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TELEGRAM-MEDIATED PROJECT-BASED ESP FOR TECHNICAL WRITING AND WILLINGNESS TO COMMUNICATE IN ELECTRICAL ENGINEERING

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Abstract: While it is necessary for electrical engineering students to produce technical documents and discuss disciplinary ideas in English, ordinary English teaching may not provide them with many chances to practice these activities. In this explanatory sequential mixed-methods study, technical writing scores, observable communication behavior, student beliefs, and teacher perspectives were studied in an eight-week, Telegram-mediated, project-based English for Specific Purposes (ESP) course. Two entire classes of eighty second-semester students were involved in staged engineering writing projects. Writing was evaluated before and after the course on a four-criterion 20-point scale, and a weekly index registered involvement in English-language Telegram. Qualitative explanation of quantitative trends was derived via questionnaires and follow-up interviews. Writing scores increased from 10.63 to 14.38 (mean gain = 3.75), and the weekly communication index increased from 2.95 to 6.77. The main effect of week was significant for the communication index, $F(7, 553) = 193.16$, $p < .001$, $\eta p^2 = .710$, and weekly writing, $F(7, 553) = 170.44$, $p < .001$, $\eta p^2 = .683$. Interview themes suggested reasonable explanations from relevant engineering tasks, opportunity to practice digitally, peer interaction, and teacher scaffolding. The results promote further research of guided mobile project work in engineering ESP. Because there was no non-intervention control group, changes cannot be uniquely attributed to the intervention or to Telegram.
Keywords: *English for Specific Purposes; technical writing; desire to communicate; project-based language learning; Telegram.*

INTRODUCTION

Electrical engineers use English to describe parts and systems, to record methods, to talk about defects, and to report solutions. Workplace evidence on frequency and functions of English use (Hodges & Seawright, 2023; Rahaman et al., 2026) makes these communicative tasks a relevant target for engineering ESP. Broader assessments of ESP research also highlight disciplinary specificity and transfer of learning to target contexts (Basturkmen, 2025; Xin, 2023; Yan et al., 2025). Analyzes in other postsecondary contexts indicate why courses should start with the texts and communicative situations that students actually encounter (Nateghian, 2024; Smith et al., 2024).

The problem is societal and linguistic. Students may grasp a circuit but have a hard time putting that understanding into a short description, a set of steps, or an explanation of troubleshooting. Research on engineering texts and writing suggests that genre knowledge and rhetorical organization need to be explicitly addressed (Birhan & Nurie, 2024; Parkinson et al., 2022, 2023). Studies of engineering-medium instruction have elaborated on the issues students and lecturers confront when disciplinary understanding must be conveyed in English (Alonso et al., 2025; Charoenpornsook & Thumvichit, 2025).

Students must also select whether to communicate. Willingness to communicate (WTC) is responsive to perceived competence,

anxiety, interlocutors, and the immediate job (Anwar, 2025; Lee & Chiu, 2023; Peng, 2024). Teacher support and cooperation may increase the probability of participation, although these associations are variable by activity and context (Y. Li et al., 2025; Rahaman et al., 2026; Supunya, 2023; Yang et al., 2024; W. Zhang, 2026). This is important in ESP: technical knowledge cannot enter into peer debate or revision until students develop workable ways of expressing it.

Project-based language learning (PBLL) can provide a purpose to write and respond: a group has to explain a device, diagnose a malfunction, edit a manual, communicate a result. Purposeful products and contextual support are highlighted as valuable in a synthesis of project-based language learning in East and Southeast Asia (Beckett et al., 2025; Jaleniauskiene & Venckiene, 2025). Engineering-oriented genre education also connects model texts, feedback, and authentic purposes to disciplinary engagement (Mangalindan et al., 2025; Umarova et al., 2024). Authenticity alone is not adequate without the language resources for learners to accomplish a project.

Messaging platforms can expand those possibilities beyond the classroom boundary. Telegram offers uploading drafts, archiving feedback, and text or voice rehearsal. Research on Telegram in ESP and task-based social media learning suggests benefits in terms of engagement and communication, but studies on mobile-assisted projects center on the instructional tasks associated with the technology (Benlaghrissi & Ouahidi, 2024; Borasheva, 2026; Falah et al., 2023; Yuvaraj et al., 2025). The theoretical question is how teachers relate these digital exchanges to genre direction, feedback, and classroom work (Joseph, 2025; Zadorozhnyy & Lee, 2025; W. Zhang, 2026).

