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## TECHNOLOGIES FOR LEARNING WRITING IN L1 AND L2 FOR THE 21ST CENTURY: EFFECTS ON WRITING METACOGNITION, SELF-EFFICACY, AND ARGUMENTATIVE STRUCTURING

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### ABSTRACT

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Aim/Purpose	Quality in higher education assumes the challenge of developing in all citizens of the 21st century the cognitive, motivational, and socio-cultural dimensions that provide them with communication competences including the use of information and communication technologies, for the dissemination of sustainable scientific knowledge in different languages. Hence this paper evaluates a didactic-technological process called “Ensayo Científico Multilingüe” or ECM (“Multilingual Scientific Essay”), which guides the construction of argumentative texts in a shared didactic space in the native language (L1) and in the first foreign language (L2).
Background	Although the use of information and communication technologies (ICTs) in educational contexts stands out as an index of quality, some studies indicate that these technologies, by themselves, do not produce changes in learning. The possibility that ICTs can contribute to a university-quality education is by providing measures that allow verification of the effects on the real improvement of the learning of communication competences of students and, especially, in the learning of written communication for the purpose of scientific dissemination. In order to do so, this research is based on the Metasociocognitive Written Composition (MWC) model that explains university writing as a

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complex process in which, metacognitively, cognitive-linguistic competences and socio-cultural experiences interact with motivational factors to achieve outreach objectives within a disciplinary field. This interaction always takes place by applying a specific textual genre.

Methodology	For this research, a mixed quasi-experimental research design was proposed, with a control and an experimental group with 50 university students in each group. This design included two repeated measures (pre-test, post-test) for three dependent variables: (i) metacognition of writing; (ii) self-efficacy of argumentative writing; and (iii) structuring of the argumentative essay, in both L1 and L2. Validated instruments were selected and the correlations between the variables described both before and after the application of the ECM, in L1 and L2, as well as their correlations with the didactic-technological procedures integrated in the ECM: written activities, their extension, languages used, Lesson and Forums.
Contribution	This article analyses the didactic-technological procedures that may be influencing the improvement in the learning of argumentative writing, both in L1 and L2, with validity and reliability. This enables the establishment of technological strategies for teaching shared in L1 and L2, both real and contrasted.
Findings	It can be stated that the ECM creates a shared didactic-technological space in different languages, producing similar effects in L1 and L2, both on writing metacognition and on self-efficacy and argumentative structuring. The ECM enhances the association of writing metacognition with argumentative self-efficacy in L1 and L2. However, these dimensions are not associated with the structuring of argumentative essays, either in L1 or in L2. Furthermore, it is verified that the described variables are associated with the didactic-technological procedures integrated in the ECM in the following ways: (i) the procedure to promote writing metacognition (through the Lesson tool) is associated with argumentative structuring in L2; (ii) the extent of writing activities is associated, only, with argumentative self-efficacy in L1; and (iii) participation in the Forums presents a very low association with all the variables measured.
Recommendations for Practitioners	The present study promotes the application of the ECM by introducing changes in the procedures to improve its effectiveness in argumentative writing learning of a scientific nature, in L1 and L2. In this sense, it is proposed: (i) to adapt and implement the genre-based writing instructions methodology to the technological context; (ii) incorporate more collaborative technologies in the construction of the text; and (iii) reduce the number of forums and replace the extensive activities with micro activities.
Recommendations for Researchers	Present the ECM in an open mode that allows access to international students and, thus, to be able to validate the instruments in different languages, checking its effects with a diversity of groups.
Impact on Society	The results of this research show that it is possible to promote the learning of argumentative writing in L1 and L2 from the first year of university, sharing didactic-technological learning spaces. The potential of ICT to help students manage and acquire better scientific writing skills in different languages and its positive results to meet the needs of students, both in L1 and L2, is especially demonstrated. In short, the procedures, resources, applications, and tools integrated in a didactic process are described, demonstrating their effectiveness, for the development of communicative competences of scientific dissemination.

Undoubtedly, this contributes to a quality higher education, so demanded internationally, for the creation of a culture of peace and cooperation that enables sustainable global development.

Future Research	Another line of research that is being developed in the future is the adaptation of ECM to the teaching of other genres and educational levels, as well as for the integration of people with functional diversity and immigrants.
Keywords	metacognitive writing, argumentative writing self-efficacy, structure of the argumentative essay, L1, L2, web-based writing instruction

## INTRODUCTION

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The 2030 educational challenges, included in Objective 4 and approved at the United Nations General Assembly on September 25th, 2015 aim to ensure inclusive and equitable education that promotes lifelong learning with equal opportunities, and this education is called quality education. In short, a quality education is one that guides the learning of communicative skills for respectful social and ecological development, all of which is in order to create a culture of peace and cooperation that makes sustainable global development possible.

More specifically, Objective 4.3 aims to achieve access to quality higher education for both men and women. Therefore, the challenge is to teach all citizens of the 21st century the cognitive, motivational, and socio-cultural dimensions that enable them to overcome the demands of communication at university level. Furthermore, the development of these dimensions has to be of quality, for which the design and application of didactic models that provide the necessary logistical support and materials are demanded, including the use of information and communication technologies (ICTs) (Gao, 2018). In this way, studies such as that of Andrew et al. (2018), who investigate attitudes in higher education towards ICTs, demonstrate that students enjoy using those technologies when learning because they believe they enhance their learning and prepares them for future jobs. The data also reveals that they prefer to learn through a combination of traditional resources (e.g., books, paper) and ICTs media (e.g., laptops, tablets). This research is centred on responding to the cognitive and motivational demands specific to university written communication in different languages, applying didactic designs in ICTs and checking their effect on the learning of such dimensions. Therefore, it fully covers the objective described.

In short, ICTs in the learning of written communication are essential in the quality of higher education (Motallebzadeh et al., 2018). This is so because both writing and ICTs are a basic institutional, governmental, and administrative competence for employment, entrepreneurship and scientific progress at a global level. In a more specific way, written argumentative communication is the best method for solving real problems in a critical and cooperative manner (Putu Dian Sawitri, 2019). Therefore, written argumentation is configured as a decisive competence for academic, technical, and business purposes, with clear implications for the development and dissemination in research articles of scientific models of ecological and social sustainability (Hsu & Liu, 2019). Undoubtedly, critical reflection through argumentative writing implies an effective scientific communication of contrasted positions, and this is the basis for promoting a technological culture devoid of violence and aggression. Consequently, argumentative written communication in the use of ICTs guarantees higher education of quality (Benetos & Betrancourt, 2020; Cotos et al., 2020; Lammers et al., 2019; Palermo & Wilson, 2020).

