Creation and validation of a technopedagogical design with flipped learning and collaborative writing

Creación y validación de un diseño tecnopedagógico con aprendizaje invertido y escritura colaborativa

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ABSTRACT

Academic writing is a complex transversal competence that still represents a challenge for the development of university education. This challenge involves improving the capacity for argumentation, organization of ideas, and linguistic skills through the implementation of appropriate practices in didactic processes. The objective of this research is to create and validate a technopedagogical design with flipped learning and collaborative writing (TPD-FLCW) to enhance the production of academic texts. The research was conducted with Peruvian university engineering students (diagnostic stage = 89 and experimental stage = 40) and 16 expert professors. The ADDIE model with five phases was used: analysis, design, development, implementation, and evaluation. The initial diagnosis revealed that students had difficulties in academic writing. Based on these results, the proposal was designed and validated with the participation of judges (CVC > 0.9; K_{Fleiss} > 0.3, $p < 0.05$). The application in the experimental group showed significant improvements in the essays produced before and after the intervention ($p < 0.05$; $\hat{g} > 1.20$). Additionally, the students' assessment was positive, and they reported having improved their writing skills, autonomy, and teamwork capacity. It is concluded that the TPD-FLCW proves to be effective and adequate for learning academic writing, and its use is recommended for learning other types of texts.

Keywords: learning strategies; flipped learning; collaborative writing; technopedagogical design; validity.

RESUMEN

La escritura académica es una competencia transversal compleja que aún representa un desafío en el desarrollo de la formación universitaria. Este reto implica mejorar la capacidad de argumentación, organización de ideas y habilidades lingüísticas mediante la implementación de prácticas apropiadas en los procesos didácticos. El objetivo de este trabajo es crear y validar un diseño tecnopedagógico con aprendizaje invertido y escritura colaborativa (DTP-AIEC) para mejorar la producción de textos académicos. La investigación se realizó con estudiantes universitarios peruanos de ingeniería (etapa diagnóstica = 89 y etapa experimental = 40) y con 16 docentes expertos. Se empleó el modelo ADDIE con cinco fases: análisis, diseño, desarrollo, implementación y evaluación. El diagnóstico inicial evidenció que los estudiantes presentaban dificultades en la escritura académica. Con base en estos resultados, se diseñó y validó la propuesta con la participación de jueces (CVC > 0.9; K_{Fleiss} > 0.3, $p < 0.05$). La aplicación en el grupo experimental evidenció mejoras significativas en los ensayos producidos antes y después de la intervención ($p < 0.05$; $\hat{g} > 1.20$). Además, la valoración de los estudiantes fue positiva y manifestaron haber mejorado sus habilidades de escritura, autonomía y capacidad de trabajo en equipo. Se concluye que el DTP-AIEC demuestra ser eficaz y adecuado para el aprendizaje de la escritura académica y se recomienda su empleo para el aprendizaje de otros tipos de textos.

Palabras clave: estrategias de aprendizaje; aprendizaje invertido; escritura colaborativa; diseño tecnopedagógico; validez.

INTRODUCTION

Current education is strongly influenced by socio-constructivism (Da Fonseca et al., 2021). This theory assumes that the understanding, meaning, and significance of learning develop in the interaction between people (Amineh & Asl, 2015). Learning occurs first at the social level and then individually (Vygotsky, 1978). In 21st-century pedagogy, collaborative learning is a practical response to the theoretical approaches of socio-constructivism. Collaborative learning is defined as the teamwork of two or more people working towards the same goal with a common and symmetrical commitment (Jeong & Hmelo-Silver, 2016). In addition, collaboration among members fosters critical thinking and active participation, enhances learning, and models various techniques for solving problem situations (Laal & Ghodsi, 2012).

Writing competence is transversal in nature and is associated with the achievement of generic competencies within the curricular structure (Barreda-Parra et al., 2023). However, the difficulties lie at the beginning of professional training and are associated with paraphrasing (Tan & Carnegie, 2022), recognition of authorship in citations and references (Acosta et al., 2023), use of language, organization of the text, writing processes (Direkci et al., 2022), and adoption of inappropriate practices such as plagiarism (Festas et al., 2023). This is further compounded by the existence of implicit theories that make writing practice invisible; for instance, assuming it as a mere act of transcription, talent, inspiration, basic skill, lexis, or spelling and not as an object of teaching (Navarro & Mora-Aguirre, 2019) may end up diverting its practical exercise.

Given this situation, various strategies have been implemented to improve academic writing competence (Andueza-Correa, 2022; Yuliani et al., 2023). Successful experiences in recent years have highlighted collaborative learning as the strategy that has the most significant impact (Sundari & Febriyanti, 2023; Zou et al., 2022). Collaborative learning and online education are the new challenges in subjects that require hands-on development (Roxas, 2023), where interaction between peers and teachers is indispensable. Collaborative writing begins with brainstorming during text planning (Svenlin & Jusslin, 2023) and culminates in revising drafts of the writing before final submission (Thirakunkovit & Boonyaprakob, 2022).

The use of collaborative writing (CW) is becoming increasingly common in the development of writing competence (Fanguy & Costley, 2021). In pedagogical settings, teachers have started to incorporate it in the presentation of final-year work (Pham, 2023). However, they spend most of their class time on content presentation (Palau & Fornons, 2022), which leads to the technique being applied outside of class (asynchronously) to accomplish the assigned task, rather than as a didactic strategy during the session (Hsu, 2020). Although empirical evidence for writing development has been relatively successful in addressing the achievement of writing proficiency, there are still methodological difficulties in the role of students and teachers (Zhang et al., 2021).

