Collaborative Work as an Alternative for Writing Research Articles

El trabajo colaborativo como alternativa para la escritura de artículos investigativos

Nancy Emilce Carvajal Medina*
Universidad Pedagógica y Tecnológica de Colombia, Tunja, Colombia
Eliana Edith Roberto Flórez**
Universidad Santo Tomás - Tunja, Colombia

Academic writing in English in our context is a significant aspect that can be innovative when a convergence model of writing stages is used along with collaborative work. This article reports on a study aimed at analyzing how collaborative work relates to undergraduate electronics students' academic writing development in English as a foreign language at a Colombian university, following some specific writing stages. Field notes, students' artifacts, and semi-structured interviews were the instruments used to gather information. The results showed that writing is achievable if students can follow stages and receive feedback from the teacher. Additionally, collaborative work allowed students to write research articles in an easy and dynamic way.

Key words: Academic writing, collaborative work, feedback.

Los escritos académicos en inglés, en nuestro contexto, representan un aspecto significativo que puede ser innovador cuando se usa un modelo de convergencia en las etapas de la escritura a través del trabajo colaborativo. En este artículo se presenta un estudio que buscó analizar cómo el trabajo colaborativo se relaciona con los escritos académicos que desarrollan en inglés los estudiantes de pregrado de ingeniería electrónica de una universidad colombiana, que seguían etapas específicas de escritura. Para la recolección de la información se tuvieron en cuenta apuntes, escritos hechos por los estudiantes y entrevistas semi-estructuradas. Los resultados muestran que la escritura es viable si los estudiantes siguen las etapas y reciben retroalimentación por parte del profesor. Así mismo, el trabajo colaborativo permitió la escritura de artículos de investigación de una forma fácil y dinámica.

Palabras clave: escritos académicos, trabajo colaborativo y retroalimentación.

* E-mail: n.carvajalmedina@email.wsu.edu.co
** E-mail: elianarbrt9@gmail.com

How to cite this article (APA, 6th ed.): Carvajal Medina, N. E., & Roberto Flórez, E. E. (2014). Collaborative work as an alternative for writing research articles. *PROFILE Issues in Teachers' Professional Development, 16*(1), 119-136. http://dx.doi.org/10.15446/profile.v16n1.36965.

This article was received on February 1, 2013, and accepted on August 9, 2013.

Introduction

This article aims at sharing the results of a research project based on collaborative work as a way to write research articles with undergraduate electronics students at Universidad Santo Tomás (USTA), a private university located in Tunja, Colombia. This project was carried out from 2011 until 2012.

Teaching writing in a foreign language, in this case English, is not an easy mission, and the need to write research articles in English in order to be socialized into other institutions or published in magazines is a great challenge. Based on the previous statements, this current research proposed to observe and explore the ways students developed academic writing abilities.

The proposal was established based on a pedagogical intervention in which collaborative work was applied in the electronics engineering program to a group of undergraduate students in their tenth semester. These students wrote research articles using topics related to their majors. The idea was to help participants find an enjoyable way to write research articles and to provide them with the appropriate writing input by following specific stages, modified according to the *Hyland model* and the standards of the *Institute of Electrical and Electronics Engineers* (IEEE). Implementing collaborative work strategies was another goal of the intervention.

Statement of the Problem

After a questionnaire and a written exercise were administered to electronics engineering students, characteristics of their written production in English as a foreign language were identified. The analyses of these instruments showed that students recognized and used some English language structures and vocabulary. They also appeared to enjoy working in groups because they could achieve their academic goals more easily as a team. The participants in this project also mentioned that they wanted to write academic papers, such as research articles, in order to improve their writing skills.

The written diagnosis exercise that was applied to the students reflected that when they read a text related to basic bioinstrumentation systems, they wrote the summaries in their own words based on this material. This written exercise allowed us to examine the ways that the learners used language, in terms of form and function, and what kinds of English technical vocabulary dominated their writing. When students created their written exercises, it was evident when they were struggling with certain items of writing, such as incoherent sentences, incorrect grammatical structures, a lack of connectors and punctuation marks, and the limited use of technical vocabulary, among others. This analysis showed that most of the students had difficulties in academic writing.

Based on the abovementioned aspects, the research question that guided this project was as follows:

What does collaborative work among tenth-semester electronics engineering students at USTA inform us about their academic writing development?

Research Setting and Participants

Context

This research project took place at USTA, a private Catholic university in Colombia. This institution was created in 1996 in Tunja, and it aims at promoting the integral education of its students and staff based on the principles proposed by Santo Tomás de Aquino. This university has approximately 2,500 students from a number of cities and towns throughout Colombia. English as a foreign language is a mandatory subject in all academic programs at the university and constitutes a prerequisite for attaining any degree. Students take five obligatory levels of English.

Participants

The selected participants were a group of nine students in their tenth semester in the Electronics

Engineering Faculty at USTA: five men and four women. These students were not attending English classes because they had already completed the five required language levels. The main criterion for selecting English for Specific Purposes (ESP) students was the type of English program they had experienced. Additional criteria for selecting the participants came from the needs analyses and the students' similar profiles and needs regarding writing in English.

The Engineer's Role

An electronics engineer played a very significant role throughout this project when he helped students to use correct technical vocabulary and proper IEEE standards and verified the appropriate contents of the articles. He was a great support in this project, sharing meaningful ideas that were considered by the students in their written compositions.

The Researchers' Role

As researchers, we were participant observers throughout the entire process and were responsible for collecting data, watching interactions, taking notes, and evaluating and reflecting on the use of materials and the activities implemented. We focused our attention on writing activities—guiding the implementation process throughout the research project.