Although research has provided data about engineering ESP, PBLL, digital communication, and WTC, few studies evaluate technical writing scores, recurrent behavioral participation traces, student beliefs, and instructor accounts together in the same engineering course. Digital WTC measures tend to focus on reported readiness, whereas participation logs are a record of enacted behavior and might be indicative of opportunity and task demands as well as willingness (Charoenpornsook & Thumvichit, 2025; Dayat et al., 2025; Lee & Drajati, 2020; Lee & Liu, 2024). This study deals with the integration gap in two entire Electrical Engineering classrooms. It uses logged participation as a behavioral proxy for WTC, not a direct assessment of mental intention, nor a test of Telegram as an independent cause.

Changes were quantified using an explanatory sequential design and interpreted with the use of student and teacher narratives. The study sought to answer four questions: 1. How did the technical writing scores vary during the eight-week sequence of projects? 2. What was the pattern of recorded English language engagement during the eight weeks? 3. How did students assess task management, development of ideas, and language use? 4. How did students and teachers explain the trends and the conditions of implementation?

WTC was first conceived as a state of readiness to communicate in a second language, influenced by confidence, environment, and relationships (Bui & Boonsuk, 2024; Macintyre et al., 1998). More recent syntheses discuss dynamic, ecological, and digital views and warn that operational definitions matter (Charoenpornsook & Thumvichit, 2025; Dayat et al., 2025; Ke et al., 2025; Peng, 2024). Readiness and overt engagement are connected but separate: a message can signal an authentic choice, a course obligation, or the availability of a task.

In digital contexts, WTC has been associated with communication anxiety, teacher support, perceived competence, and peer interaction (Lee & Chiu, 2023; S. Li et al., 2024; Y. Li et al., 2025; Mai, 2023; Solhi, 2024; Yang et al., 2024; Zarrinabadi et al., 2021). WTC can also shift throughout an online class or group assignment, so multiple observations are more meaningful than a single response at the end of a course (Lee & Liu, 2024; W. Li, 2024). Research into informal digital learning and conversational technologies expands the available contexts of communication, but the results do not show that any single platform promotes willingness (Khan & Sanosi, 2024; Wanyu et al., 2026; Zadorozhnyy & Lee, 2025; W. Zhang, 2026).

In this study, the weekly index captures enacted English-language engagement in Telegram activities: volunteer turns, English messages, peer feedback, and voice notes. It can tell us when and how learners engaged, but not what their private aim to communicate was. The rise in the index must be balanced with the opportunity to work on the task, instructor prodding, and students' interview responses because the activities are different each week. This study's addition to WTC research is that it makes such behavioral traces accessible over a project cycle and delimits exactly what they assess.

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ESP connects language teaching to specific genres and communicative demands. Engineering students are exposed to specialized lexis, disciplinary descriptions, and professional texts, yet their course requirements could differ from what is expected by a standard English curriculum (Huang & Wible, 2024; Nateghian, 2024; Rahaman et al., 2026). Research into learning specialized registers points to the need to focus on how learners learn, use, and transfer that language across classes and target situations (Basturkmen, 2025; Smith et al., 2024). Component descriptions, circuit function explanations, troubleshooting notes, progress reports, manual explanations, and presentation scripts are among the project sequence of this study. Accuracy, sequencing, cause-and-effect thinking, and knowledge of a reader's intent are essential for these genres. Recent engineering English and genre learning research has highlighted the necessity of addressing disciplinary content and rhetorical form together (Alonso et al., 2025; Birhan & Nurie, 2024; Burhan-Horasanlı, 2024; Charoenpornsook & Thumvichit, 2025; Mangalindan et al., 2025; Mohammad & Amirian, 2025; Parkinson et al., 2023; Supunya, 2023).

One possible explanation is that authentic activities give students something important to say, while model texts, glossaries, sentence frames, and revision feedback allow them to express it clearly. The combination relates ESP relevance to learnable writing moves and embeds language support into the project design (Basturkmen, 2022, 2025). Relatedly, research on blended genre education provides an explanation of how guided collaboration might assist writing development (H. Zhang et al., 2025).

PBLL structures language use around inquiry, collaborative decisions, staged drafts, and a shared product (Jaleniauskiene & Venckiene, 2025; Khalisah et al., 2023; L. Zhang & Ma, 2023). Its significance for technical writing lies in the necessity to continuously explain and update a disciplinary solution. Projects can create meaningful language tasks; however, differences in level, setting, and outcome measures prevent direct comparison (Chekol et al., 2023; Chi, 2023; Garib, 2022; Mai, 2023; Vu et al., 2023; L. Zhang & Ma, 2023), as shown in ESP and other EFL contexts.