An active methodology such as Flipped Learning (FL) applied by teachers to the teaching of writing would optimize the time devoted to the development of higher-order thinking and competencies (Sargent & Casey, 2020). FL involves modifying the order of the teaching-learning processes: at home, learning is mainly individual with the use of various study techniques such as videos, texts, audios, among others;

whereas, in the classroom, students apply that theoretical knowledge (Santiago & Bergmann, 2018). Research in the field of writing has empirically investigated the benefits of FL at cognitive, procedural, and emotional levels (Ebron & Mabuan, 2021; Özdemİr & Açik, 2019). The acquisition of content knowledge is matched to students' learning paces, more class time is devoted to workshop execution, and there is greater confidence in hands-on activities due to teacher supervision (Owen & Dunham, 2015).

Technopedagogical design for academic writing

The combination of technology, content, and pedagogy (Koehler et al., 2015) shapes a scenario in which technopedagogy is of crucial importance in today's education. From this perspective, the teacher assumes the role of technopedagogue to provide solutions to educational problems, such as the development of writing skills. However, he/she must first have developed technopedagogical competencies to plan, implement and evaluate educational processes (Niess, 2005). Hence, the use of software, simulations, platform navigation, among other resources, is imperative.

Current writing demands the mastery of various resources, such as search engines, text editing tools, reference management, style correction, plagiarism detection, etc. (Martínez-López et al., 2019). These resources are used in educational practice through activities that direct the interactive triangle (teacher, student, and content), giving rise to the technopedagogical design (Hernández & Muñoz, 2012). This design involves the integrated exploration of the contributions of digital technology in the teaching and learning processes of academic writing (Shanks & Young, 2019). It requires systematic and rigorous planning of the activities and procedures that the teacher will apply to ensure that students acquire learning efficiently, making use of methods or techniques and digital or technological resources.

Flipped Learning and Collaborative Writing

FL is a model rooted in constructivist pedagogical theories, positing that the construction of students' learning is attributed to their cognitive ability to comprehend the material or course content (Lindeiner-Stráský et al., 2022). In FL, students engage in various activities before the start of class with the aim of acquiring content knowledge to then apply that knowledge during in-person sessions. (Santiago & Bergmann, 2018). In addition to improving writing proficiency (Zhao & Yang, 2023), FL promotes autonomy, motivation, metacognition, adaptation to learning pace, ease of feedback, and engagement (Huang et al., 2023; Thai et al., 2023).

Parallelly, CW is presented as an effective strategy to carry out the writing processes. This activity implies that co-authors (students) actively participate in all phases of writing, assuming a responsible commitment and ownership of the final document (Storch, 2019). CW is grounded in theories such as socio-constructivism (Vygotsky, 1978), group cognition (Stahl, 2004), and connected learning (Ito et al., 2013). Its didactic application demands the use of collaborative digital tools, such as blogs, wikis, interaction rooms, academic forums, or more up-to-date tools such as Google Docs (Suwantarathip & Wichadee, 2014).

The interest in proposing an enhancement in the production of academic texts by university students leads to the objective of developing a technopedagogical design that

integrates Flipped Learning and Collaborative Writing in virtual educational settings, with the subsequent aim of validation. The proposal encompasses five phases in the process.

METHODOLOGY

Method

In the study, qualitative and quantitative techniques are employed, because the creation and validation process unfolded in five phases following the ADDIE model: analysis, design, development, implementation, and evaluation (Kurt, 2018). Phase 1, "analysis", involves conducting a student diagnosis to identify the content to be developed and the needs of the educational context. In phase 2, "design", the syllabus of the course is developed, maintaining a pedagogical focus, the approach to the proposal, and the organization of content. Phase 3, "development", involves the selection, organization, and creation of content and materials used for learning based on the previously elaborated design. Phase 4, "implementation", focuses on the practical execution of the training action during the teaching and learning process of the students. Phase 5, "evaluation", represents the evaluative process of the previous stages and assesses the relevance of the proposal. The actions implemented in each phase are described below:

Phase 1 "Analysis": Firstly, the academic writing situation was diagnosed in three groups of students belonging to the Communication I course in the 2022-I term. The students composed a short argumentative text, with a length between 700 and 1000 words over a period of 8 hours asynchronously, addressing the question "What is the main contribution of the engineering field you study?" Subsequently, the generated products were reviewed to identify the issues. Secondly, the literature was reviewed, exploring the intervention of flipped learning and collaborative writing in the WOS and Scopus databases. Thirdly, the main theories of technopedagogical design were identified.

Phase 2 "Design": Fourthly, the technopedagogical design with Flipped Learning and Collaborative Writing (TPD-FLCW) was developed. The moments of each learning session (beginning, development, and closure) were taken into account, to which new designations were assigned (pre-phase, execution, and exit).

Phase 3 "Development": Fifthly, topics were selected and organized for the didactic guide through 9 learning sessions. Sixthly, didactic resources were developed in different formats (text, slides, audiovisual material). Seventhly, content validation was carried out with the participation of 16 expert judges in the field of university higher education. These judges were selected considering the following requirements: holding a doctoral degree, having at least 5 years of experience, being active in practice, and possessing experience in scientific research and writing. They evaluated the TPD-FLCW using the "Content Validity Protocol" instrument, based on 13 criteria on a Likert scale from 1 to 5, where 1 = inadequate, 2 = slightly adequate, 3 = moderately adequate, 4 = substantially adequate, and 5 = completely adequate.

Phase 4 "Implementation": Eighthly, the pre-assessment was applied; subsequently, after the intervention of the 9 sessions, the post-assessment was carried

out on an experimental (pilot) group of university students enrolled in the Communication II course in the 2022-II term.

Phase 5 "Evaluation": Ninthly, all students who participated in the experiment were surveyed to obtain their appreciation regarding the model. Tenthly, 7 randomly selected students belonging to different workgroups were interviewed to understand their experiences during the sessions.

Participants

In the diagnostic phase, 89 engineering students participated: 35 in civil engineering, 19 in systems engineering, 13 in environmental engineering, 15 in industrial engineering, and 7 in electronic engineering. Among these, 55 were males (48.95%) and 34 were females (30.26%), with an average age of X=18.74 and SD=3.54. These students are enrolled in the Communication I course, corresponding to the first cycle of their degree program. In the validation phase, 16 expert judges with doctoral degrees, expertise in writing, and experience in university teaching participated. In both the implementation and evaluation phases, 40 university students from civil engineering (28), systems engineering (3), environmental engineering (6), industrial engineering (1), and electronic engineering (2) programs participated, enrolled in the second cycle of the Communication II course. Among this group, 13 were females (32.50 %) and 27 were males (67.50 %), with an average age of 18.53 and a standard deviation of 2.65. In the interviews, seven students randomly selected from different work teams of the experimental group participated.