Literature Review

In this research, the main concern was to identify what collaborative work among students from electronics engineering could tell us about their academic writing development. In order to achieve this goal, it was necessary to contemplate five key issues: the definition of academic writing (research articles); the definition of ESP; clarifying how collaborative work might be integrated into the development of this proposal; clarification of the IEEE standards; and the importance of feedback in this research.

Academic Writing and the IEEE Standards

Today, writing is a skill that is becoming essential in education because students and teachers share their ideas and academic outcomes through articles, books, and essays, among others. Feng-Checkett and Checkett (2006) state that being able to write well and express yourself will help you throughout the rest of your life. There are at least three situations in which writing may take place most often: at school, at work, and at home.

Genesee (1994, p. 130) states that "writing is a language process in which the individual creates meaning by using symbols to construct a written text." However, most EFL students see writing as a tedious, complex, and time-consuming process. Thus, students assume a reluctant attitude when writing in English. This fact leads us to consider the role teachers are playing when they guide the writing process. What opportunities are truly being offered in order to turn writing into a pleasure? How can the gap between writing and other language skills development be reduced? There is a need to break down barriers and build bridges towards making the writing process pleasant.

Coryell (2008, p. 5) affirms that, "writing is also a valuable tool for learning. When you write you must think extensively about your subject. When you write, you are likely to make new connections that you might not have made if you had not written about the subject." Thus, writing became a very important tool for the participants in this research, electronics engineering students, because it allowed them to share their research outcomes and explore their own viewpoints. By following a guided cooperative reflection and writing process, students began to unveil and understand the criteria for and implications of academic writing.

Rodríguez (2004, p. 28) affirms that the "academic writing process needs knowledge of forms and

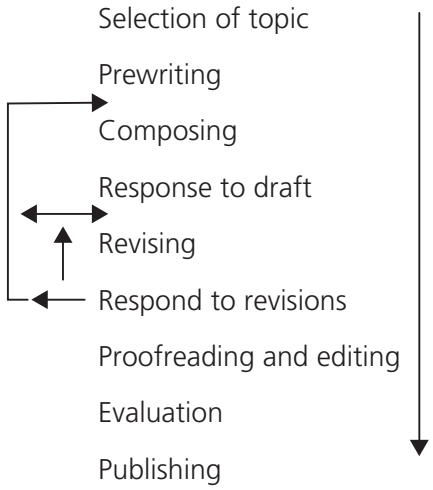
functions, but it also requires assuming academic commitment, responsibility, and discipline." Based on this definition, we would say that the use of collaborative work might produce positive interdependence that would permit students to develop these values. When students work in groups, they have the opportunity to realize what their roles are and how these roles may affect, in a positive or a negative way, the final written product and academic performance of the group. Thus, academic writing demands time, effort, and permanent discipline.

Academic writing may be guided by guidelines such as the APA (American Psychological Association) or the MLA and, in the case of electronics engineers, IEEE. A *convergence writing model* was created based on the writing stages proposed by Hyland (2003), the IEEE standards, and some of the principles of cooperative work.

On the one hand, Hyland (2003, p. 15) points out that the writing process should develop "student's abilities to plan a rhetorical problem, propose, and evaluate solutions." He noted a number of stages to be followed in the writing process: First, *selection of the topic* by teachers or students; *prewriting*, including brainstorming and note taking; *composing*, putting ideas on paper; *response to draft*, the process in which teachers or peers comment on students' ideas; *revision*, which includes refining ideas; followed by *response to revisions*, when the teachers respond to ideas, organization, and style; then, *proofreading and editing*, which include checking and correcting structures; *evaluation*, during which teachers evaluate the progress throughout the process; and *publishing*, which concerns circulation or presentation. Figure 1 displays the stages described above.

On the other hand, the IEEE is the world's largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. IEEE and its members inspire

Figure 1. Model of the Writing Process (Hyland, 2003)



the global community through their frequently cited publications, conferences, technology standards, and professional and educational activities. IEEE provides useful guidelines for electronic engineers to follow when they want to publish research outcomes. Writing and submitting papers for publication are essential for electronics engineers and for undergraduate electronics engineering students. This group of students is taught English for specific purposes. Currently, the process of teaching English as a foreign language is focused in many parts of the world on ESP, defined as the teaching of English used in academic studies or professional purposes. Duan and Gu (2005) defined ESP as a pedagogy in which the syllabus, contents, and methods are determined according to the needs of learners' specialized subjects. Students who want to learn ESP should have basic knowledge of English and previous knowledge of their disciplines, because ESP is generally designed for intermediate and/or advanced students. For instance, at USTA, all of the students who belong to the different academic programs complete five English levels, and the final level is based on ESP because it focuses on learners' specialized subjects and therefore the contents are organized according to the students' needs. Thus, the

participants in this project had already completed these levels of English, and they had previous knowledge about their specialized subjects in English. It would have been difficult to work with students who did not have basic knowledge of the English language and some technical vocabulary, an important reason to include ESP during the development of this proposal.

In this way, knowing the needs of a particular community allows teachers to make decisions in terms of the teaching approach to be implemented. In our case, we saw that cooperative work might support students' academic writing practices. According to Artz and Newman (1990), cooperative work is seen as a small group of people who work as a team to solve a problem, complete a task, or achieve a common goal. In this research, by working cooperatively, engineering students discussed academic topics, generated ideas, found solutions to specific problems, made decisions, and established agreements and disagreements. Additionally, more sympathetic relationships and a more positive work atmosphere began to emerge as part of the dynamics of group work. This cooperative work also permitted participants to activate their background knowledge in terms of biomedicine and English. Finally, they wrote research articles, which are considered a positive social outcome.