The framework links three mechanisms. First, there is a reason and an audience for communication: an engineering challenge. Second, milestones and peer roles share the responsibility of writing a technical document. Third, models and feedback from teachers enable modification. These qualities may underlie writing performance and observed participation. In the current architecture, PBLL and a digital channel should not be seen as a separate isolated treatment.

Students used Telegram to post a draft, read an example, respond to a peer, revisit feedback, or practice an explanation by voice note. The affordances are consistent with previous research on mobile-assisted projects, digital writing, and Telegram-based ESP (Benlaghrissi & Ouahidi, 2024; Borasheva, 2026; Jose et al., 2025; Joseph, 2025; Khlaisang & Sukavatee, 2023). A broader research objective suggests that digital participation is most meaningful when it is aligned with the aims and feedback systems of formal teaching (Kruse et al., 2023).

The guided eight-week project sequence was expected to be related to higher technical writing scores and greater observed participation in English language. The qualitative phase sought to investigate how participants made sense of these shifts, exploring the roles of disciplinary relevance, scaffolding, peer interaction, and digital rehearsal. This anticipation is interpretative and not a causal hypothesis concerning Telegram only.

METHOD

The study used an explanatory sequential mixed-methods design and involved two interconnected phases (Fetters & Tajima, 2022). First, pre- and post-course writing scores, eight weekly participation records, and student and teacher ratings were used to describe change and perceived practice. Then, four ESP teachers and students with diverse improvement profiles were interviewed to discuss the quantitative trends and the obstacles to implementation. Integration happened at the interview selection and again in the joint display (Table 9) when each quantitative pattern was evaluated with relevant interview themes. Both intact classes received the intervention; hence the design estimates within-cohort change rather than a controlled treatment effect.

Qualitative evidence helped to explain potential mechanisms and exceptions rather than converting an observed connection into a causal finding. The interpretation kept divergent evidence such as language challenges and unequal group work. This sequence links the four research questions: writing outcomes, weekly involvement, student beliefs, and teacher perspectives.

The context of the study was an electrical engineering ESP course at Universitas

Muhammadiyah Gresik. The sample was 80 second-semester students from two entire courses (A: n = 40; B: n = 40), aged between 18 and 20 years; 71 men and 9 women. Students had previously studied general English but had not received rigorous training in technical English writing. The original study characterizes their competence as low-intermediate to intermediate based on institutional placement data and their initial writing performance. The study began in February 2025 in two intact second-semester electrical engineering ESP classes at Universitas Muhammadiyah Gresik (Class A, n = 40; Class B, n = 40). The training was 8 weeks long, with 100 minutes of course time every week, and work was done through Telegram between sessions. Follow-up interviews were carried out with four ESP teachers and ten students with high, moderate, and poor improvement profiles. Teacher ratings with N = 30 are also presented in Table 5. The data report 71 boys and nine girls among the students. The high gender imbalance precludes the study of gender differences, and no gender-specific inference is drawn.

During eight weeks, project activities ranged from negotiating roles and describing components to explaining circuits, troubleshooting, writing a proposal, writing a progress report, explaining a handbook, and writing a screenplay for a final presentation. This cycle shifted from descriptive to procedural and problem–solution writing. The tasks, reported Telegram actions, goods, and language support are listed in Table 1.

During the eight weeks of the project, students posted drafts of their technical writing on Telegram, asked questions, provided each other with peer comments, and practiced their explanations in voice notes. Teachers supported these exercises using model texts, technical glossaries, sentence frames, rubrics, and comments on modifications. A chat record was kept and used for practice between the weekly classes. As project tasks and teacher support were provided concurrently with Telegram, the study cannot disentangle the discrete impact of the platform on writing skills and readiness to communicate.

Table 1. *Eight-week project sequence and Telegram activities*

Week	Project task	Language focus	Telegram activity	Output	Scaffolding
1	Technical self-introduction and project role negotiation	Role description; self-introduction; simple technical identity statements	Post a short technical self-introduction; negotiate roles in the group chat.	Profile note and group role list	Sentence frames and role-description prompts
2	Electrical component description	Descriptive phrases; technical adjectives; component functions	Post the component description draft; exchange peer comments.	Component description paragraph	Technical glossary and model component description
3	Circuit-function explanation	Cause-effect relations; function verbs; explanation sequence	Share a voice-note explanation of the circuit; comment on peers' explanations.	Circuit-function explanation	Model text and language template
4	Troubleshooting note	Problem-solution reasoning; procedural sequencing; fault description	Discuss a fault diagnosis in the group; receive teacher comments on the note.	Troubleshooting note	Troubleshooting phrase bank and checklist
5	Mini-project proposal	Purpose statements; justification; feasibility language	Upload a short proposal draft; review and revise after feedback.	Short mini-project proposal	Proposal template and assessment rubric
6	Project progress report	Progress reporting; status updates; sequence markers	Post a progress update; discuss group feedback and next steps.	Project progress report	Feedback checklist and revision prompts
7	Product/manual explanation	Procedural language; imperative forms;	Share the manual draft; review clarity of peers' instructions.	Product/manual explanation	Model manual and technical glossary

		manual-style concision			
8	Final presentation script	Presentation signposting; summarising findings; audience-oriented explanation	Rehearse by voice note; upload the final presentation script.	Final presentation script	Rehearsal feedback and presentation rubric