Although the use of ICTs in educational contexts stands out as an index of quality (Marciniak & Salán, 2018), some studies indicate that these technologies, by themselves, do not produce changes in the learning of ideas, feelings, and constructive practices with the social and ecological environment (European Commission, 2013). Therefore, it is necessary to articulate ICTs in a didactic design with

explicit objectives, defined methodology and diversity of support. In addition, an evaluation system must be integrated to ensure student learning and design improvement. In short, the possibility that ICTs can contribute to a university-quality education is by providing measures that allow verification of the effects on the real improvement of the learning of communication competences of students (Blau et al., 2020).

Studies on the use of ICTs in order to promote the learning of written communication highlights the necessary mediation of digital competence, both in teachers and students (Evia & Arroyo, 2018; Relles & Tierney, 2013). Also, the dialogic dimension between students, teachers and texts is emphasised when ICTs are used (Sousa, 2017), and the need for a positive evaluation of writing learning is highlighted both in monolingual technological contexts (Arroyo et al., 2021; Cebrian-Robles et al., 2018; Luna et al., 2020) and in bilingual or multilingual technological contexts (Arroyo et al., in press; Hsu & Liu, 2019).

In addition, a number of higher education studies draw attention to the effects of internet technologies on writing learning showing the connection between the two items: (i) Relles & Tierney (2013) use Facebook to analyse their writing skills and confirm that technological demands increase the use of such skills; (ii) Raedts et al. (2017) use tutorial videos to promote research summary writing, demonstrating a positive effect on self-efficacy and academic writing metacognition; (iii) Fathi et al. (2019) discover the positive effect of the blog on motivation, self-efficacy and writing self-regulation; (iv) Wichadee (2010) reveal that Wiki usage improves scores and attitudes towards learning in the writing of summaries; and (v) Liu et al. (2018) propose the collaborative tool Cooperpad in a post-test only design, with an experimental group and a control group, with the results showing that the quality of communication writing in the experimental group is significantly higher than in the control group when carrying out difficult tasks.

In relation to argumentative writing, Cebrian-Robles et al. (2018) apply an online rubric (e-rubric), in b-learning mode, and confirm its positive impact on argumentation processes and scores awarded to texts written by the students and, for their part, Noroozi et al. (2016) study the effects of the online argumentative peer feedback script on the written argumentative essay, with the results showing the conditions for applying this technology in order to achieve quality in argumentative writing.

These investigations all encourage the use of ICTs to promote writing learning at university; nevertheless, this study focuses on web systems designed for the teaching of writing; that is, web-based writing instruction (WBWI), understood as an environment for writing instruction in which applications, tools and internet resources are integrated into a pedagogical system, to guide and support writing instruction in its many dimensions (Cleveland & Larkins, 2004; Van Waes et al., 2014; Wible et al., 2001). These tools, applications and resources coexist in an interrelated manner with the teaching processes, and the implementation thereof is based on the physical conditions of the technological environment.

But how is written communicative competence and, especially, argumentative written communication conceptualised to design quality education at university?

The Metasociocognitive Written Composition (MWC) model (Arroyo, 2018) explains university writing as a complex process in which, metacognitively, cognitive-linguistic competences and socio-cultural experiences interact with motivational factors (Chang, 2020; Wilson & Soblo, 2020) to achieve outreach objectives within a disciplinary field (Brown & Marshall, 2012). This interaction always takes place by applying a specific textual genre (McCune, 2004). Therefore, the teaching of quality writing, which includes the learning of metacognitive, motivational, and socio-cultural dimensions, is always linked to the teaching of how a literary genre is structured. In other words, the awareness of a specific genre structure improves the communicative ability of the writer and the quality of the text, as highlighted in the proposals, for quality teaching of written communication of genre-based writing-instruction models (Kuiper et al., 2017; Wingate, 2012). In addition, the predictive power of the structural rhetorical moves on writing metacognition, expressed in argumentative essays written by

university students, has been demonstrated in a study conducted by Arroyo et al. (2020). The findings suggest the connection between writing metacognition and a motivational factor; that is, argumentative writing self-efficacy. Furthermore, the MWC serves as the basis for the design of writing programmes at university level focused on the proper structuring of the text, promoting writing metacognition and motivational factors.

Moreover, the MWC highlights that written communication must be fluent in different languages (Van Waes & Leijten, 2015), focusing attention on the use of the native language and on the transfer of skills across language (Roca et al., 2006), and point out that the increase in students with different languages creates a multilingual space conducive to promoting writing learning in L1 and L2. In this regard, Costino and Hyon (2011) base the teaching of textual genre as a bridge for shared learning, in the mother tongue (L1) and in the first foreign language (L2), using shared didactic procedures, such as “assignment sheet and several supporting activity handouts moves activities” (Roca et al., 2006, p. 30). For this, specialists in L1 and L2 collaborate by developing genre-based teaching materials, applicable to guide learning, both L1 and L2.

The importance of an argumentative written communication in different languages using WBWI for quality university education is very prominent, but there is a clear absence of research to verify the effectiveness of bilingual or multilingual didactic designs in web systems for the teaching of written argumentation in higher education. Following the precedents described, the present research designs a multilingual space with shared technological-didactic procedures, that is to say technological applications, tools, and resources available in different languages and integrated on a WBWI which guide the planning, organization and review of the argumentative essay for scientific dissemination. Thus, this research investigates the effects of a WBWI called “Escritura Científica Multilingüe”, or ECM (Multilingual Scientific Essay) in which the learning of metacognition and writing motivation is shared when written argumentation is structured in L1 (Spanish) and in L2 (English).

Therefore, the questions posed by this study are as follows. Does the application of the ECM to a group of university students when they write in L1 and L2 significantly improve writing metacognition, self-efficacy in argumentative writing and the structuring of the argumentative essay in both languages? Does the technological context of the ECM stimulate the associations between the variables: writing metacognition, self-efficacy in written argumentation, and the structuring of the argumentative essay in L1 and L2? Is there a correlation between the variables described and the shared technological-didactic procedures in L1 and L2? Before answering these questions, the background is presented in relation to the mentioned variables.