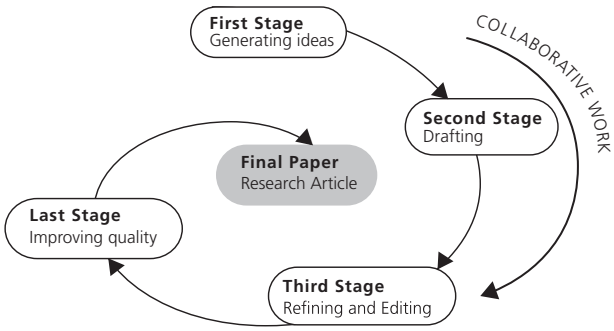
When developing a cooperative approach in an EFL context, both teachers' and students' roles change. Montecino and Williams (2001) state that when people work together, they have to recognize the varying group roles. Thus, during the writing process developed in the different workshops applied in this research, electronics engineering students and teachers held roles such as leader, encourager, harmonizer, compromiser, facilitator, monitor, and listener.

Subsequently, a model that comprised cooperative work and synthesized clear academic writing guidelines for electronics engineering students was a necessity at USTA. That is how the convergence writing model emerged.

The Convergence Writing Model

As previously mentioned, the convergence writing model was created considering the writing stages proposed by Hyland (2003), the IEEE standards, and some of the principles of cooperative work. The word "convergence" means the linking of two or more things that approach one specific goal—in this case, one writing stage is supported by the following ones. Thus, the model created resembles a snail (Figure 2).

Figure 2. The Convergence Writing Model (CWM)



This model comprises four vigorous stages that will be presented as follows:

- *First stage*: *Generating Ideas*—when students give ideas and opinions in order to select the topic on which to work.
- *Second stage*: *Drafting*—in this stage, students are able to put ideas on paper.
- *Third stage*: *Refining and Editing*—when students have received feedback and comments from the teacher in order to better organize the information, which helps students check their mistakes and correct themselves.
- *Last stage*: *Final Paper, Improving Quality*—teachers and students carefully check the final documents before delivering them to be published.

The electronics engineering students were positive and enthusiastic when they faced each one of the stages proposed, even when the writing process was not simple because it required training, practice, and careful planning to promote effective communication among the group participants during the entire process. One thing that may have contributed to this attitude was the feedback given.

Feedback

Feedback is one of the most common strategies teachers use to correct students' performance. Zeus and Skiffington (as cited in Arcas, 2004) define feedback as the way people give opinions or assess a person's behavior. The electronics engineering students received constant written and oral feedback in order for them to self-reflect on their individual and group progress. Feedback became a dialogue or interaction between the students and teachers. Toward this end, the researchers used an error correction chart proposed by Hedge (1988, see Appendix). It contained different symbols and their related meanings. This tool allowed the participants in this project to be aware of their mistakes and to analyze if the mistakes were related to spelling, grammar, or sentence order, among others. The students discovered their mistakes, and then they corrected them on their own because they were familiar with the use of the codes.

Research Method

This research was developed using a qualitative approach. According to Williams (2006), a qualitative approach is a general way of thinking about conducting qualitative research. It describes, either explicitly or implicitly, the purpose of the qualitative research, the role of the researcher(s), the stages of research, and the method of data analysis. Additionally, a qualitative approach gathers information about human beings as related to people's behaviors, beliefs, opinions, and interactions.

Based on the previous concept, this study was framed within this approach in that we established specific stages in order to apply the workshops and to conduct data collection and data analysis. Moreover, we attempted to observe, analyze, and understand the behaviors, attitudes, and ways of thinking of the participants in this research, electronics engineering students.

Type of Research

This project was developed using an action research methodology. According to Wallace (1998), *action research* is small-scale intervention in real-world functioning and the close examination of the effects of this intervention. Moreover, Wallace states that action research is situational because it is concerned with diagnosing a problem in a specific context and attempting to solve it in that context; it is usually collaborative, with teams of researchers and practitioners working together on a project. Action research is participatory and self-evaluative in order to improve practice in one way or another. In this case, we identified a problem in a specific ESP group, and two researchers designed a writing model that was presented in ten workshops. Then, the data collected were analyzed in order to generate categories and conclusions.

Data Collection Instruments

Field notes, artifacts, and semi-structured interviews were the instruments used to gather information.

The field notes led us to take notes about how electronics engineering students interacted among themselves and with the teacher. They also allowed us to realize how the students' research article writing processes were characterized. The artifacts provided information about the students' writing progress, considering their processes from the beginning to the end. Semi-structured interviews were used to

learn the participants' opinions about the workshops that were implemented and how the proposed convergence writing model related to their academic writing processes. The interviews also attempted to learn how the collaborative work was perceived by the electronic engineering students.

Pedagogical Design

For the pedagogical design, we utilized relevant aspects from academic writing as well as the theory that lies behind collaborative work. The question that guided this study was: What does the implementation of workshops using the convergence writing model under the principles of collaborative work inform us about electronics engineering students' writing processes at USTA? The researchers designed and implemented a new model for writing in ten workshops. The students who participated in this research had been developing projects considering contents related to biomedical instrumentation, and therefore, those topics were included in the workshops. Table 1 depicts the activities implemented in each of the applied workshops.