Technical writing was rated at pretest and posttest on four criteria: Content, Communicative Achievement, Organization and Language, each scored 0–5 (maximum 20). These correspond to the Cambridge English writing assessment domains for task fulfillment, communicative purpose, organization, and vocabulary and grammar (Cambridge Assessment English, 2020). Tasks here included component and circuit explanations, troubleshooting notes, project reports, and presentation scripts. Each script was assessed by two independent raters. The source documents do not specify a level-specific Cambridge rubric, precise descriptors, or a verifiable inter-rater agreement coefficient. It is thus that we report the 4-domain scoring technique without claiming usage of an unaltered Cambridge test rubric or quantitative absolute agreement.

Telegram records included weekly English messages of each student, volunteer turns, feedback from peers, and audio notes. These counts represent visible participation, while WTC signifies preparedness to speak in a circumstance (Charoenpornsook & Thumvichit, 2025; Macintyre et al., 1998). Therefore, the involvement index presented here is viewed as a proxy for enacted communication rather than a validated psychological assessment. One should be careful in making comparisons across weeks because the initial weights, coding methods, and task-opportunity denominators are undocumented. The 13 student-belief items addressed Task Management, Idea Development, and Language Use; two General Impression items were analyzed independently. Teacher practice ratings are presented in Table 5.

Descriptive statistics described writing, participation, and survey replies. Paired t tests compared pretest and posttest writing and Week 1 and Week 8 participation. Independent t tests compared the 2 intact classes at baseline and on gains. Weekly trends and class interactions were reported using repeated measures ANOVA and linear mixed effects models. Cohen's d and partial eta squared were used to indicate the magnitude of within-student variation. Longitudinal estimates were interpreted as reported associations, as model parameters, missing-data judgments, sphericity checks, and sensitivity analyzes. After quantitative analysis, ten students and four ESP teachers were interviewed, and the data were thematically analyzed using familiarization, coding, and theme refinement (Braun & Clarke, 2006; Byrne, 2022). The manuscript reports 87.5% coding agreement and Cohen's $\kappa = .83$ on a subset of. A joint display linked quantitative outcomes to explanatory accounts (Fetters & Tajima, 2022) without attributing causal consequences to Telegram.

RESULTS AND DISCUSSION

Questionnaire item analysis and internal consistency

Table 2 presents item-total and corrected item-total correlations and Cronbach's alpha for the student belief dimensions. The whole 13-item scale had α=.846. These correlations give some preliminary support to the relationship between items and their intended scores but do not in themselves demonstrate construct validity; no factor-analytic evidence is presented. General Impression (two items) is reported separately from the 13-item total scale.

Task Management showed an acceptable internal consistency (α =.752). Language Use (α = .627) and General Impression (α = .609) should be interpreted cautiously, as exploratory. Idea Development was less strong (α =.537), with corrected item–total correlations as low as .254. Its mean should not be seen as a reliable, stand-alone assessment of the construct. The item language and dimensional structure require more evaluation and replication:

Table 2. *Student-belief item analysis and internal consistency*

Dimension (items)	Item–total r	Corrected r	α	Interpretation
Task Management (5)	.601–.783	.386–.607	.752	Acceptable
Idea Development (4)	.543–.734	.254–.431	.537	Low; descriptive use only

Language Use (4)	.588–.730	.290–.458	.627	Modest; exploratory
Overall student belief (13)	.435–.730	.330–.652	.846	Good internal consistency
General Impression (2)	.845–.851	.438	.609	Modest; separate score

Note. Uncorrected item-total r includes the focal item; corrected item-total r removes it from the subscale total. These coefficients are preliminary item-function evidence, not a substitute for construct validation. The overall 13-item score excludes the two General Impression items.

Technical writing performance

The average writing score of 80 students out of 20 points went from 10.63 (SD = 2.12) pre-course to 14.38 (SD = 2.28) post-course, with an average improvement of 3.75 (SD = 1.43). The four criteria of the rubric are: substance, communicative achievement, organization, and language. Criterion-level pre- and post-test data were not available; therefore, aggregate scores do not demonstrate which criterion changed the most.