Instruments

1. For the initial diagnosis of writing competence, an "Assessment Scale for Written Production" was applied, consisting of 10 criteria distributed across 3 aspects: structure, text property, and linguistic register. The scale (from 1 to 4) evaluates a brief argumentative text of 500 to 800 words.

2. To evaluate the TPD-FLCW, the "Pedagogical Proposal Validation Form" was utilized. The instrument comprises 13 evaluation criteria (relevance, justification, foundation, coherence, structuring, sufficiency, methodology, resources, updating, linguistic aspects, academic format, evaluability, and viability) on a Likert scale (1 = inadequate, 2 = slightly adequate, 3 = moderately adequate, 4 = substantially adequate, and 5 = completely adequate).

3. The academic essays were evaluated using an "Academic Essay Evaluation Rubric". The instrument presents 14 indicators assessing textual superstructure (title, introduction, written argumentation, written counter-argumentation, conclusion, references), textual macrostructure (coherence and thematic progression), textual microstructure (lexical relationships, references, and discourse markers), and stylistics (lexicon, spelling, and syntax) (Van Dijk, 1992). The descriptors include a scale ranging from poor (1) to excellent (4). It has an adequate content validity index (V_{Aiken}= 0.926) determined by 12 expert judges. Construct validity was measured with the participation of 117 academic essays written by university students and evaluated by 4 teachers. Exploratory Factor Analysis (EFA) identified adequate indices with an explained variance of 93.735

% (Bartlett < 0.05, KMO > 0.5), and Confirmatory Factor Analysis (CFA) with relevant adjustments in GFI, CFI, TLI (> 0.9), RMSEA (≤ 0.08) and factor weights > 0.5. The Composite Reliability Index (CRI > 0.9) was adequate.

4. A "Proposal Assessment Questionnaire" composed of 10 items with a 5-level Likert scale, ranging from (1) completely disagree to (5) completely agree, was used. The items assess students' perception of participation, peer learning, ease of writing, use of collaborative tools, argumentative improvement, time management, proofreading skills, intergroup revision, advanced information, and recommendation.

5. Additionally, a "Semi-structured Interview Guide" was applied as a control strategy to verify students' feelings about the functioning of the TPD-FLCW. The guide consists of 11 open-ended questions organized to explore three aspects: writing skills before the TPD-FLCW (3 questions), after the intervention of the TPD-FLCW (5 questions), and the difference between both (3 questions).

Procedures and information analysis

The qualitative analysis involved a literature review and interpretation of the interviews. The results were processed using grounded theory to analyze the interviewees' responses. On the other hand, the quantitative part comprised the evaluation of the diagnosis, experimental assessment, and questionnaire results with descriptive and inferential statistics. To assess agreement among judges, the Content Validity Coefficient (CVC) by Hernández-Nieto (Pedrosa et al., 2014) was employed. The results of the experiment were analyzed using the Student's t-test for paired samples (the data met the assumption of normality and homoscedasticity). Data processing and analysis were conducted using the R Studio program.

RESULTS

This section shows the different phases of elaboration and validation of the Technopedagogical Design with Flipped Learning and Collaborative Writing based on the ADDIE model. In each phase, the results found are described.

1. Analysis phase

a) Diagnosis

The results allowed us to identify that over 60% of the students present difficulties with the structure of their texts (introduction, development, and conclusion), properties (coherence and cohesion), and linguistic register (lexis, syntax, and spelling). Around one-tenth achieved a rating of good in each criterion (Table 1).

Table 1
Diagnostic assessment of students' writing situation

Criteria	Deficient		Enough		Well		Total	
	f	%	f	%	f	%	f	%
Structure	55	61.80	25	28.09	9	10.11	89	100.00
Text property	57	64.04	25	28.09	7	7.87	89	100.00
Linguistic register	61	68.54	20	22.47	8	8.99	89	100.00

The main needs for attention were identified in the lack of structural knowledge of an argumentative text, lack of coherence between statements, redundancy of ideas, little or no use of citations and references, problems with the thesis statement, poor argumentation, and confusion with the writing of expository texts. Some issues correspond to a lack of ethical conduct, as situations of copy-pasting information stored on the web were observed (Figure 1).

Figure 1
Fragment of an argumentative text presented by a student in a diagnostic assessment

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b) *Literature review*

Based on the results of the previous diagnosis, the literature was reviewed in the Scopus and Web of Science databases and two models were found to have a high impact on academic writing: Flipped Learning and Collaborative Writing. Significant changes in the production of different texts after the implementation of these models in the learning sessions are due to the use of technological support, active student participation, and teacher monitoring. The different experiments ranged in duration from 6 to 11 sessions with samples ranging from 24 to 113 university students (Table 2).

Table 2
Review of models for technopedagogical design

Model	Definition	Successful experiences	Authors
Flipped Learning	Instructional learning takes place at home through videos, lectures, or podcasts. Whereas in the classroom, more space is given to dynamic and interactive learning, where concepts are applied creatively in the course (Bergmann & Sams, 2012).	Paragraph improvement, argumentative essays, self-perception of academic writing	(Chura-Quispe et al., 2022; Khojasteh et al., 2021; Umutlu & Akpinar, 2020)
Collaborative Writing	It is an iterative and social process that requires the involvement of a collaborative team throughout all stages while engaging in activities such as communication, negotiation, coordination, supervision, socialization, among other activities (Lowry et al., 2004).	Improvement of review articles, essays, scientific articles, expository texts	(Baldwin et al., 2019; Roohani & Rad, 2022; Shafiee Rad et al., 2022; Zou et al., 2022)

c) *Identification of the main theories*

After reviewing the models that underpin the TPD-FLCW, the main theories that provide pedagogical support for the proposal were identified (Table 3).