The first stage was a diagnosis to identify aspects of the students' academic writing as well as the ways the participants worked in groups. Subsequently, the researchers provided the participants the chronogram of the activities. Prior to the implementation of the workshops, an introductory session was held in which the researchers created materials and activities to illustrate the main constructs to the participants and encouraged them to write through collaborative work. The researchers introduced and explained each of the writing stages based on the new model. Similarly, they explained to the students the different activities they needed to complete, the amount of time they had for each task, the importance of feedback, and the decision to work in groups. The topics considered for developing the academic writing workshops that emerged from the research interests of the participants who were already settled in other subjects were: "Design of a Robot for Brain Surgery," "Design of a Prototype to Detect Shapes to Be Used in Brain Surgery," and "Design of a Robotic Arm Prototype Oriented to Surgical Applications."

The development of the first workshop started with key constructs: academic writing and collaborative work. In this workshop, the students organized their teams, and the teacher-researchers gave them a short article in English based on electronics engineering topics. The students skimmed the full text and became aware of the importance of writing research articles in English. When the students were developing parts of the first and second workshops, they were asked to *generate ideas* (first stage: brainstorming session) and to create a mind map based on a picture given by the researcher**s**.

Then in the third workshop, students began the second stage (*drafting*) of the new model, in which they were able to identify main and supporting sentences. In addition, they had a clear understanding of the six different parts of a research article: abstract, introduction, materials and methods, analysis of results, conclusions, and references. We organized activities to introduce the electronics engineering students to the research article writing process, including an explanation of how paragraphs should be developed, by providing samples from different sources and styles. For the initial compositions, the students considered the mind maps that they had previously created themselves and established the different roles each would play during the writing process. In order to support the step-by-step writing process, field notes were taken to monitor and verify how the activities made sense to students as well as to record impressions of conversations and interactions among project participants.

In the fourth workshop, the learners studied connectors and how to link sentences and paragraphs. In the fifth workshop, an error analysis chart, taken

Table 1. Workshops Implemented in This Project

Workshops / **Activities**	**Workshop 1** CWM Stage 1: Generating Ideas	**Workshop 2** Knowing about academic articles	**Workshop 3** CWM Stage 2: Drafting Composing sentences	**Workshop 4** CWM Stage 3: Refining and Editing Providing tools	**Workshop 5** Learning about written academic articles in collaborative work
Collaborative work and writing activities	The students developed a brainstorming activity based on a picture. They also applied skimming and scanning reading to a research article that was used as a model.	The students shared ideas, and the full group created a mind map. They shared knowledge about the main topic and supporting sentences. They analyzed the structure of academic articles.	The students began to organize ideas for an academic article taking into account main and supporting ideas. The students played different roles during the development of the activities implemented in the workshops.	Students began to familiarize themselves with the meanings of some of the connectors, and they wrote sentences with logical connectors.	The students received their first comments from the teacher, and they grew accustomed to using error chart analysis.
Workshops / **Activities**	**Workshop 6** Refining and correcting	**Workshop 7** Gathering information	**Workshop 8** CWM Stage 4: Improving Quality - Editing final - Polishing - Writing the conclusion	**Workshop 9** CWM Stage 4: Improving Quality	**Workshop 10** CWM Stage 4: Improving Quality
Collaborative work and writing activities	The students considered their mistakes and began the process of composing: writing and rewriting with the correct use of punctuation marks.	The students made decisions related to the use of technical vocabulary.	The students kept improving their written compositions and applied the IEEE standards.	The students submitted the final writing product.	The students defended the written documents through oral presentations.

from Hedge (1988), was presented and explained in order to guide students toward self-correction. In this way, students began to develop the third stage: *refining and editing*. Students began to submit their first compositions and to receive feedback on form and content. They then had to improve their writing based on the comments provided by the teachers and the engineer who was in charge of the class. These comments emphasized the language students needed to master, the content or expressions they needed to clarify, the correct technical vocabulary, and the use of punctuation marks. All of these facts emerged in the sixth workshop. In the last workshops, students' papers were returned so that they could make final adjustments in order to develop the final stage: *improving quality.* In addition, guidelines were given to the students in order to fulfill the standards established by the IEEE. By the end of the exercise, the participants were able to complete the entire writing process following the stages established in the convergence model.

Findings

Different items, such as the research findings, were included in two main categories and five subcategories that arose from the current research project (see Table 2). The main objective of this project was to analyze how collaborative work and the implementation of the convergence writing model related to undergraduate electronics engineering students' academic writing development in English as a foreign language at USTA.

Table 2. Categories and Subcategories Established Through the Data Analysis

What does collaborative work among tenth-semester electronics engineering students at USTA inform us about their academic writing development?

Sub-questions	Categories	Subcategories
What features of collaboration are recurrent as electronics engineering students develop their academic writing skills?	Collaborative Features: Roles, Values and a Participatory Environment	• Teamwork: A Determinant of Learners' and Teachers' Roles • Values That Emerged Among Participants as a Result of Cooperative Writing Practices • Providing a Confident Environment Strengthens Students' Writing Skills Development and Teamwork
What does the implementation of a writing model reveal about undergraduate electronics engineering students' academic writing development as they create their research articles?	Adapting a Practical Model of Writing to Strengthen Students' Academic Writing Styles	• A Convergence Writing Model and Linguistic Features Development • Feedback as a Way to Raise Students' Self-Confidence in Writing Academic Papers

The grounded theory approach was used to analyze the data collected. Strauss and Corbin (1990) state that this approach consists of a set of steps to formulate hypotheses based on conceptual ideas that guarantee a useful theory by creating categories based on the data gathered. In order to validate the findings of this study, we used methodological triangulation.