## LITERATURE REVIEW

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### *METACOGNITION IN WRITING IN L1 AND L2*

The writing process is understood as the metacognitive interaction of cognitive processes and motivational writing factors, in a technological and multilingual socio-cultural context (Jakobs & Perrin, 2014; MacArthur et al., 2017). Specifically, at the university level this means that written communication requires the development of cognitive-linguistic processes, among which attention, memory, planning, transcription, and review in writing stand out (Limpo, 2018; Meneses, 2013). But in addition, writing is configured based on experiences of a socio-cultural nature that affect the choice of feelings, linguistic codes, lexicon, format, structure, and supports (Izquierdo-Magaldi et al., 2016; Prior & Thorne, 2014). These choices allow the written expression of a cultural-professional identity (Kinloch & Burkhard, 2017; Kwok et al., 2017) that is built in connection with an audience, for the achievement of shared objectives. Finally, writing demands the learning of metacognitive writing that happens when awareness of all writing skills and experiences is made, to self-regulate and control the construction of a specific literary genre.

Thus, writing metacognition refers to the reflection on the writing process in all its complexity for the understanding of it, in addition to the self-regulation and control of such a process (Hammann, 2005; Schraw & Dennison, 1994; Zimmermann, 2000). This is in order to achieve communicative objectives in a socio-cultural, professional and/or scientific context. Therefore, the importance of checking the level of awareness that students have regarding their writing process, experiences and factors in a global way is emphasised (Karlen, 2017; MacArthur et al., 2017), in order to guide learning towards new levels of writing conceptualisation that make written communication effective. This new level of writing conceptualisation has to go hand in hand with the use of ICTs to meet the requirements of quality education.

However, in the theoretical framework described, studies on writing metacognition in L1 with university students show, on the one hand, writing metacognitive deficiencies (Arroyo, 2013; Arroyo & Gutierrez-Braojos, 2016) and, on the other, limited use of technologies when writing academic texts. However, Arroyo et al. (2021) and Arroyo et al. (in press), show that the use of technological resources, applications, and tools, integrated into a well-structured digital system, favour writing metacognition. For its part, studies in L2 highlight the application of didactic strategies for learning writing metacognition (Eckstein & Ferris, 2018; Sasaki et al., 2018), in order to respond to the needs detected in university students. Some of these needs are dedication of more time to read, think, formulate, review, and edit texts, or the lack of a lexicon and a varied syntax (Kwon, 2009; Mu & Matsuda, 2016). Finally, Arroyo et al. (2016), verify an increase in metacognition on planning, transcription, and revision of the text, as well as self-control, self-regulation and expression of identity, in L1 and L2, after following a shared technological didactic process in both languages.

In short, the literature highlights the need to continue deepening the metacognitive writing learning of university students, both in L1 and L2, applying technologies to improve the quality of written communication at these levels. But writing metacognition is linked to writing motivational constructs, such as self-efficacy, which support self-control of emotional potential (Amin, 2019; Csizér & Tankó, 2017) in order to achieve effective and creative communication.

### ***SELF-EFFICACY IN WRITTEN ARGUMENTATION IN L1 AND L2***

Writing self-efficacy is a complex motivational construct referring to the feeling of competence in written communication (Pajares & Valiante, 2006). Therefore, self-efficacy is important in writing learning and its value is also considered when evaluating writing learning dimensions (Raedts et al., 2017).

Several studies with university students in L1 (MacArthur et al., 2016; Ramos-Villagrasa et al., 2018; Teng et al., 2018) identify university writing self-efficacy with a sense of competence, either to display language skills and self-regulation, express a textual content, or to plan, organise and review writing. Moreover, correlation studies in L1 highlight the importance of writing self-efficacy due to its association with other motivational constructs, such as apprehension and attitudes towards writing (Erkan & Saban, 2011). In addition, MacArthur et al. (2016) discover correlations of self-efficacy with the self-regulation of the writing process, the performance of writing tasks, and cognitive writing skills.

But writing self-efficacy does not only correlate with motivational and metacognitive constructs. Teng et al. (2018) also discovered a correlation between writing self-efficacy and the scores obtained in written products; that is, self-efficacy is associated with the quality of the text. In line with this, Arroyo et al. (2021) demonstrate the correlation between argumentative self-efficacy, writing metacognition and the structuring of argumentative texts, and Amin (2019) discovered this correlation between writing self-efficacy and the quality of the written products (measured by the scores given to the text) in the follow-up of a technological didactic process.

For their part, correlation studies in L2 highlight that self-efficacy in writing review is related to the quality of textual products (Chen & Zhang, 2019). Furthermore, Teng and Zhang (2020) show an increase in the levels of writing linguistic self-efficacy and self-efficacy in writing performance, after

following a didactic process for learning writing self-regulation strategies. Likewise, Wilby (2020) points out a strong correlation between self-efficacy and writing self-regulation and shows that self-efficacy increases significantly after following a didactic writing process.

All these studies indicate the implication of the motivational construct of self-efficacy in the process and result of university written communication in both L1 and L2. Consequently, it is foreseeable that its promotion in the design of technological-didactic processes improves the quality of argumentative written communication in both languages. In regard to this, a clear antecedent is the study by Arroyo et al. (2016), in which a didactic context is shared in L1 and L2 on a WBWI. This study shows the correlation of self-efficacy with writing metacognition, both in L1 and L2, as well as an improvement in writing self-efficacy in both languages, after following the bilingual technological-didactic process.

In short, the research highlights the need to enhance writing self-efficacy to support awareness of the writing process, under the premise that this awareness regulates and controls the construction of well-structured text, both in L1 and in L2.

### ***STRUCTURING OF ARGUMENTATIVE WRITING IN L1 AND L2***

The theory of textual genre (Swales, 2004) focuses on a community of knowledge that structures its written communication, using certain strategies for shared purposes. This theory is developed by analysing the movements and structural steps of texts to identify their function in written discourse (Kanoksilapatham, 2005). Structural movements and steps organise the ideas of the text in order to give it communicative effectiveness and stimulate cooperation between writers and readers (Hyland, 2016; Swales, 2011).

Specifically, when it comes to implementing the argumentative genre, its communicative effectiveness is conditioned, in addition to metasociocognition and writing motivation, by the ability to generate arguments and to combine these with counter-arguments and rebuttals, from different sources and perspectives to demonstrate a premise. That is, the argumentation must be guided by a clearly defined objective on which it is argued (Nussbaum & Kardash, 2005; Nussbaum & Schraw, 2007). In short, argumentative communication in quality higher education requires learning the structure of the argumentative genre, which integrates an introduction, the formulation of a premise, an argument, and a conclusion, as well as the inclusion of citations and bibliographic references, whatever the language in which it is written. This structure is revealed in studies such as Arroyo (2016), Nimehchisalem and Mukundan (2011), Ragonis and Shilo (2018), Takao and Kelly (2003), and Venables and Summit (2003).