Table 3
Main theories of the TPD-FLCW

| Theory	Author	Theoretical framework
Theory of social-constructivism	(Vygotsky, 1978)	Cognitive development is first social and then individual. knowledge lies in the interactions between individuals.
Constructionism	(Papert & Harel, 1991)	It assumes the existence of skills for learning through experience and the ability to build a mental structure that organizes and synthesizes information and experiences. The student designs projects and is assisted by the computer.
Group cognition	(Stahl, 2004)	Learning is based on the exchange of strategies and a shared vision for problem-solving.

Theory	Author	Theoretical framework
Connectivism	(Siemens & Fonseca, 2007)	Learning takes place in changing scenarios (virtual environments and networking). It resides outside the individual and in the diversity of opinions. The student learns to choose information and the teacher guides him/her to discern it.
Connected learning	(Ito et al., 2013)	It encompasses learning according to students' interests and their relationship with others. It focuses on the abundance of information and connection through digital communication media.

2. Design phase

After exploring the main needs underlying students' academic writing, the TPD-FLCW was developed with three phases applied to each learning session (Figure 2): pre-phase, execution phase, and exit phase, representing continuous and cyclical activities (represented by arrows in both directions).

Figure 2
Technopedagogical Design with Flipped Learning and Collaborative Writing
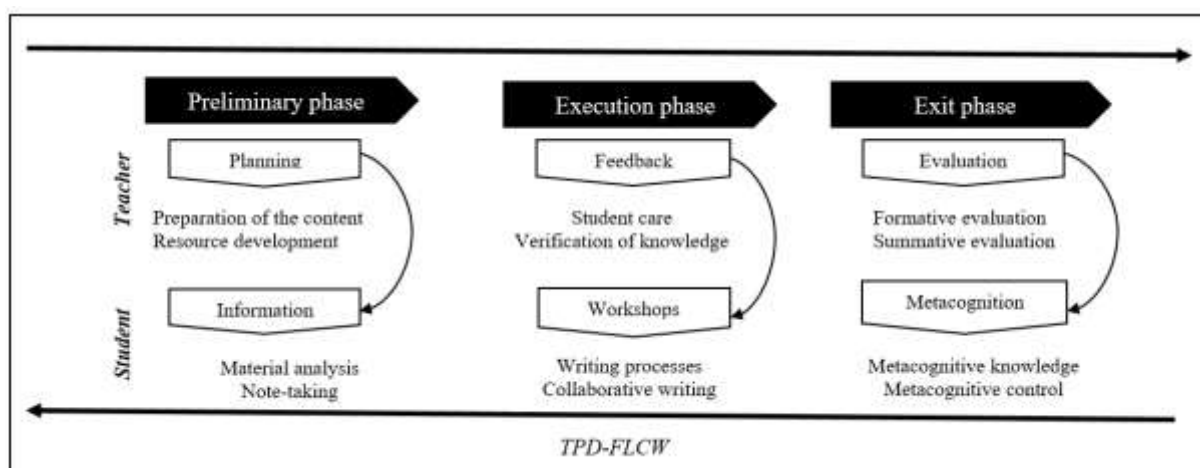
Source: Chura-Quispe & Garcia Castro (2024).

a) Preliminary phase of the TPD-FLCW

It is the moment preceding the classroom session and occurs within the home environment.

(1) Planning. The teacher prepares the class content using updated sources and develops didactic resources in various formats (text, audio, video, images, etc.). While video is the most commonly used format, it is complemented by other resources. He/she also creates tools to guide students in acquiring theoretical content, such as questionnaires, prompts, reading guides, etc.

(2) Information. This is the stage in which the student analyses the digital resources provided by the teacher in various formats. Additionally, students individually

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record key content through note-taking using various learning strategies such as underlining, summarizing, creating organizers, etc. (Baldwin et al., 2019).

b) *Execution phase of the TPD-FLCW*

These are the activities that take place during the session. It comprises the dynamic processes of learning in a synchronous way in class.

(3) Feedback. This is the moment when the teacher monitors and attends to the individual learning of the students, after having reviewed the materials. Feedback is provided through forums, workshops, gamification strategies, personalized tutorials, among others that actively involve the students. Cognitive, emotional, social, and structural dimensions are addressed.

(4) Workshops. This represents the specific activities that students carry out to apply their theoretical knowledge to writing. The workshops are developed through the active methodology of Collaborative Writing, under the guidance and direction of the teacher. Students apply their knowledge to the presentation of a product that demonstrates their socio-constructive learning (progress of the written text, elaboration of the outline of the writing plan, register of sources consulted, among others).

c) *Exit phase of the TPD-FLCW*

It consists of actions that are executed at the end of the learning sessions.

(5) Assessment. It consists of collecting information on the learning achieved by students to obtain a standard. It is carried out through formative and summative assessment. The first one allows knowing the learning achievement of the students according to the difficulties and progress. In addition, it examines what they learned and could learn through self-assessment, co-assessment, and heteroassessment (Traverso, 2023). The latter identifies their academic progress based on criteria outlined in the assessment instruments.

(6) Metacognition. It represents the moment when students reflect on their learning processes through self-critical questions, what they learned easily and where they had difficulty, as well as the use of solution strategies. This stage is composed of questions oriented to metacognitive awareness, which consists of knowing their potential and limitations for learning, and extension activities for metacognitive control characterized by assuming an active and participatory role in their learning.

3. Development phase

a) *Organisation of the content for the sessions*

A guide of 09 learning sessions on the content of the academic essay has been developed with the application of the TPD-FLCW (Table 4).