Collaborative Features: Roles, Values, and a Participatory Environment

This category answers the first sub-question of this project: What features of collaboration recur while electronics engineering students develop their academic writing skills? This category highlights how each group was characterized according to their performance, the different roles that each participant played during the research article writing process, and the values that were necessary to achieve common goals. This category also explains the relationships that emerged among students, their tutor-engineer and the teacher-researchers while the learners were working in the groups, and it also describes and analyzes the characteristics of cooperative work that emerged when the electronics engineering students worked together. From the aspects mentioned above, the following subcategories emerged.

Teamwork: A Determinant of Learners' and Teachers' Roles

This subcategory refers to how the different activities developed by each of the groups, as they progressed through the different proposed writing stages, permitted the electronics engineering students to develop specific work roles.

We observed that most students showed a positive attitude during the development of each workshop and enjoyed working in groups, because they could help each other, and also that they acquired specific roles and conducted significant negotiations.

The roles that each study participant—electronics engineering students (EES), the teacher-researchers (TR) and the engineer tutor (ET)—assumed were significant. The teacher-researchers and the engineer tutor continuously guided the electronics learners in their writing processes. Students became more engaged in their projects' development and did their best even as they presented weaknesses when they were writing their research articles. Each of the participants contributed meaningful ideas and information to create an academic paper. Among the different writing activities linked with collaborative work, there emerged different kinds of roles from informal and spontaneous conversations, and these roles allowed each participant and each variety of teamwork to be characterized by specific features.

Each of the implemented workshops encouraged the participants to take on different work roles, such as leaders, harmonizers, facilitators, and compromisers, among others. The process was very useful because the students helped each other and learned new things from their partners without pressure from the teacher. This study created a positive pedagogical tool for the researcher because the participants were motivated to write in groups. From the beginning of the development of the first stage, the students worked collaboratively, considering the strategies of collaborative work.

> Excerpt 1
>
> The activity related to the picture was very meaningful because we noticed the way each participant interacted even if some of them participated more than others within their groups. For example, S1, S2 and S3 expressed ideas often, whereas S4, S5 and S6 shared opinions after FG interacted, and S7, S8 and S9 interacted after the first and second groups expressed their ideas a few times. (March 30, 2011, Field Notes, Researcher's Analysis)
>
> Excerpt 2
>
> Today when the students were reading the article to be followed as the example, in group 1, S1 led the activity, S4 took the initiative

to develop the activity and S7 asked questions about the way they could do the activity. (April 6, 2011, Field Notes, Researcher's Analysis)

Excerpt 3

All of the electronics engineering students have special characteristics. For example, S1 enjoys being the leader of the group. (April 11, 2011, Field Notes, Researcher's Analysis)

In the samples above, it was evident how the students began to immerse themselves in the proposed activities and how each member of each group adopted a specific role in an autonomous way. Thus, we can conclude that no one can become a leader, harmonizer, guide, or monitor unless s/he feels the desire to do so. Roles are not imposed but discovered and strengthened.

Values That Emerged Among Participants as a Result of Cooperative Writing Practices

This subcategory refers to the values that emerged among the participants when they were developing the different writing activities. The permanent dialogue among the EES, the TR, and the ET about the writing processes that developed permitted the participants to become more empathetic, to be careful with how they expressed opinions or critiques and to be able to recognize their mistakes and weaknesses. Thus, values such as respect, tolerance, commitment, and responsibility began to take shape beginning in the first workshop. By workshop ten, more respectful attitudes were shown. The emergence of this set of values permitted the groups to make more meaningful and productive negotiations and decisions when they edited papers, for instance, when selecting correct article titles, connectors, and the pictures to be displayed, among other decisions.

In conclusion, we can say that the electronics students, the ET and the TR were willing to work together and that they enjoyed and supported collaborative writing practices. The participants exchanged their opinions in a respectful and tolerant way. Everyone was willing to listen to others, making the writing process meaningful, easy, and dynamic. Each participant's voice was heard.

Excerpt 4

When we began to talk to the students for the first time, we were a little bit nervous because we didn't know the students' answers about this project…but later on, we felt so good because most of them were listening to us carefully…They are very polite with us and asked questions about the project such as: "Teachers, how much time can we take to work on the writing project in the biomedical classes?"[1] (March 30, 2011, Field Notes, Researcher's Analysis)

Excerpt 5

Respect value was evident from the beginning to the end of the project…today was the last session, and each group defended their research articles; while the first group was explaining their topic, the rest of the groups were listening to them…So they respect each other. (June 1, 2011, Field Notes, Researcher's Analysis)

Excerpt 6

Q9: Did you like working on writing with your classmates?