At university, genre analyses in L1 indicate the lack of structuring of the argumentative essay (Arroyo & Jiménez-Baena, 2016; O'Hagan & Wigglesworth, 2015; Sydney, 2014). Other analyses highlight that even with improvements in the structuring of argumentative texts deficiencies continue to be identified, even after having followed a didactic process (Arroyo et al., 2021; Cebrian-Robles et al., 2018; Luna et al., 2020). These studies, therefore, show the need to teach genre structure at university, improving the didactic designs to achieve greater argumentative communicative efficiency in L1. Moreover, although studies on argumentative genre analysis in L2 are not widespread, the literature emphasises that the structure of the text in L2 should be explicitly taught (Shen, 2018) and its improvements are demonstrated after following a didactic process (Eckstein et al., 2011).

Lastly, studies which compare writing in L1 and L2 detect needs in the organisation of argumentative essays in both languages (Ferris et al., 2017; Taghizadeh et al., 2014). In addition to this review, it is concluded that ICTs, applied to the learning of writing, can provide opportunities to meet educational needs, although they are underused.

## ***WEB-BASED WRITING INSTRUCTION IN L1 AND L2***

The impact on writing learning of web-based instruction is highlighted in literature (Fernando, 2018; Ferriman, 2013; Mizumoto et al., 2017; Yeh et al., 2014), because web systems create a context that exceeds the physical limits of the classroom, therefore, the students manage their own time, space, and interaction. They also enable guidance in the learning process, offering the possibility of hosting multimedia resources; that is, different communication channels are combined (auditory, visual). These multimedia stimulate working memory by facilitating the processes of selection, organisation, and integration of the information necessary to communicate effectively in writing.

In this line, some WBWI has been developed: (i) Cotos et al. (2020) use the Research Writing Tutor (RWT), for encouraging the metacognitive process during the review of texts; (ii) Benetos and Bertrancourt (2020) use the Computer-Supported Argumentative Writer (C-SAW) to check the benefits in relation to the number of arguments, knowledge of components of argument, knowledge of subject and changes in epistemic beliefs; (iii) Palermo and Wilson (2020) use MI Write, which promotes and evaluates the argumentative moves; and (iv) Lammers et al. (2019) apply the “Scientific Argumentation Model” to evaluate the structural moves in research articles.

In addition, two studies use a WBWI on the Moodle platform: (i) Luna et al. (2020) check for improvements in the number of for and against arguments, along with the level of integration therein, when argumentative summaries are written; and (ii) Arroyo et al. (2021), using the Argumentative Writing (AW), promote writing metacognition, argumentative self-efficacy, and the structure of the argumentative text.

All the research mentioned highlights the didactic possibilities of WBWI to promote written communication at university, either in L1 or in L2. However, Hsu and Liu (2019) and Lin et al. (2017) offer a WBWI with a shared interface on L1 and L2. The results of these studies indicate that the participants consider that are useful for improving the learning of writing research articles in L2. But beyond the proposal described, a study by Arroyo et al. (2016), offers bilingual technological didactic procedures (integrated in a WBWI designed on Moodle), such as: (i) forums for socio-cultural discussion; (ii) telematic applications for metasociocognitive reflection; or (iii) on-line schematisations to guide the writing processes. These didactic-technological procedures are factors that produce significant improvements in metacognition and writing self-efficacy, both in L1 and L2.

Ultimately, the literature underpins the need to continue investigating aspects of technological didactic processes that may be influencing specific variables of writer learning, both in L1 and L2, all with greater validity, reliability, and depth.

## **RESEARCH METHOD**

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In order to answer the questions raised, a mixed quasi-experimental design (Morgan, 2007) was applied, with two repeated pre-test and post-test measurements, for the three dependent variables of writing metacognition, self-efficacy in written argumentation, and structuring of the argumentative text, in L1 (Spanish) and L2 (English). In addition, five intervening variables were analysed: digital writing activities, their extension, languages in which it is written, Lesson, and Forums.

### ***PARTICIPANTS***

Students are selected from among those taking the first year of the Primary Education Degree at the Faculty of Education of a university in southern Spain. All participants are fluent in Spanish (L1) and able to write a text in English (L2) on a current topic of personal interest, using simple language to list advantages and disadvantages, give and justify their opinion (Council of Europe Language Policy Portal, 2011), which is equivalent to a level of B1 in L2.

In the first place, a natural group of 50 students with voluntary enrolment take a post-test three months after taking the pre-test. This group acts as a control group, since it does not undergo any

specific writing treatment, beyond the instructions usually given by the teachers of the subjects to carry out writing tasks. The participants of the control group comprised 14 (28%) men and 36 (72%) women. Their age ranges between 18 and 34 years ( $M = 20.86$ ;  $SD = 3.077$ ).

Second, another natural group of 50 students with voluntary affiliation is offered the ECM, as a complementary activity within a subject of their academic curriculum. All students follow all of the didactic-technological procedures outlined below. Of the participants, 17 (34%) are men and 33 (66%) are women. Their age ranges between 18 and 45 years ( $M = 19.62$ ;  $SD = 3.896$ ). This group acts as an experimental group.

### ***TREATMENT: “ENSAYO CIENTÍFICO MULTILINGÜE” OR ECM (MULTILINGUAL SCIENTIFIC ESSAY)***

ECM is available on a Learning Management System, or SML, called Moodle (Deng & Tavares, 2013) with identified access only for students enrolled in the University. It is a WBWI that promotes the construction of an argumentative essay for scientific dissemination and is presented with an interface in the following languages: Spanish, English, German, Italian and Catalan. Therefore, it creates a multilingual technological space that allows writing learning for the diversity of students that the Spanish university of the 21st Century hosts (Pérez-Llantada, 2015). Each student can choose the language in which they build their essay, although this research considers the data of the students who follow it in Spanish (L1) and English (L2).

ECM takes place over three months in 24 Sessions. Each Session has a digital guide (see an example in Appendix A) in which the objective is specified as well as the tasks (with their respective technological supports) and the evaluation activity. These Sessions are developed throughout the following Phases:

Phase 1: Initial Evaluation (Sessions 1-6), in which the evaluation instruments described below are applied.

Phase 2: Shared didactic-technological procedures (Sessions 7-19), with the support of applications, tools and resources, in order to guide the planning, organisation and review of an argumentative essay for scientific dissemination. These procedures are described below:

A.- Activities, using outlining in digital templates (see an example in Figure 1), of the type (a) planning and organising the argumentative essay, (b) reviewing the argumentative essay individually and in pairs, (c) applying self-instructions to write a good argumentation; and (d) identify and analyse the moves and steps of the argumentative essay in argumentative essay models. All activities are sent for review by the teacher, using the tool: Tasks.