Table 4
Content of learning sessions with TPD-FLCW

Session	Content	Preliminary phase*	Implementation phase**	Exit phase**
01	Academic essay. Characteristics, types, and structure.	Analysis of textual and audiovisual content. Response to a four-question sheet on the content and note-taking.	Feedback with 4 questions, development of multiple choice questionnaire, identification of topic, thesis, main argument of paragraphs (in teams).	Evaluation with observation sheet, metacognitive questions, crossword reinforcement, and a preview of the next session.
02	Text properties: appropriateness, correctness, coherence, and cohesion (reference, substitution, ellipsis, and markers).	Synthesis of important ideas from textual and audiovisual content of Youtube video and answer to 4 questions, note-taking.	Feedback with 4 questions, solving a 10-question questionnaire with Google Forms, participation in Jamboard, rewriting incoherent texts, and creating paragraphs with non-cohesive sentences (in teams).	Assessment of texts with a checklist, response to 3 metacognitive questions, and reinforcement activity with the creation of a coherent and cohesive text.
03	Writing process: Planning (brainstorming and research), understanding sources, processing information, and developing the outline.)	Synthesis of ideas from lecture material and answer to 4 questions, note-taking	Participation and socialization of previous writing concepts in Padlet, feedback questionnaire in Moodle, planning of essay "What does the 21st-century engineer need to practice his profession properly?"	Evaluation of the planning scheme with a checklist, response to 4 metacognitive questions, socialization of the scheme in a forum, and evaluation of work (co-evaluation).
04	Textualisation, structure (contextualisation, thesis, and mapping), and types of introduction.	Viewing and taking notes on the material. Analysis of the 5 introductory examples.	Response to 3 content questions, participation in Kahoot development, creation of Google Docs in teams, and choice of topic, thesis, and introduction writing.	Evaluation of the introductory paragraphs with the checklist, response to metacognitive questions, and assessment of the introduction of other teams.
05	Citations (direct and indirect) and references in APA format.	Analysis of the videos and taking notes and practical exercises.	Response to 4 content questions, Wordwall feedback, and APA citation and referencing exercise.	Assessment of citations and references with the checklist, response to metacognitive questions, and progress of the essay.
06	The development of the academic essay. Elements of the paragraph and argumentative strategies.	Analysis, note-taking, and reflection on the examples of argumentative structures.	Response to 4 argumentation questions, feedback with Kahoot, construction, and outlining of 8 paragraphs.	Evaluation of paragraphs and response to metacognitive questions, socialization, and analysis of paragraphs in the forum.

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Session	Content	Preliminary phase*	Implementation phase**	Exit phase**
07	Counter-argumentation and conclusion (reiteration of thesis, synthesis of arguments, and reflection)	Analysis and note-taking of the materials and reflection on the types of conclusion.	Response to 4 counter-argument/conclusion questions, Kahoot feedback, and paragraph writing.	Assessment of counterargumentation and conclusion paragraphs with the checklist, response to metacognitive questions, and socialization and comments in the forum.
08	Revision process. Syntax, spelling, and lexis.	Analysis and note-taking of the "Revision" material. Reflection on revision strategies.	Response to 5 content-related questions, Moodle feedback, anonymous sharing of the academic essay, and assignment of papers for review.	Evaluation of the quality of evaluators' suggestions with observation guide, response to metacognitive questions, and essay correction.
09	Intra-group agreement. Intra-group review strategies. The publication process.	Analysis of the material "Intra-group agreement and steps for publication".	Response to content-related questions, oral feedback, application of intragroup revision techniques, and presentation of the final work with similarity report and journal elaboration.	Self-assessment of the quality of their academic essay and contribution to the team with a self-evaluation form, response to 3 reflection questions, and presentation of the journal.

Note 1. The content used in each pre-phase was audio-visual, textual, and slides. In the exit phase, the next session was previewed.

Note 2. * Each session in this phase is worked on individually, asynchronously, and at home (online). ** Each session in this phase is worked on in teams, synchronously, and in class (online).

b) Validation of the Technopedagogical Design FLCW

The agreement among judges is high (CVC > 0.90) for all criteria (Table 5). Furthermore, the assessment among these criteria shows significant and acceptable agreement (p > 0.05, k > 0.3). Therefore, it is possible to affirm that the TPD-FLCW demonstrates adequate content validity and presents the conditions for implementation in the experimental group.

Table 5
Agreement among expert judges

Criteria	S_{x1}*	Mx**	Epi***	CVC_i	CVC_{tc}
Rel	73	4.563	5.4E-20	0.913	0.913
Jus	73	4.563	5.4E-20	0.913	0.913
Sub	74	4.625	5.4E-20	0.925	0.925
Coh	75	4.688	5.4E-20	0.938	0.938
Str	75	4.688	5.4E-20	0.938	0.938
Suf	74	4.625	5.4E-20	0.925	0.925
Met	78	4.875	5.4E-20	0.975	0.975
Res	73	4.563	5.4E-20	0.913	0.913
Upd	77	4.813	5.4E-20	0.963	0.963
Lia	76	4.750	5.4E-20	0.950	0.950
Acf	74	4.625	5.4E-20	0.925	0.925
Eva	73	4.563	5.4E-20	0.913	0.913