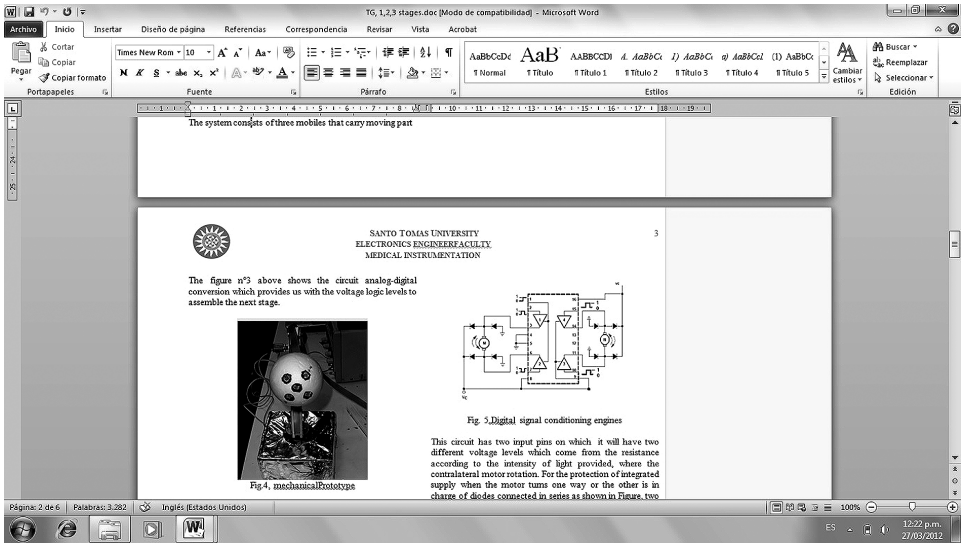
S1: Yes teachers. In our group, there were different situations in which we were disappointed because we had different ideas, but finally we always took decisions and made agreements and finally we could write our research article in a group.

S6: Also, I learned how to listen to my classmates, and I accepted their opinions respectfully.[2] (Interviewees 1 and 6, Question 9)

Working in higher education private and public institutions has allowed us to see how students develop projects and make oral presentations to fulfill class requirements. One observation is that no one is particularly interested in what other groups

1 The original excerpt was in Spanish.
2 The original excerpt was in Spanish.

Figure 3. Sample of Students' Artifact



are doing. In this category, interviews and field notes demonstrated how initial disrespectful and careless attitudes began to be replaced by mindful and thoughtful opinions. Therefore, cooperative work permitted values such as tolerance, commitment, and responsibility to emerge, and it strengthened the academic writing practice. Thus, students could write texts such as the sample provided in Figure 3.

Providing a Confident Environment Strengthens Students' Writing Skills Development and Teamwork

From the beginning of this research, the TR planned and implemented activities in which students felt comfortable and pleased. The EES, ET, and TR sat at round tables to establish conversations instead of giving lectures. The TR and ET were always willing to resolve students' doubts during all parts of the process, demonstrating how collaborative work emerged when participants had the chance to work in groups; how students interacted among themselves; and how students felt supported by their classmates, the ET, and the TR, which allowed them to create a confident environment when they were writing their research articles in English as a foreign language and when they held informal conversations using both Spanish and English. According to Panitz (1996, p. 8), there are benefits of working collaboratively: "create an environment of active, involved exploratory learning, build self-esteem in students and enhance students' satisfaction which the learning experience provides greater ability of students to view situations from others' perspectives." Thus, making writing a team activity rather than an isolated practice made it possible to realize this vision of learning.

> Excerpt 7
>
> s4: …in English, teacher?// RT: yes, please, try to speak in English// s4: ok, the map has different ummm…how do you say "categorías" in English, teacher?// RT: categories // s4: yes, yes, categories…
>
> Today when students were trying to understand the meaning of a mind map and its organization, students expressed their ideas in English and Spanish…we noticed that when some students didn't know how to express a word in English, they asked for help from the teacher and from their partners…or when one student pronounced a word badly, immediately others pronounced the word correctly. (April 6, 2011, Field Notes, Researcher's Analysis)

From the sample above, we can say that when a relaxed and confident environment was created, informal learning groups emerged and students ex-

pressed their ideas freely and in a relaxed way. Students were not afraid of correcting or being corrected by others in relation to pronunciation or meaning. Thus, this environment permitted students to solve language-related problems and finally understand mind maps. Thus, collaborative work can be seen as a small group of people who work as a team to solve a problem, complete a task or achieve a common goal (Artz & Newman 1990).

Excerpt 8

Q6: Based on your experience with collaborative work in English, which of the following activities did you actively participate in? Why?—Sharing knowledge, interacting with each other, negotiating, making decisions, solving problems, having fun while learning.

S6: I remember when we asked for a favor from our classmate S1 because we wanted him to check our paper, and we accepted our mistakes and we helped each other.[3] (Interviewee 6, Question 6)

These samples demonstrate that the attitudes assumed by the engineer-tutor, teacher-researchers, and students influenced the way the students worked. They were more collaborative and became more conscious of the mistakes they made. In the end, this self and group reflection led students to write more coherent and cohesive papers.

Adapting a Practical Model of Writing to Strengthen Students' Academic Writing Styles

This category attempts to answer the second subquestion of this proposal: What does the implementation of a writing model reveal about undergraduate electronics engineering students' academic writing development as they create their research articles? Furthermore, this category describes the process in which electronics engineering students were involved in writing an academic paper using technical vocabulary, correct sentence structure, and paragraphs with connectors, main ideas, and supporting ideas, as well as the correct organizational order that a research article requires and the importance of providing timely feedback. From the aspects mentioned above, the following subcategories emerged:

A Convergence Writing Model and Linguistic Features Development

This subcategory refers to linguistic features in terms of language (technical vocabulary, correct sentence structure, paragraphs with connectors, main ideas, supporting ideas, the correct order of images, and well-organized information) that were evident in the students' artifacts after we implemented a new model of writing (convergence model, see Figure 2).

At the end of the implementation of this proposal, three research articles were created. Nine students worked on a robotic prototype with different approaches. All of those articles were analyzed in order to identify the linguistic aspects we mentioned in the previous paragraph.

This subcategory revealed that students were able to better organize information if they followed a model that explained to them what to do and how to do it before writing, but it was necessary to encourage the students to write academic papers in order to help them to achieve their academic goals. As they participated in the writing activities, the students followed the stages proposed in the convergence model, which was demonstrated in their written papers. They expressed how this model supported them in understanding how to write a research article.