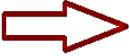
B.- Participation in Forums, where students express their reflections on metasociocognitive writing issues. Each line of discussion is initiated by the teacher. The answers can be in Spanish or English, and in any other language known to the students (see Figure 2).

C.- The Lesson is a digital tool that describes the dimensions of the writing process. This digital document is divided into sections to sequence its reading and to support comprehension by means of questions, whose correct answers allow us to proceed to the next section (see Figure 3).

Phase 3: Final Evaluation (Sessions 20-24), in which the same evaluation instruments are applied as in Phase 1.

**Sesión 14 / Session 14 / Sessione 14 / Sessió 14**

 Sesión 14 / Session 14 / Sessione 14 / Sessió 14  
 Plantilla X / Template X / Vorlage X / Modello X



**Sesión 15 / Session 15 / Sessione 15 / Sessió 15**

 Sesión 15 / Session 15 / Sessione 15 / Sessió 15  
 Plantilla XI / Template XI / Vorlage XI / Modello XI

**OBJECTIU:** Planificar un text científic

**INSTRUCCIONS:** Iniciarà el procés d'escure un text científic sobre el tema que triï (és el mateix que el de la sessió anterior)

**OBIETTIVO:** Planificare un testo científico

**ISTRUZIONI:** Si inizierà il processo di scrittura di un testo scientifico sull'argomento scelto

**ZIEL:** Planen Sie einen wissenschaftlichen Text

**HINWEISE:** Sie beginnen mit dem Schreibprozess eines wissenschaftlichen Textes über ein bestimmtes Thema

**OBJECTIVE:** Planning a scientific text

**INSTRUCTIONS:** You will start the process of writing a scientific text on the topic you choose (should be the same theme chosen in Session no.4). To plan and write the text think the answers to these questions in English

Plantilla X/Template X/Vorlage X/Modello X		
Apellidos/Surname/Nachname/Cognome/Cog noms	Horas de trabajo/ Hours of work/Arbeitsstunden/ Ore di lavoro/ Hores de treball	Sexo/Gender/ Geschlecht/ Sesso/Sexe
Nombre/Name/Name/Nome/Nom	Edad/Age/Alter/Ètà/Èdat	

**OBJETIVO:** Planificar un ensayo científico

**INSTRUCCIONES:** Va a iniciar el proceso de escribir un ensayo científico sobre el tema que elija (es conveniente que continúe con el mismo tema que eligió en la Sesión n.º4). Para planificar ese texto piense y anote las respuestas a estas preguntas en español.

Preguntas	Respuestas
1. ¿Por qué voy a escribir este ensayo?	
2. ¿Para qué escribo el ensayo?	Tipo de publicación: Nombre de la Editorial/Revista: Dirección Postal: Dirección Web: E-mail: Soporte: impreso o electrónico
3. ¿En qué idioma voy a escribir?	
4. ¿Quién va a leer este ensayo?	
5. ¿Sobre qué tema voy a escribir el ensayo?	

Figure 1. Example of an outlining

¿Es importante para tu futuro profesional expresarte por escrito? ¿Por qué? / Is it important for your professional future to express yourself in written? Why? de ... - domingo, 16 de febrero de 2014, 09:52

Podéis comenzar a escribir en este foro / You cant start to write in this forum

[Editar](#) | [Borrar](#) | [Responder](#)

Re: ¿Es importante para tu futuro profesional expresarte por escrito? ¿Por qué? / Is it important for your professional future to express yourself in written? Why? de ... - lunes, 12 de mayo de 2014, 19:47

Sí, por supuesto. Es muy importante. En general, en el futuro, todos tendrán que escribir un documento importante. Por ejemplo: CV, carta de presentación, etc Si la gente comienza a practicar la escritura ahora en el idioma oficial y el vocabulario oficial, que será útil para todos en el futuro. Y para nosotros - los futuros profesores es un tema muy importante, lástima pues vamos a transferir el conocimiento a las generaciones futuras. Así que lo más importante es que debemos aprender a hablar correctamente y escribir. Se trata de dar un buen ejemplo para los niños.

/

Yes of course. It is very important. In general, In the future, everyone will have to write an important document. For example: CV, cover letter, etc. If people start practise writing now in the official language and official vocabulary, it will be useful to everyone in the future. And for us - future teachers is a very important issue, because we will transfer our knowledge to future generations. So the most important is that we should learn how to properly speak and write. This is to set a good example for children.

/

Tak, oczywiście jest to bardzo ważne. Jestem przekonana, że w przyszłości każdy z Nas doświadczy takiego momentu, w którym będzie musiał napisać jakikolwiek ważny dokument. Np. Cv, list motywacyjny, itp. Jeśli ludzie zaczną praktykować tego typu wypowiedanie się już teraz, na pewno będzie im to przydatne w przyszłości. Mam tu na myśli praktykowanie pisania w oficjalnym języku oraz używanie oficjalnego słownictwa. A dla Nas – przyszłych nauczycieli to tym bardziej ważny temat, ponieważ naszym zadaniem jest przekazywanie wiedzy kolejnym pokoleniom. Tak więc bardzo ważne jest to abyśmy my odpowiednio się wszystkiego nauczyli. Po to, aby dawać przykład naszym przyszłym uczniom.

Figure 2. Forum of Session 1

**Sesión 5 / Session 5 / Sessione 5 / Sessió 5**

Sesión 5 / Session 5 / Sessione 5 / Sessió 5

- Document 1
- Documento1
- CM1 (Español)
- QM1 (Italiano)
- QCM1 (Català)

### 1. Metacognition in written composition

All these dimensions of metacognition in written composition are shown in Figure 1.

Metacognition in written composition implies the following:

- Being conscious of the personal intentions or purposes that lead to the writing of a text (duty, fun, the need of expressing ideas, denouncing something, applying for something, sharing experiences and/or feelings (see Beard, 2000, 2005 for discussions of the implications for educators) and its social functions (waking the others' conscience up, informing others about something that happened, promoting values in others, and engendering feelings in others);
- Being able to self-regulate one's own cognitive and motor performance in written composition, according to the knowledge acquired on what a text is what composing a text is and the way in which a text is composed. In order to achieve this, an individual must be able to choose and apply strategies according to the intentions or purposes established;

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2.- Las dimensiones de la metacognición en la escritura son / Metacognition writing dimensions are / Die Dimensionen der Metakognition im Schreiben sind / Le dimensioni della metacognizione nella scrittura sono / Les dimensions de la metacognició al' escriturason:

- c) intenciones, memoria, planificación, semántica, gramática y léxico / intentions, memory, planning, semantics, grammar and vocabulary / Absichten, Gedächtnis, Planung, Semantik, Grammatik und Wortschatz / intenzioni, la memoria, la pianificazione, la semantica, grammatica e vocabolario / intencions, memòria, planificació, semàntica, gramàtica i lèxic
- b) intenciones, autorregulación, autocontrol, motivación intrínseca y motivación extrínseca / purpose, self-regulation, self-control, intrinsic motivation and extrinsic motivation / Absichten, Selbstregulierung, Selbstkontrolle, ex- und intrinsische Motivation / Intenzioni, autoregolamentazione, autocontrollo, motivazione intrinseca e motivazione estrinseca / intencions, autorregulació, autocontrol, motivació intrínseca i motivació extrínseca

**Figure 3. Lesson (Documento 1 and Document 1)**

The student also has an Introductory Session with (i) a Study Guide in Scorm packages (see Appendix A) to guide the student in following the ECM, (ii) didactic videos linked from YouTube to motivate the student in the writing learning, displaying technological skills, and (iii) a table in HTML (see Appendix B) to temporarily organize the activities.