Both intact classes showed better post-test averages. Class A improved from 10.75 to 14.78 while Class B improved from 10.51 to 13.99. These parallel patterns in descriptive language improved during the same eight-week term. They cannot identify the causal effect of the program without a comparison class not receiving the project sequence.

Table 3. *Descriptive statistics for writing performance*

Group	N	Pre-test M (SD)	Post-test M (SD)	Gain M (SD)
Overall	80	10.63 (2.12)	14.38 (2.28)	3.75 (1.43)
Class A	40	10.75 (2.18)	14.78 (2.17)	4.03 (1.58)
Class B	40	10.51 (2.07)	13.99 (2.35)	3.48 (1.22)

Note. The scores are based on the Cambridge Writing Scale, and the maximum score is 20.

Weekly WTC and writing progression

The measure of behavioral participation increased from a mean of 2.95 (Week 1) to a mean of 6.77 (Week 8). Weekly writing increased from 11.38 to 14.30 throughout this period. (Table 4). The sequence involved distinct activities each week; thus the rising trajectories should be understood as change over a shifting collection of chances, not as an identical task repeated eight times. The specific index units and range must be stated in the Methods section.

Table 4. *Weekly WTC and writing progression across the project cycle*

Week	Key project task	WTC index M (SD)	Weekly writing M (SD)	On-time submission
1	Technical self-introduction & project role	2.95 (1.00)	11.38 (2.05)	83.8%
2	Electrical component description	3.42 (0.97)	11.75 (2.16)	82.5%
3	Circuit function explanation	4.23 (1.00)	12.24 (2.01)	83.8%
4	Troubleshooting note	4.53 (1.18)	12.61 (2.08)	92.5%
5	Mini project proposal	5.35 (0.95)	12.94 (2.09)	85.0%
6	Project progress report	5.66 (1.01)	13.56 (2.29)	97.5%
7	Product/manual explanation	6.20 (1.05)	14.00 (2.26)	96.2%
8	Final project presentation script	6.77 (1.02)	14.30 (2.24)	98.8%

Note. The participation index draws on Telegram English turns, English messages, peer feedback, and voice notes. Its scoring rule and possible range require author confirmation; the values describe recorded participation rather than a direct observation of private intention to communicate.

The parallel trends are consistent with joint development of writing performance and recorded participation, but these descriptive series do not show that one outcome caused the other.

Student beliefs and teacher practices

Students were generally positive in their ratings (M = 3.91/5; Table 5). The mean level of Task Management (M = 3.94), Idea Development (M = 3.95), and Language Use (M = 3.84) was similar. These descriptive averages should be understood in light of the rather low reliability of Idea Development and Language Use; a positive mean does not imply that all students had similar experiences of the course.

ESP Alignment had the highest teacher-practice rating (M = 4.11/5), followed by WTC Support (3.73), Assessment and Feedback (3.60),

Digital Practice (3.43), and Project-Based Practice (3.42). The claimed N = 30 for these ratings needs confirmation vis-à-vis the four instructor interviewers. The preconditions for implementation were underlined by interviewees in the model texts, glossaries, rubrics, feedback, and monitoring of individual contributions.

Table 5. *Student beliefs and teacher practices*

Scale / Dimension	N	Mean	SD	Interpretation
Task Management	80	3.94	0.46	Positive
Idea Development	80	3.95	0.39	Positive
Language Use	80	3.84	0.48	Positive
Student Belief Overall	80	3.91	0.39	Positive
General Impression	80	4.09	0.49	Positive
ESP Alignment (teachers)	30	4.11	0.31	Strong
Project-Based Practice (teachers)	30	3.42	0.34	Moderate
WTC Support (teachers)	30	3.73	0.36	Strong
Digital Practice (teachers)	30	3.43	0.51	Moderate
Assessment and Feedback (teachers)	30	3.60	0.32	Strong
Teacher Practices Overall	30	3.66	0.18	Strong

Note. Student and teacher rows use five-point response scales. Student N = 80; the reported teacher-rating N = 30 requires clarification in Section 3.2. Idea Development and Language Use have limited internal consistency (Table 2).

Inferential statistics

The overall paired writing comparison was statistically significant, $t(79) = 23.39$, $p < .001$, $dz = 2.61$ (see Table 6). This is a very substantial standardized within-student change throughout the eight weeks. The estimate describes change in this cohort, not the unique effect of the intervention. Both intact classes also exhibited considerable within-class gains.

