (to review my progress).
7. As I study for my English class, I keep track of how much I understand, not just if I am getting the right answers
8. If what I am working on in English language is difficult to understand, I change the way I learn the material

Second, the Agentic Engagement Scale

Agentic Engagement in learning English language
1. During English language class, I express my preferences and opinions.
2. If I don't agree with the English teacher's statement, I tell him/her.
3. I let my English teacher know what I need and want.
4. I let my English teacher know what I'm interested in.
5. If I think that English teacher behaviour is unfair, I tell him/her.
6. I make sure that my English teacher understands if there is something I don't like.
7. During English class, it can happen that I introduce new issues or discussion topics.
8. When I need something in English class, I'll ask the teacher for it.
9. During English class, I ask questions to help me learn.
10. I defend my opinions even if they are not in line with those of my English classmates.

Appendix B

Reflection Journal Entry Template

- Name: …… Date: ……
- Title of Entry (Optional): ……

1. Engagement in English Learning:

Reflect on how your engagement with English learning changed during the GenAI-supported collaborative project. What factors increased or decreased your motivation, focus, or participation?

Prompts for Reflection:

- Describe a moment that enhanced your interest or motivation in English. What contributed to that feeling?
- Were there times you felt disengaged, frustrated, or overwhelmed? Why, and how did you respond?
- Identify one successful learning moment and one challenging experience. What did each teach you?

2. Learner Agency in English Class:

Think about your role in the project. To what extent did you feel in control of your learning? Were you able to make decisions or take initiative?

Prompts for reflection

- Describe a time when you made a key decision or influenced the project direction. How did it affect your learning?
- Were there moments you felt limited or unsure about your role? How did you handle them?
- How did using GenAI tools affect your ability to express preferences or take ownership of your learning?

3. Perceived Benefits and Challenges

What were the most valuable aspects of participating in the project? What difficulties did you face?

Prompts for Reflection:

- How did the project affect your English skills, confidence, or collaboration abilities?
- Discuss any difficulties—technical, interpersonal, or learning-related. How did you deal with them?
- What advice would you give to future students working on similar projects?

Additional Reflections:

You may include any other thoughts or experiences related to your engagement, autonomy, or use of AI in language learning that you feel are important.

Appendix C

GenAI-Driven Collaborative Project Planning Worksheet

Team No: _____ **Team Members**: _____

Project Title: _____

1. Project Theme

Select one core theme aligned with Saudi Vision 2030 to guide your project direction:

□ **Entrepreneurship & Innovation** – Fostering creativity, business thinking, and solution-based projects

□ **Sustainable Development & Environmental Conservation** – Addressing ecological challenges through innovative strategies

□ **Tourism & Cultural Heritage** – Showcasing Saudi Arabia's heritage through engaging and educational content

□ **Digital Transformation & Technological Advancement** – Promoting progress through tech-enabled solutions

□ **Social Development & Community Engagement** – Encouraging civic participation and local impact

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2. Project Product Type

Choose one of the following GenAI-enhanced collaborative product formats:

□ **AI-Enhanced Digital Presentations** – Use platforms like Canva or PowerPoint, integrating AI-generated visuals,

infographics, or charts.

 Multilingual Digital Stories or Videos – Use tools like Vyond, Animoto, Adobe Spark, or iMovie. Incorporate AI for language modeling, proofreading, or translation support.

 AI Chatbots for Cultural Conversations – Design a chatbot (e.g., using Dialogflow or IBM Watson) that facilitates culturally themed conversations or learning interactions.

 Personalized AI-Powered Learning Experiences – Create a tool or learning app using platforms like Duolingo or custom-built prototypes for adaptive language learning.

 Other (Self-Proposed GenAI Project)

Describe your unique concept leveraging GenAI in language learning. Specify tools, intended outcomes, and educational purpose:

_____

3. Project Implementation Plan

*Outline key stages and timelines using a flowchart or timeline format (refer to **Figure 1** in the main text). Define individual responsibilities within your team:*

Task Area	Description	Assigned Member(s)
Research & Analysis	Collect and evaluate information on the selected topic; provide evidence-based insights.	
Content Development	Write scripts, texts, or multimedia narratives aligned with the project theme.	
GenAI Integration	Select and apply appropriate GenAI tools; test and refine integration.	
Project Coordination	Manage deadlines, team communication, and task delegation.	

Instructor Approval

Instructor Name: _____

Signature: _____

Appendix D

Table A1. Examples of GenAI tools used in student projects and their functions.

Purpose	Tool Name	Function
Content Generation	ChatGPT	AI-powered text generation for scripts, dialogues, and brainstorming.
	Copy.ai	Automated content creation for marketing and writing tasks.
Paraphrasing/Rewording	QuillBot	Paraphrasing and grammar checking tools.
	Grammarly	Grammar checking and writing enhancement.
Visual Content Creation	DALL·E	AI-generated images from text prompts.
	Canva AI	Design tool with AI features for graphics and presentations.
	Midjourney	AI art generation via Discord.
Video Production	Pictory	Converts text content into videos.
	Synthesia	AI video creation with avatars and voiceovers.
Voice Narration (TTS)	Narakeet	Text-to-speech tool supporting Arabic and other languages.
	ElevenLabs	Advanced AI voice generation in multiple languages.
Presentation Design	Canva	Design tool for creating presentations and visual content.
	Beautiful.ai	AI-powered presentation design tool.
Translation/Multilingual	DeepL	High-quality translation tool.
	Google Translate	Translation service supporting numerous languages.
Project Management	Trello	Project management and collaboration tool.
	Google Docs & Drive	Document creation and storage with collaboration features.

Appendix E

Table A2. Summary of reflective journal themes across four dimensions of engagement.

Dimension	Description	Themes	Representative Quotes
Emotional Engagement (RQ1 & RQ2)	Emotions expressed in response to the GenAI-driven project experience, peer collaboration, and AI tools; influence on motivation and classroom atmosphere.	Motivation, Confidence, Positive Affect	"I feel excited to learn English using GenAI tools because it's something new and fun." "The project boosted my interest and excitement toward English."
Behavioral Engagement (RQ1 & RQ2)	Observable participation in class and project tasks, collaboration with peers, and application of GenAI tools.	Participation, Peer Interaction, AI Tool Use	"We divided tasks effectively, and everyone contributed." "We created a chatbot and translated the clip into four languages."
Cognitive Engagement (RQ1 & RQ2)	Reflections on problem-solving, planning, and critical thinking during the project; strategies for task completion.	Deep Learning, Problem-Solving, Critical Thinking	"Using AI helped me plan better and solve problems." "We had to think of alternatives when issues popped up."
Agentic Engagement (RQ1 & RQ2)	Expressions of autonomy, choice-making, and proactive learning during the project.	Autonomy, Decision-Making, Self-Regulation	"I chose to use AI for designing visuals." "I made choices that influenced how I learned." "The project helped me to be more proactive and have a voice."

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