Excerpt 9

The students completed the first stage, and it was not easy. The students tried to do their best. This session was very important because they established the topic to be worked on, they generated ideas, and they organized the different sections of the articles, the main topics and the subtopics in a mind map. In conclusion, they are ready to start the second stage. (March 6, 2011, Field Notes, Researcher's Analysis)

Excerpt 10

(Introduction)

3 The original excerpt was in Spanish

> A surgical procedure is a difficult task that depends of many variables that can't be controlled directly and of the ability and experience that the medical Dr. has in the field. Nowadays the operating room needs to be a safety environment where the technology and the human skills are combined to improve the quality of complex procedures where a Human life is at risk. The robotics systems present a new paradigm of possibilities to this procedures giving to the precision and the stability that the medical personal requires in an operating room and sometimes, providing images of the action region that the medical doctor can't see in a simple sight. However, these systems are not perfect, there are expose toward many factors that affects their functionality and put in risk the procedure [*sic*]. (Students' Artifact, s1, s2, and s3)

Observing the student artifacts below, it can be noted that the participants improved their use of appropriate technical vocabulary and connectors and the way they organized the information into paragraphs:

> Excerpt 11
>
> Besides, this was done with digital logic used for a truth table and it is necessary to take into account the variables to use and replace the power. (Students' Artifact, s7, s8, and s9)
>
> Excerpt 12
>
> However, these systems are not perfect, there are expose toward many factors that affects their functionality and put in risk the procedure [*sic*]. (Students' Artifact, s1, s2, and s3)
>
> Excerpt 13
>
> Although most of robotic applications are in test or in process of investigation, many of these applications are already used in the world with good results. (Students' Artifact, s4, s5, and s6)

These samples strengthen the idea that writing is a skill that develops progressively. As a result of participating in guided written practice and following each of the stages of the writing convergence model, the students found support for organizing ideas, conjugating verbs and using connectors. On a similar note, students clarified the structure to consider when creating articles, such as the abstract, introduction, previous work, materials and procedures, data analysis, conclusions and references.

Feedback as a Way to Raise Students' Self-Confidence in Writing Academic Papers

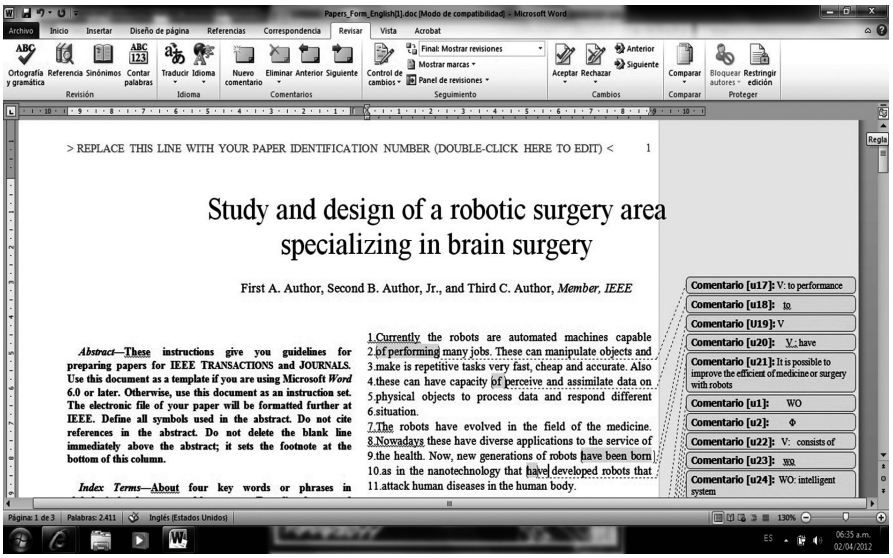
This subcategory illustrates how feedback from the electronics engineer and the English teachers was meaningful to the participants because it allowed them to raise their confidence when they were writing in the foreign language; increased their ability to correct mistakes themselves; and contributed to the texts' enrichment. According to Zeus and Skiffington (as cited in Arcas, 2004), feedback may become a supporting tool for others when one person's opinions are provided.

Once students were asked to produce their first drafts, feedback was provided with the purpose of empowering the writing process. This feedback was used again in the third stage proposed in the convergence model, when students rewrote and revised their compositions until they reached the final stage (improving quality).

Finally, it is necessary to identify the best way to encourage students to write, even if they make mistakes. It is important to find a way to guide them in this process and to help them understand their errors, because it is not easy to write research articles. The students were able to improve the quality of their written compositions through feedback and the use of the error analysis chart, which were necessary in order to help students become aware of their mistakes while they were writing their research articles, which were the final outcome for this study.

Figure 4 shows the symbols used on the error analysis chart. For instance, when students needed to check conjugation, the symbol that represented this mistake was the letter (v); (wo) meant wrong word order; (^) appeared when something was missing; and (Φ) appeared when the information included was not necessary. In this way, the electronics students recognized their mistakes, analyzed what was wrong and, finally,

Figure 4. Sample of Students' Artifact (s4, s5, and s6)



made corrections. The students progressively became familiar with the use of the codes we implemented.

Excerpt 14 describes the way feedback was provided and how it determined the students' responses to the writing process. It should be noted that when students were writing their research articles, they had sufficient time to submit the tasks and to correct their mistakes. The students did not develop the writing activities under pressure, and the TR attempted to bolster the students' self-confidence no matter what the mistake was.