Baseline comparison revealed no difference in writing score between Classes A and B, $t(78) = 0.50$, $p = .619$. This does not imply formal equivalence. Nor was their gain-score difference statistically significant, $t(78) = 1.74$, $p = .086$; the result does not establish equivalent effects. The comparison of Week 1 participation to Week 8 involvement was significant, $t(79) = 25.48$, $p < .001$, $dz = 2.85$, a very large within-student change on the reported index. It is difficult to assess its substantial magnitude unless the index scale and coding rules are specified.

Table 6. *Inferential statistics for writing performance and WTC development*

Comparison	t(df)	p	Mean difference	Effect size	Interpretation
Baseline Class A vs B	0.50 (78)	.619	0.24	d = 0.11	No difference detected
Overall pre to post	23.39 (79)	< .001	3.75	dz = 2.61	Very large within-student change
Class A pre to post	16.06 (39)	< .001	4.03	dz = 2.54	Within-class increase
Class B pre to post	17.95 (39)	< .001	3.48	dz = 2.84	Within-class increase
Gain Class A vs B	1.74 (78)	.086	0.55	d = 0.39	No difference detected
Participation Week 1 vs 8	25.48 (79)	< .001	3.83	dz = 2.85	Very large index change

Note. Paired comparisons report Cohen's dz; independent comparisons report Cohen's d. A nonsignificant difference is not an equivalence test. Effect sizes describe observed change or contrast and should be interpreted with design limitations in mind.

Table 7. *Longitudinal analyses of participation and weekly writing*

Outcome	Main statistical finding	Interpretation
WTC Behaviour Index	RM-ANOVA: $F(7, 553) = 193.16$, $p < .001$, $\eta p^2 = .710$	Large week-associated change in the recorded participation index; not a causal estimate.
Weekly Writing Score	RM-ANOVA: $F(7, 553) = 170.44$, $p < .001$, $\eta p^2 = .683$	Large week-associated change in weekly writing scores; not a causal estimate.
WTC LMM Linear Slope	b = 0.522 per week for Class A, $p < .001$	Positive linear slope for the Class A reference group.
Writing LMM Linear Slope	b = 0.443 per week for Class A, $p < .001$	Positive linear slope for the Class A reference group.

Week × Group Interaction	WTC: p = .127; Writing: p = .260	No difference in trajectories detected at the .05 level.
Quadratic Growth	WTC: p = .111; Writing: p = .611	Quadratic terms did not reach the .05 level.

Note. RM-ANOVA = repeated-measures analysis of variance; LMM = linear mixed-effects model; ηp^2 = partial eta squared. The reported week effects are large on a conventional scale, but the absence of a non-intervention comparison group limits causal attribution. Slopes are reported for the Class A reference group.

The repeated-measures analyses reported a week effect for the participation index, $F(7, 553) = 193.16$, $p < .001$, $\eta p^2 = .710$, and for weekly writing, $F(7, 553) = 170.44$, $p < .001$, $\eta p^2 = .683$. Both partial eta-squared values indicate a large proportion of modelled within-sample variation associated with week, not a treatment effect. The mixed models also reported positive linear slopes for the Class A reference group (participation b = 0.522; writing b = 0.443; both $p < .001$). Week-by-class tests did not detect different trajectories (participation p = .127; writing p = .260). These results describe a progressive trend across the eight-week sequence, conditional on the model and index specifications requested above.

Qualitative findings

Ten student and four instructor interviews helped to interpret the quantitative patterns. Themes that emerged were participant confidence, instructor scaffolding, task management, impediments to implementation, relevance of ESP, language use, and digital practice (Table 8). 87.5% agreement and Cohen's $\kappa = .83$ for a subset of coding. Theme counts refer only to coded references and not to the number of participants endorsing a theme or the strength of a theme's causal influence. Collaboration only has five references and is therefore considered a feature of task management rather than a separate major finding.

Students reported feeling anxious about grammar, pronunciation, and assessment, and appreciated the ability to write a short response before attempting a voice note or presentation. Teachers reported that the technical writing assignments were made easier by example texts, technical glossaries, feedback, rubrics, and reasonable milestones. These hypotheses are reasonable for the observed trends, accounting for variances among students. Participants also described unequal group involvement, technical vocabulary requirements, time strain, and technology distraction. Some descriptions of felt components, troubleshooting notes, and manuals were more relevant than general English assignments but still needed aid in converting technical concepts into correct professional phrases. These impediments temper what are otherwise favorable survey and performance outcomes.