### ***PROCEDURES FOR DATA COLLECTION AND VALIDATION***

All data collection instruments and procedures are applied in Phase 1 and 3 of the ECM. These are:

First, the templates for the argumentative essay in L1 (hereafter Texto) and in L2 (hereinafter Text), on a given topic.

Second, the Questionnaire on Writing Metasociocognition in L1 (hereafter CM) and in L2 (hereafter QM). This is a written interview that consists of 20 closed questions. In it, the student expresses agreement with each item, with 0 being the most negative value and 100 the most positive value. The items extract information about the knowledge, self-regulation, and control of the writing process, in its cognitive and socio-cultural dimension, and are of the type: “Before writing a text I do some preliminary tasks.”

Third, the Argumentative Essay Self-Efficacy Scale, in L1 (hereafter EA) and in L2 (hereafter AE), which includes 10 items. Likewise, the student must express agreement with each item, scoring it from 0 to 100. The items that make up this questionnaire extract information about how the student is perceived when faced with the task of writing an argumentative essay, and they are of the type: “I can write the premise when I write an argumentative essay.”

The process of construction and validation of the questionnaires and scales is carried out in a previous study, with 518 students taken from the same context of the present investigation (Arroyo et al.,

2021). First, the following are verified: (i) the internal consistency, with the value of Cronbach's alpha coefficient, taking this as a value of 0.846, for the total of the CM scores and 0.925 for AE; (ii) reliability, with McDonald's Omega coefficient of 0.913 for CM and 0.857 for AE; and (iii) stability, applying Pearson's test-retest, which shows values of 0.635 for CM and 0.614 for AE. Subsequently, the Exploratory Factor Analysis (hereafter EFA) determines the existence of six factors for a total explained inertia of 58.465%, in the CM: Factor 1, referring to the emotional control of writing; Factor 2, referring to the self-regulation of writing; Factor 3, referring to the planning of the deed; Factor 4, referring to the transcription of writing; Factor 5, referring to the review of the writing; and Factor 6, referring to the hearing of the writing. For its part, the EFA for AE determines a single factor with a total explained inertia of 60.016%. In addition, a Confirmatory Factor Analysis is performed for the CM, using Structural Equation models and calculating the degrees of absolute, incremental and parsimony adjustment of the model, obtaining values of  $\chi^2 P=.000$ , GFI=0.929, CMIN/DF=2.51, RMSA=0,054, NFI=0,854, IFI=0,907, CFI=0,906 and PNFI=0.697, which demonstrates the adequacy of the model.

All the instruments described are translated into English by a native expert.

Regarding the instruments for the collection of data related to the intervening variables, they are the following: (i) 15 digital templates where the evaluation activities of each Session are collected, downloaded and sent for registration through the Tasks tool and (ii) Telematic reports, accessible to the teacher, that offer a description of the use that each student makes of the Lesson and Forums tool.

The procedures applied to collecting data related to the dependent variables are as follows. In a face-to-face class, the professor explains the content and how to complete the instruments CM, QM, AE and EA. Later, the students have one hour to answer their items and send them using the Questionnaire digital tool. In another session, also in the presence of the teacher, the students write, in a totally independent way, an argumentative essay in a template on a given topic, in Spanish and English, indicating that they must send it with the Tasks tool. They have two hours for this task.

The procedures applied to collecting data related to the intervening variables are the following. All the templates that collect the evaluation tasks, carried out by the students in each session are sent through the Tasks tool. This tool allows the storage of these documents on the Moodle platform and their subsequent download by the teacher to be analysed. Each student sets their own pace in the completion of these tasks, so the download of the templates is done as the students send them. Likewise, when all students have completed Phase II of the ECM, the teacher accesses each student's report, accessible on the Moodle platform, in order to consult both their interventions in the Forums and their interactions with the Lesson tool.

### ***PROCEDURES FOR ANALYSIS***

First, in the analysis of textual data, the Content Analysis Method is applied. For this, the documents to be analysed are determined. In this case, they are the templates, reports and the texts. The data sets that offer information on each of the categories established in the systems developed for this purpose are established as registration units.

To classify the data in the reports and templates, a category system is developed and validated in a discussion group. The validation procedure is as follows: (i) reading of all documents; (ii) definition of the categories via inductive and description thereof; and (iii) definition of the counting rules. Subsequently, this system is empirically validated in the research of Arroyo et al. (2016). After this exploration, it is adapted again in a discussion group and the descriptions and counting rules are adjusted, remaining as presented in Table 1.

**Table 1. System of categories for the analysis of the technological didactic process**

Code	Categories	Description	Rules for counting (is a perfect score equal to 10)
A	Writing activities	Completion of the tasks of each of the 15 “Templates”	Divide 10 by 15 (maximum of “Templates”), to establish the score for each “Template”, giving a result of 0.66. If the “Template” is incomplete, it is given a score of 0.33.
E	Extension of writing tasks	Number of written pages in each Template	The following intervals are established: a) if you write between one and three pages, it has 0.5; and b) if you write between four and seven you get 0.66, per “Template”
I	Idiom	Use of one, two or three languages	If you use all the languages that are requested in the tasks you get 0.66, if you only use one language when two are requested, then you get 0.33. If you use one language when you are asked for three, you get 0.22 and if you use 2, you get 0.44.
F	Forums	Messages written in the 7 Forums	Each “Forum” is scored as follows: a) if you write 1 or 2 messages: 0.47; b) if you write 3 or 4 messages: 0.94; and c) if you write 5 or more messages: 1.42
L	Lesson	Comprehensive reading of documents, in Spanish and English	Reading and correct answering all the comprehension items, in Spanish and English, is a 10. Reading and comprehension of a single language is a 5.