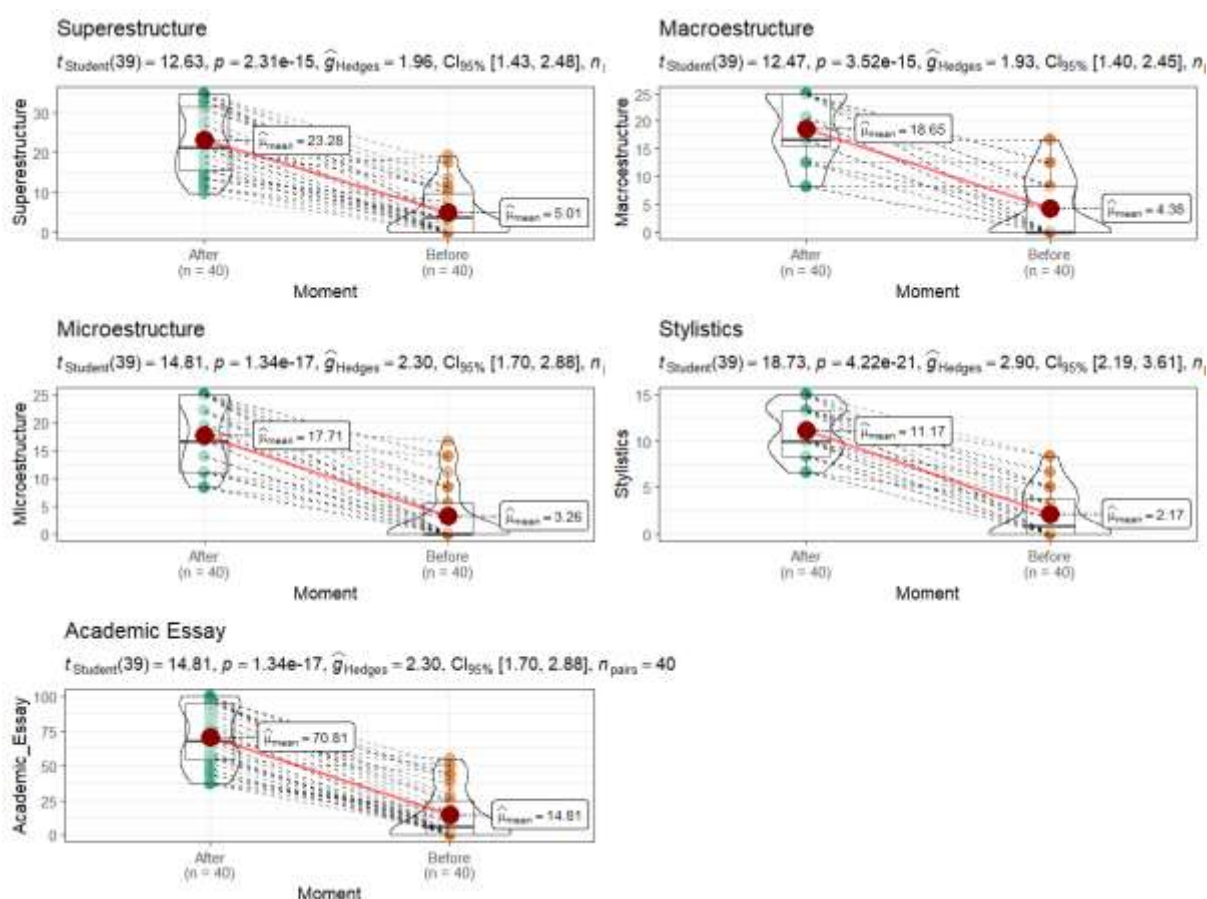| Criteria	S_{x1}*	Mx**	Epi***	CVC_i	CVC_{tc}
Via	76	4.750	5.4E-20	0.950	0.950
CVC Total	CVC = 0.934				
K_{Fleiss}	K = 0.392, p = 0.000, IC95% L = 0.342 - H = 0.442)				

Note 1. * summative score, ** sum/maximum value of judge, *** error probability
Note 2. Rel: relevance, Jus: justification, Sub: substantiation, Coh: coherence, Str: structuring, Suf: sufficiency, Met: methodology, Res: resources, Upd: update, Lia: linguistic aspects, Acf: academic format, Eva: evaluability, Via: viability

4. Implementation phase

The results of the experiment show significant improvements in superstructure, macrostructure, microstructure, and textual stylistics ($p < 0.05$; $ĝ_{Hedges} > 1.20$), as well as in the overall average of the academic essay (Figure 3). These changes explain that with the TPD-FLCW intervention, students write their individual academic essays better.

Figure 3
Comparison of evaluation before and after the TPD-FLCW

Chura-Quispe, G., García Castro, R. A., Limache Arocutipa, G. P., & De La Cruz, B. D. L. (2024). Creation and validation of a technopedagogical design with flipped learning and collaborative writing. [Creación y validación de un diseño tecnopedagógico con aprendizaje invertido y escritura colaborativa]. *RIED-Revista Iberoamericana de Educación a Distancia, 27*(2). https://doi.org/10.5944/ried.27.2.38995

5. Evaluation phase

a) Quantitative evaluation

The results highlight that almost all students (≥ 90 %) consider that they at least agree that they have improved their argumentative and proofreading skills. The positive trend extends to more than 80% affirming that they actively and collaboratively participate, find team writing easier than individual writing, use communicative tools, manage time, revise their texts, and maintain originality (Figure 4). They agree with receiving information in advance and recommend using TPD-FLCW in other texts.