Table 8. *Interview themes and coded-reference counts*

Theme	Student refs.	Teacher refs.	Interpretation
WTC Confidence	20	7	Confidence, anxiety reduction, speaking rehearsal, safe digital practice
Teacher Scaffolding	12	11	Model text, feedback, rubric, differentiation, confirmation
Task Management	16	1	Milestones, checklists, role division, and time discipline
Implementation Barriers	11	6	Unequal participation, vocabulary load, time pressure, and digital distraction
ESP Relevance	11	5	Authentic engineering tasks, troubleshooting, manuals, and professional communication
Language Use	11	4	Technical vocabulary, grammar accuracy, glossary, model sentences
Digital Practice	10	4	Telegram archive, peer learning, catch-up, voice notes
Idea Development	10	0	Technical explanation, problem-solution pattern, organization
Teacher Beliefs	0	6	Sustainability, material preparation, and PBL feasibility
Collaboration	4	1	Peer roles, contribution, and group fairness

Note. Counts are coded references, not participant counts or inferential estimates. Collaboration (five references) is interpreted within task management; it is retained separately in the table to avoid adding potentially overlapping codes.

Integrated evidence reveals greater technical writing scores and more recorded English-language engagement during the project cycle. Interviews connect these tendencies to discipline-

specific activities, staged rehearsal, peer interaction, and teacher feedback. This pattern is consistent with PBLL research on purposeful products (Beckett et al., 2025; Jaleniauskiene & Venckiene, 2025) and with work on authentic material and learner engagement (Ghorbanian et al., 2024; Heydarnejad et al., 2021). The design does not allow for separating the impacts of project work, Telegram, maturation, repetitive practice, or other course events.

For WTC theory, the study adds a longitudinal perspective on enacted participation to literature that often depends on stated intention (Charoenpornsook & Thumvichit, 2025; Ke et al., 2025; Lee & Drajati, 2020; Peng, 2024). Interviews reveal a possible progression from brief written pieces to vocal rehearsal and to larger public communication. WTC has been associated with digital anxiety, supportive connections, and the type of activity in similar work (Lee & Chiu, 2023; Y. Li et al., 2025; Rahaman et al., 2026; Saftari et al., 2025; Yang et al., 2024). The Telegram index is a proxy of behavior that is contingent upon opportunity and should not be offered as a validated measure of psychological willingness unless its score and evidence of validity are provided.

The findings point to the possibility of a relationship between genre relevance and explicit support in ESP pedagogy. The engineering themes gave content to convey, and examples, terminology resources, sentence frameworks, and recurring feedback provided ways to express. This interpretation is in line with studies on specialized registers, engineering genres, and blended genre instruction (Basturkmen, 2025; Mangalindan et al., 2025; McLellan et al., 2021). However, the current aggregate score does not differentiate changes in disciplinary content from improvements in organization or accuracy in language.

The contribution of mobile learning is the pedagogical use of a persistent, asynchronous channel. Drafts, comments and voice rehearsals were sent over Telegram between scheduled sessions, similar to findings in studies on Telegram-mediated ESP and mobile-supported project work (Benlaghrissi & Ouahidi, 2024; Borasheva, 2026; Falah et al., 2023). A technology-centred explanation would go beyond the data: all students have access to Telegram along with the activities, models, milestones, and teacher comments. The research on connecting learning across settings also suggests that the designed connection matters (Salloum et al., 2025).

Interpretation is limited by the belief questionnaire. The total 13-item scale demonstrated strong internal consistency (α = .846), but Idea Development was low (α = .537), and Language Use (α = .627) and the two-item General Impression score (α = .609) were modest. Item-total correlations do not support the hypothesized factor structure. Student interviews should be used in future instrument development to update problematic phrasing, cognitive pretesting, expert content review, factor analysis in an independent sample, and criterion-level checks against real writing. Until this point, subscale means describe rather than provide compelling evidence for different opinions.

Results are aggregated at the outcome level in Table 9. Writing and participation trajectories are in line with participants' reports of relevant tasks and scaffolded rehearsal. Favorable ratings co-exist with worries about workload and uneven teamwork. The nonsignificant comparison of class gain provides only modest support for differences between the two intact groups. The joint course design could have facilitated writing and involvement in this environment, but the distinct contribution of each component is unknown: this is a conditional joint conclusion.