Source: Adapted from Arroyo et al. (2016, p. 407)

With this System of Categories, two researchers score the information. The reliability between the evaluators’ scores is higher than 90%, applying Kappa, and in cases where there is no agreement, a third researcher resolves the discrepancies (Eckstein & Ferris, 2018).

The category system for structuring the texts is elaborated inductively in a discussion group, using the Nvivo11 program for the definition of the categories and counting rules. In this case, the counting rule established is the frequency of each structural step in each movement (see Table 2). This System is developed and validated in the study by Arroyo and Jiménez-Baena (2016), and it is updated in the studies by Arroyo et al. (2020), and Arroyo, Fernández-Lancho, & Maldonado (2021).

In the present research an exploration by two researchers of all argumentative essays is carried out, coding them in Nvivo11. The reliability of the evaluators’ coding is higher than 90%, applying Kappa. In cases where there is no agreement, a third investigator resolves the discrepancies. Finally, the counting rules are applied, that is, the number of times that one of the steps of each structural movement is expressed, in each of the tests.

Finally, for the quantitative analysis of the data, descriptive statistics of the pre-test and post-test measurements are calculated. Afterwards, the normality test is applied with the Saphiro-Wilks statistic. As all the measures pass this test, they are compared with the parametric contrast for related samples, using the IBM SPSS Statistic 20 program. In addition, the effect size (Cohen’s d) is calculated with the G \* Power 3.1.9.7 program (Cárdenas & Arancibia, 2014). Finally, the correlations between the measures are estimated using Spearman’s Rho Coefficient.

**Table 2. System of Categories for scoring the structure of the argumentative essay**

<b>Movements</b>	<b>Structural Steps</b>
Introduction	Presentation of the topic, interest and social relevance of the topic, innovations and quotes.
Premise	Formulation of the premise, definition of the concepts and quotes
Argumentation	Reasons in favour, reasons against, rebuttals, definition of concepts, quotes from experts and research
Conclusion	Synthesis of reasons, definitive reasons, projection and quotes
Bibliography	Bibliographical references quoted, following referencing criteria

Source: Adapted from Arroyo & Jiménez-Baena (2016, p. 358)

## RESULTS

The contrasts between the measures are presented first, and then the correlations.

### *CONTRASTS*

Table 3 shows the significant differences between the pre-test and post-test measurements of the experimental group.

**Table 3. Descriptive measures and parametric contrast in the experimental group**

<b>Variables</b>	<b>Pre-test</b>		<b>Post-test</b>		<b>Difference</b>	<b>p</b>	<b>SE</b>
	<b>Mean</b>	<b>SD</b>	<b>Mean</b>	<b>SD</b>			
CM (L1)	1396.14	196.677	1579.50	188.233	183.360	0.000**	1.173
EA (L1)	661.08	129.818	740.38	109.735	79.300	0.000**	0.770
MQ (L2)	1393.64	201.838	1564.58	206.247	170.940	0.000**	1.135
SA (L2)	611.40	174.769	705.80	137.778	94.400	0.000**	0.787
Texto (L1)	8.54	1.940	15.58	3.796	7.040	0.000**	1.558
Text (L2)	8.38	2.221	16.12	4.024	7.740	0.000**	1.754

Note: SD = standard deviation; SE = size of the effect; CM/MQ = writing metacognition; EA/SA = argumentative writing self-efficacy; Texto/Text = argumentative essay

In the first place, a homogeneous increase is observed in all variables, of more than 6 points. The standard deviation decreases in all measured variables, except for Texto and Text. Second, highly significant pre-test post-test differences ( $p < 0.001$ ) are observed in all variables, with effect sizes above 0.65. The differences are largest in Texto and Text and CM and MQ, and smallest in EA and SA.

Table 4 shows the differences for the control group and it can be observed that there are no significant differences for any of the measures between the pre-test and post-test. It is also seen that the effect size is negative in CM, EA, MQ and Text.

**Table 4. Descriptive measures and parametric contrast in the control group**

Variables	Pre-test		Post-test		Difference	p	SE
	Mean	SD	Mean	SD			
CM (L1)	1362.54	210.369	1313.10	267.847	-49.440	0.187	-0.189
EA (L1)	641.70	109.545	611.80	148.010	-29.900	0.223	-0.174
MQ (L2)	1299.98	405.241	1262.80	274.376	-37.180	0.610	-0.072
SA (L2)	568.52	187.697	608.70	152.171	40.180	0.105	0.233
Texto (L1)	8.10	3.495	8.42	3.459	0.320	0.609	0.072
Text (L2)	7.86	3.670	6.96	3.817	-0.900	0.075	-0.257

Note: SD = standard deviation; SE = size of the effect; CM/MQ = writing metacognition; EA/SA = argumentative writing self-efficacy; Texto/Text = argumentative essay

In Table 5, the measurements of the control group are compared with the experimental one, and it was found that there are no significant differences between the pre-test measurements of the control group and the experimental group both in L1 and L2. This means that both groups begin with similar standards in writing metacognition, self-efficiency, and argumentative structuring both in L1 and L2.

**Table 5. Parametric contrast between the experimental group and the control group in the pre and post measures for L1 and L2**

Variables	Difference	SD	p	SE
CM-pre exp./CM-pre control (L1)	33.600	287.884	0.413	0.116
CM-post exp./CM-post control (L1)	266.400	302.188	0.000**	0.881
EA-pre exp./EA-pre control (L1)	19.380	177.270	0.443	0.109
EA-post exp./EA-post control (L1)	128.580	184.150	0.000**	0.698
MQ-pre exp./MQ-pre control (L2)	93.660	424.013	0.125	0.220
MQ-post exp./MQ-post control (L2)	301.780	307.480	0.000**	0.981
SA-pre exp/SA-pre control (L2)	42.880	265.936	0.260	0.161
SA-post exp/SA-post control (L2)	97.100	207.258	0.002*	0.468
Texto-pre exp./Texto-pre control (L1)	0.440	4.357	0.479	0.100
Texto-post exp./Texto-post control (L1)	7.160	4.896	0.000**	1.462
Text-pre exp./Text-pre control (L2)	0.520	3.945	0.356	0.131
Text-post exp./Text-post control (L2)	9.160	5.751	0.000**	1.592

Note: \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; SD = standard deviation; SE = size of the effect; CM/MQ = writing metacognition; EA/SA = argumentative writing self-efficacy; Texto/Text = argumentative essay

The significant differences between the control group and the experimental group are also confirmed in the post-test, in L1 and L2. The results as revealed in Table 3 verified in L1 in CM ( $p = 0.000$ ;  $E = 0.881$ ), in EA ( $p = 0.000$ ,  $SE = 0.698$ ) and in Text ( $p = 0.000$ ,  $SE = 1.4$ ), although in this last variable the effect size is smaller. Likewise, these differences are observed in L2 in MQ ( $p = 0.000$ ,  $SE =$

0.981), in SA ( $p = 0.002$ ;  $SE = 0.468$ ) and in Text ( $p = 0.000$ ,  $SE = 1.5$ ). It can be seen that the effect size is greater in L2 than in L1 for the three variables.