Figure 4
Students' assessment of the TPD-FLCW
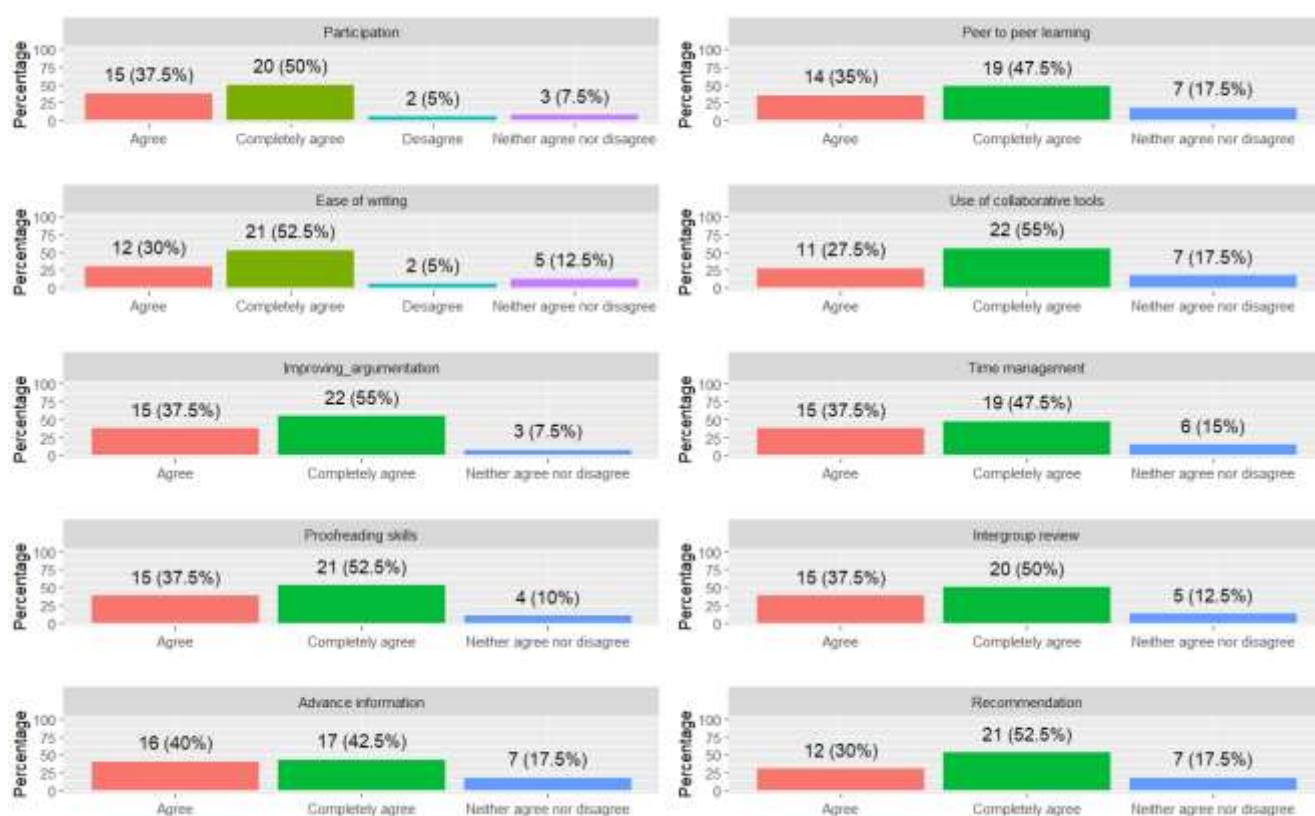
b) Qualitative evaluation

The analysis of the students' assessment is carried out based on 3 sections:

Before the TPD-FLCW

The students claim that initially, they faced difficulties due to a lack of knowledge of the formal writing process. The lack of training in basic education regarding the attainment of writing competence in argumentative texts, citation and reference

norms, and information retrieval conditions the rigor of their essays. The absence of a thesis statement left their arguments disoriented. Some statements made by students were as follows:

- «[…] nunca, o sea, no lo había hecho, no lo había realizado […]» [“never, I mean, I had never done it, I had never done it before”] (E07).
- «[…] al momento de revisarlo me di cuenta que ni siquiera había usado formato APA, que no tenía referencias bibliográficas y que no me había apoyado en ninguna cita o no había investigado lo suficiente, que simplemente lo que había hecho es, digamos que, hasta una opinión personal, sin ningún fundamento teórico que pueda defender mi postura […]» [“when I reviewed it, I realized that I hadn't even used APA format, that I didn't have bibliographic references, and that I hadn't relied on any citations or hadn't researched enough, that basically what I had done was, let's say, purely a personal opinion, without any theoretical foundation to defend my stance”] (E02).
- «[…] en ese ensayo, me hizo falta tener la originalidad, se podría decir, porque prácticamente, como dije, me guiaba de otro ensayo […]» [“in that essay, I lacked the originality, you could say, because practically, as I said, I was guided by another essay”] (E01).

Another point that frequently emerged in the responses was the lack of originality. Papers submitted to the Turnitin plagiarism detection system reported similarities exceeding 50%. The coincidences originated solely from web pages or blogs (without authorship or publication date), which explains the limited development of informational competencies. Furthermore, their unfamiliarity with the chosen topic led them to search various sources from which they extracted fragments to include in their essays.

- «[…] sacaba quizás muchas cosas de Internet, las unía y ponía las referencias y, pensaba que esa manera iba a estar bien hacer un ensayo […]» [“I would take maybe a lot of things from the internet, put them together, and add references, and I thought that way it would be fine to write an essay”] (E03).
- «[…] lo que hizo falta más, ser más propio de mí, porque si netamente me basé en información de páginas y sobre todo pienso que le faltó ser más verídico porque no tuve fuentes de páginas confiables o de revistas, de repositorios […]» [“what was missing was more, to be more of my own, because if I purely relied on information from websites and especially I think it lacked credibility because I didn't have sources from reliable websites, journals, or repositories.”] (E06).

After the TPD-FLCW

With the TPD-FLCW, students reported improving their writing skills, due to the planning process focused on intra-group interaction and recognition of each member's writing strategies. They perceived constant peer feedback, taking an active role in empowering them to achieve proficiency. Although the distributions of certain paragraphs were done individually, this product was reviewed in detail by the whole

team. The classroom climate in the groups generated positive, comfortable, and adequate satisfaction.

- «Empezando por la planificación, la ventaja que encontré es que todos interactuamos y dábamos bastantes ideas» ["Starting with the planning, the advantage I found is that we all interacted and gave plenty of ideas"] (E01).
- «Todos trabajamos y aportamos adecuadamente. No hubo un retraso. Creo que sí se logra aprender un poco, ya que tal vez alguien siempre tiene un poquito menos de entendimiento al momento estructurarlo (el ensayo) y lo corregimos juntos […], de este modo y así se hace una retroalimentación exactamente en conjunto» ["We all worked and contributed adequately. There was no delay. I think we did manage to learn a little bit, because maybe someone always has a little bit less understanding when structuring it (the essay) and we corrected it together […], in this way and that way we get feedback exactly together"] (E04).

Regarding the methodological procedure, the students were satisfied. They were able to acquire the content knowledge before the beginning of the class, and during the session, they shared the notes. Thus, the essay writing scenario was clarified. In addition, the didactic presentation of videos, text, and slides was indispensable for cognitive learning. However, this was complemented by registration strategies (note-taking) for in-class consultation and workshop development.