> Excerpt 14
>
> Today we noticed that students felt calm even if they received some corrections because we gave them enough time to correct their mistakes. Something important is to provide feedback to them as soon as possible because otherwise, they could lose the rhythm of the work. We don't try to be rude with them; we were worried because our intention was not to make them feel bad… even if they had more mistakes, we gave them just one part and afterwards we'd let them know the rest of their mistakes, and we made sure that they understood what to do, asking questions such as "You know what I mean? Do you understand us? Is it clear?" (May 4, 2012, Field Notes, Researcher's Analysis)

The last sample demonstrated that the four characteristics related to feedback emerged when students received timely feedback and they had sufficient time to correct their mistakes. Feedback became an important tool for providing the students the confidence and the time to reflect on and make the necessary changes.

Conclusions

Using the convergence writing model by incorporating principles of cooperative work allowed us to conclude that academic writing is a practice that needs to be clearly guided in its initial stages; otherwise, it could become dense, complex, and frustrating. Academic writing requires being supported from the beginning by peers and experts who allow students and professionals to realize how ideas may be shaped and organized and how cohesion and coherence may be provided to a piece of text by using the appropriate writing mechanics, among other aspects.

Students' needs and interests count when making decisions about topic writing in order for writing to become truly meaningful. The electronics engineering

students achieved their ultimate goal, which was to write a research article, because they were internally motivated; their voices were heard by the teacher-researchers and the engineer tutor when they made decisions about the topics they wanted to address.

Working collaboratively allowed participants to develop values such as empathy, respect, tolerance, and responsibility. By listening to each other and recognizing each other's limitations, the stage was set for them make meaningful contributions when they wrote their papers. The students changed their visions about academic writing and about the idea of writing in group. At the beginning, they were reluctant to believe that reading each other's ideas would allow everyone to grow and write a coherent and nurtured article. At the end of the process, that was the product that resulted: a research article in which the visions of each group member were presented.

Roles such as leader, harmonizer, listener, compromiser, encourager, facilitator, guider, and organizer emerged spontaneously and characterized all of the participants (the electronics students, the engineer-tutor, and the teacher-researchers) throughout the research. Additionally, the constant dialogue and feedback among participants facilitated the creation of an appropriate work atmosphere in which everyone felt confident without being concerned about the mistakes being made.

References

Arcas, J. (2004). Feedback o retroalimentación. Retrieved from http://www.jesusarcas.com/01d6f794210bf430b/01d6f7948008cd701/01d6f7948008e3207/index.html

Artz, A. F., & Newman, C. M. (1990). Cooperative learning. *Mathematics Teacher, 83*, 448-449.

Coryell, P. (2008). *The dolphin writer. Composing paragraphs and crafting essays*. New York, NY: Houghtin Mifflin Company.

Duan, P., & Gu, W. (2005). English for specific purposes: The development of technical communication in China's universities. *Technical Communication, 52*(4), 434-448.

Feng-Checkett, G., & Checkett, L. (2006). *The write start with readings: Paragraphs to essays* (3rd ed.). New York, NY: Pearson Longman.

Genesee, F. (1994). *Educating second language children: The whole child, the whole curriculum, the whole community*. London, UK: Cambridge University Press.

Hedge, T. (1988). *Writing*. Oxford, UK: Oxford University Press.

Hyland, K. (2003). *Second language writing*. Cambridge, UK: Cambridge University Press.

Montecino, V., & Williams, A. (2001). *Writing in and across new contexts*. Paper presented at the National Writing Across the Curriculum Conference, Bloomington, IN.

Panitz, T. (1996). *A definition of collaborative vs cooperative learning*. London, UK: Metropolitan University.

Rodríguez, V. (2004). *Academic writing for prospective teachers at Universidad de la Amazonia* (Unpublished master's thesis). Universidad Distrital Francisco José de Caldas, Bogotá.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures, and techniques* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Wallace, M. (1998). *Action research for language teachers*. Cambridge, UK: Cambridge University Press.

Williams, M. (2006). *Reading on the rise: A case study of a reading first school*. Minneapolis, MN: Capella University.

About the Authors

Nancy Emilce Carvajal Medina holds an MA in Language Teaching. She is a full-time teacher at Universidad Pedagógica y Tecnológica de Colombia (UPTC). A doctoral Fulbright scholar in 2013, her research interests are in critical thinking, social inclusion, inter-culturalism and multiculturalism. She belongs to the Knowledge in Action research group at UPTC.

Eliana Edith Roberto Flórez holds an MA in English Language Teaching at UPTC. She works as an English teacher and researcher at Santo Tomás University in Tunja (Colombia). She enjoys working with students to help them meet their academic goals.

Appendix: Error Analysis Chart (Hedge, 1988)

WF	wrong form:	the best (WF) will be its achievements
WW	wrong word:	patient, funny and kindly (WW)
T	wrong tense:	In the last few weeks you didn't have much fun
Λ	something is missing:	You arrived in Brighton Λ the 1st
Sp	wrong spelling:	confortable (SP)
WO	wrong word order:	You haven't seen [yet] London
p	wrong punctuation:	Look out. (P)
V	wrong verb form:	The Titanic sunk (V) very quickly
//	new paragraph needed:	
ø	not necessary:	John came in and (he) sat down
∪	You don't need a new sentence. Join up the ideas.	
?	I don't understand what you're trying to say.	
~~	This isn't quite right: it needs clearer expression (usually the teacher provides an alternative)	
[ ]	This part needs to be re-arranged or reworded.	
!!	You really should know what's wrong here because - we've just done it in class. - I've told you so many times.	