Table 9. *Joint display of quantitative trends, interview themes, and integrated interpretations*

Quantitative result	Qualitative explanatory themes	Integrated meta-inference
Writing performance increased from 10.63 to 14.38; mean gain = 3.75.	Idea development, language use, and teacher feedback.	Together, the score trend and interview accounts suggest that genre models, technical content, and feedback made repeated disciplinary writing feasible; component effects remain unknown.
WTC index increased from 2.95 in Week 1 to 6.77 in Week 8.	WTC confidence, Telegram practice, and anxiety reduction.	Together, the log trend and accounts suggest that digital rehearsal supported participation from short text to voice; the index also reflects task opportunities.
Student belief was positive overall (M = 3.91/5).	Task management, ESP relevance, and collaboration.	Together, the ratings and accounts suggest that staged work felt relevant and

		manageable for many students; low subscale reliability limits finer claims.
Teacher practices were rated strong overall (M = 3.66/5).	Teacher scaffolding, assessment, and sustainability.	Together, ratings and interviews suggest that implementation depends on models, glossaries, rubrics, and contribution monitoring; the N = 30 rating sample requires confirmation.
Between-class gain difference was not significant (p = .086).	Comparable project structure across classes.	Together, the quantitative contrast and shared task sequence show no detected class-gain difference; this does not establish equal effects or wider transfer.

Note. The qualitative themes explain how participants interpreted the quantitative trends; they do not independently verify a causal mechanism. The teacher-rating denominator and participation-index scoring await author confirmation.

Pedagogical implications

In this context, the ESP teachers can start with a needs analysis of the engineering documents that students are required to write, and then sequence short component descriptions, cause explanations, troubleshooting notes, and sections of the manual, before a final presentation script. For each genre, provide: an example text, a short technical glossary, an explicit rubric, and a revision opportunity. Document criterion-level writing scores for future cohorts to see what features change the most.

Participation can be scaffolded with a short written draft, peer response, a rewritten explanation, a voice-note rehearsal, and a more public presentation. Teachers need to be explicit about what actions are needed on Telegram, create opportunities for optional contributions, and track individual responsibilities so that group products do not mask differences in labor. Curriculum designers should include time for feedback, digital engagement that is accessible, and teacher preparation. These are design implications that are implementable and not components whose distinct effects were evaluated here.

Limitations and future research

This was a single-institution study of two intact courses within one engineering program; neither class was a non-intervention control. The cohort was comprised of 71 boys and 9 girls; therefore, gender-specific experience and subgroup differences could not be properly analyzed. The course was eight weeks long and did not include a delayed post-test therefore, it is not known how durable the increases in writing and participation were. Further documentation is required for the participation-index algorithm, inter-rater estimate, proficiency classification, and teacher-rating sample. Subscale interpretation is limited by weak internal consistency for Idea Development and low-to-moderate values for two other belief scores. These constraints restrict the statements that may be made from the results.

Future research should include a comparison to an appropriate control, a retest after a delay, and a description of the scoring process for digital participation. Cohorts across many institutions could study the impact of proficiency and gender mix on experience. Writing research should report rater agreement and criterion-level ratings. Digital trace analysis might differentiate between mandatory posts and elective turns and analyze the quality of peer criticism, revision, and vocal rehearsal rather than just count activities. Any redesigned belief instrument should be validated independently before its dimensions are considered to be established constructs.

CONCLUSION

Scores of writing and English-language engagement in two electrical engineering ESP classes were higher in an eight-week Telegram-mediated project sequence. Students and teachers reported that discipline-relevant assignments, digital rehearsal, and explicit language support were useful, but also reported workload, vocabulary expectations, and uneven group contribution. The study thus provides classroom-based evidence that a guided project sequence is promising for technical writing and engagement in this context.

The theoretical contribution is a qualified connection between specialized technical genres, conditions for located WTC, and observed digital participation throughout time. The practical contribution is a reproducible sequence of authentic writing tasks, including examples, glossaries, feedback, and staged opportunities to contribute. These actions were carried out via Telegram; the study cannot identify its independent effect.

Teachers employing this strategy should explain the communication opportunity and

scoring procedures beforehand, keep track of individual contributions, and review writing by criterion and in total. The study does not include a comparison group and the assessment is delayed, which leaves unresolved doubts about the broader effectiveness and sustainability. However, the approach should be recommended for other similar engineering ESP scenarios only when controlled comparisons and follow-up testing are done.

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K.A.: Brainstorming, analysis and modelling. N.F.: data collection, structuring and experiments. S.F.N.: data collection and analysis, testing & Analysis. U.S. R. S: Validation.

CONFLICT OF INTEREST DISCLOSURES
The authors declare that there are no conflicts of interest. There were no financial, personal or professional relationships that could have influenced the study's results, analysis or conclusions.

AVAILABILITY OF DATA
The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

STATEMENT ON USE OF ARTIFICIAL INTELLIGENCE (AI) ASSISTANCE
The authors used AI-assisted tools to verify the grammar and vocabulary used in writing the manuscript. The authors fabricated all critical materials.

ETHICAL CLEARANCE
This study followed the relevant ethical concepts and standards.

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