- «Yo tomé apuntes a todos los vídeos, a pesar de que lo teníamos en vídeos y en documentos PDF […] cualquier duda lo consultaba en clase para tenerlo claro» ["I took notes on all the videos, even though we had them in videos and PDF documents […] I consulted any doubts in class to clarify them"] (E03).
- «Esos materiales han sido precisos y que hayan estado de manera audiovisual y también escrita nos sirve a los estudiantes porque, por ejemplo, yo prefiero leer, pero tal vez alguien prefiere escucharlo o en diapositivas» ["These materials have been precise, and having them both audiovisually and in written form serves us as students because, for example, I prefer to read, but perhaps someone else prefers to listen to it or see it in slides"] (E05).

Differences between before and after the TPD-FLCW

The students identified significant changes in their learning when comparing the texts they wrote at the beginning (pre-test) with those afterward (post-test). They recognized that their first essay lacked a thesis, organization, and structuring of the paragraphs according to the superstructure of the essay (introduction, development, and conclusion). They even noticed an improvement in presentation formalities (margins, indentation, correct use of citations, etc.).

- «En el primer ensayo, no podía identificar la tesis porque —de hecho, observé que ni siquiera tenía una tesis y tampoco tenía un mapeo—. Entonces, sí hubo bastante diferencia. El ensayo que elaboré ahora (postest), siento que está muy bien» ["In the first essay, I couldn't identify the thesis because - in fact, I noticed that it didn't

even have a thesis and it didn't even have a mapping. So there was quite a difference. The essay that I crafted now (post-test), I feel, is very well done"] (E01).

- «El primer ensayo que hice no tenía como tal una estructura o sea tocaba temas en general, los párrafos no tenían un orden, no tenían las partes que corresponden, no tenían la introducción, solamente desarrollo, pero ahora con el nuevo trabajo ya tiene la introducción, la idea principal, el desarrollo del párrafo, la conclusión» [The first essay I did did not have a structure as such, that is, it covered general topics, the paragraphs did not have an order, they did not have the corresponding parts, they did not have the introduction, only development, but now with the new work, it has the introduction, the main idea, paragraph development and the conclusion] (E06).

DISCUSSION

The research was aimed at developing and validating the TPD-FLCW to promote the development of academic writing (academic essays). Based on flipped learning and collaborative writing, emphasis is placed on a design that guides the role of the teacher and student in each of the phases that constitute its implementation.

The TPD-FLCW was implemented to address the issue of academic writing. Difficulties in the development of academic writing competence were identified. Lack of understanding of the argumentative process, citations, and references promoted inappropriate practices such as academic plagiarism (Acosta et al., 2023; Festas et al., 2023). In response, the TPD-FLCW was established as a proposed solution that required an organized and systematic process for writing production learning. The diagnostic evaluation served as input for session planning (Hess & Moseley, 2016).

The TPD-FLCW significantly contributes to overcoming difficulties in students' academic essay production. This is consistent with literature that has implemented FL or CW (Khojasteh et al., 2021; Roohani & Rad, 2022). The improvement is due to the development of individual activities (before class) and collaborative work (during class), as supported by FL. Individual note-taking also contributes to content retention (Courtney et al., 2022). Therefore, it was crucial to encourage students' autonomy. At the end of each session, the teacher provided directions for the next one.

Teamwork methods constitute an efficient mechanism for learning. Although some team members had disagreements, the methodology allowed them to engage in dialogue and propose feasible solutions. Disagreements can be seen as a means to achieve objectives (Godoy, 2021). Among the strategies implemented by team members were shared reading, peer feedback, cloud-based information sharing, role exchange, and internal decision-making. Collaboration among team members stimulates the use of techniques and strategies to provide solutions to problems that arise (Laal & Ghodsi, 2012). However, this is achieved because of the interest of all members. In this regard, the role of the teacher represents an essential scaffolding to consolidate students' commitment to their learning and their team (Amineh & Asl, 2015).

Additionally, the students' assessment of the TPD-FLCW was positive, not only due to the cognitive improvements or achieved competencies but also because of their emotional state and satisfaction with the team. The cognitive, procedural, and emotional advantages stem from the disruption of the traditional class structure

(Ebron & Mabuan, 2021). During the preliminary phase of the proposal, students acquired knowledge at their own pace and preferred style (visual or auditory). This is because when the time and manner are in line with the students, they gain a greater confidence that is conducive to learning during the lesson (Owen & Dunham, 2015). Thus, virtual workspace areas were not only spaces for academic work, but also for socialization—an aspect that contributed to team engagement.

CONCLUSIONS

The study has led to the creation of a new technopedagogical design aimed at academic writing for university students in their early cycles. This design has been beneficial for improving academic essays.

The TPD-FLCW is significant and applicable in virtual educational settings; therefore, it constitutes a guide for pedagogical experiences aimed at addressing the issue of academic writing. Although the presented experience focuses on essay production, its implementation is not limited to other forms of written production. The didactic advantage that the TPD-FLCW can offer lies in focusing the writing activity on its natural (practical) form within the collaborative process.

It has been explored that the active role in learning is shared by both students and teachers. The former is a participative and autonomous agent; the latter creates the conditions for learning through material planning and feedback instruments. Students positively value the way the teacher plans, directs, and provides feedback in class, but they also appreciate the commitment of their teammates during the writing workshops.

Some limitations of the study are associated with the sample size of the experimental group. Although they are students from different engineering disciplines, it is necessary to have more empirical evidence in multidisciplinary settings and with a larger number of participants. Additionally, the interview was conducted with a small group, but it would be advisable to know the perception of all participants. Future studies could implement interventions in non-university higher education contexts, as well as in the production of other types of academic texts such as monographs, scientific articles, or theses while maintaining the processes and functions of the teaching staff to extend the empirical evidence and evaluate the team strategies employed by students more effectively within the implementation of the TPD-FLCW.

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