### ***CORRELATIONS***

First, Table 6 indicates that CM1 is highly correlated ( $p < 0.01$ ), both with EA1, MQ1 and SA1. A significant correlation of EA1 with MQ1 and SA1 is also discovered. Lastly, MQ1 maps to SA1. However, no measure shows a significant correlation with Texto1 and Text1, this being negative in Text1.

**Table 6. Coefficients of correlation between pre-test dependent variables**

<b>Variable</b>	<b>CM1</b>	<b>EA1</b>	<b>MQ1</b>	<b>SA1</b>	<b>Texto1</b>	<b>Text1</b>
CM1 (L1)	1					
EA1 (L1)	0.438**	1				
MQ1(L2)	0.909**	0.512**	1			
SA1 (L2)	0.389**	0.912**	0.512**	1		
Texto1 (L1)	-0.095	-0.145	-0.114	-0.109	1	
Text1 (L2)	0.080	0.102	0.167	0.154	-0.045	1

Note: \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; CM/MQ = writing metacognition; EA/SA = argumentative writing self-efficacy; Texto/Text = argumentative essay

Second, Table 7 indicates that CM shows a significant increase in correlation with EA2, MQ2 and SA2. Likewise, MQ2 increases its significant correlation with SA2. EA2 maintains its high correlation with MQ2, although it decreases somewhat, with MQ2 and SA2.

It is observed that no measure correlates significantly either with Texto2 or with Text2. However, EA2 and SA2 positively correlate with Text2. On the other hand, it is found that all the measures correlate negatively with Text except SA2, although this correlation decreases with respect to the pre-test.

**Table 7. Coefficients of correlation between post-test dependent variables**

<b>Variables</b>	<b>CM2</b>	<b>EA2</b>	<b>MQ2</b>	<b>SA2</b>	<b>Texto2</b>	<b>Text2</b>
CM2 (L1)	1					
EA2 (L1)	0.544**	1				
MQ2 (L2)	0.947**	0.507**	1			
SA2 (L2)	0.540**	0.888**	0.572**	1		
Texto2 (L1)	-0.170	0.092	-0.238	0.018	1	
Text2 (L2)	-0.140	-0.054	-0.095	0.007	-0.021	1

Note: \* =  $p < 0.05$ ; \*\* =  $p < 0.01$ ; CM/MQ= writing metacognition; EA/SA = argumentative writing self-efficacy; Texto/Text = argumentative essay

Finally, Table 8 shows the correlations between the dependent variables and those that measure the technological-didactic procedures followed.

**Table 8. Coefficients of correlation between dependent and intervenient variables**

<b>Variables</b>	<b>A</b>	<b>E</b>	<b>I</b>	<b>F</b>	<b>L</b>
CM1 (L1)	0.074	0.079	0.041	-0.054	0.057
CM2 (L1)	0.225	0.174	0.169	-0.148	-0.074
EA1 (L1)	0.009	0.127	-0.028	0.110	0.124
EA2 (L1)	0.106	<b>0.284*</b>	0.181	-0.008	0.107
MQ1 (L2)	0.066	0.225	0.038	-0.088	0.134
MQ2 (L2)	0.211	0.240	0.180	-0.134	-0.100
SA1 (L2)	0.086	0.201	-0.001	0.153	0.045
SA2 (L2)	0.063	0.270	0.156	0.038	0.053
Texto1 (L1)	-0.085	0.158	0.184	-0.089	0.022
Texto2 (L1)	0.086	0.120	-0.021	-0.006	-0.194
Text1 (L2)	-0.195	0.162	-0.225	0.256	-0.125
Text2 (L2)	0.090	0.001	-0.026	0.049	<b>0.293*</b>

Note: \* =  $p < 0.05$ ; CM/MQ = writing metacognition; EA/SA = argumentative writing self-efficacy; Texto/Text = argumentative essay; A = writing activities; E = extension of writing tasks; I = use of one, two or three languages; F = messages written in the forums; L = Lesson

Thus, significant associations are discovered between argumentative self-efficacy in L1 (EA2) and the extension of writing tasks (E), on the one hand, and argumentative structuring (Text2) with the Lesson tool (L), on the other.

It should be noted that no more significant correlations are discovered. However, it is observed that (i) A negatively correlates with Texto1 and Text1, this correlation being positive in the post-test (Texto2 and Text2), and A increases its correlation with all post-test measures except with SA; (ii) E increases its correlation with all the variables in the post-test except with Texto and Text; (iii) I is positively associated with EA2 and SA2, not being so in the pre-test (EA1 and SA1) and, furthermore, its correlation in the post-test with CM and MQ increases (going negative in Texto and remaining negative in Text); (iv) F correlates negatively with EA2, while it is positive in the pre-test (EA1) and its correlations with the other measures either remain negative or decrease; and (v) L slightly increases its association with SA2; however, in the other measures it decreases, or it goes from positive to negative.

## DISCUSSION

Regarding the first question – does the application of the ECM to a group of university students when they write in L1 and L2 significantly improve writing metacognition, self-efficacy in argumentative writing and the structuring of the argumentative essay in both languages? The results revealed in Table 3 indicate the significant differences in the three variables measured (writing metacognition, self-efficacy, and argumentative structuring), both in L1 and L2. These findings coincide, regarding metacognition and self-efficacy, with the study by Arroyo et al. (2016), where a bilingual didactic-technological process is applied to teach the argumentative essay in L1 and L2.

The present study also corroborates the findings of other research in relation to improvements in metacognitive learning writer using ICTs, when argumentative texts are structured (Benetos & Benetrancourt, 2020; Palermo & Wilson, 2020), or when research articles are structured (Cotos et al., 2020). Likewise, the results of the present study confirm the increase in writing self-efficacy, using ICTs (Raedts et al., 2017).

Regarding the written argumentative structuring, the improvements demonstrated in L1 coincide with the study by Luna et al. (2020, p. 245), in which it is stated, “the training group wrote better-structured texts,” applying a didactic-technological process hosted in Moodle.

The findings of the present study also coincide with those of Hsu and Liu (2019) (where a bilingual web is applied) regarding the structuring in L2. However, the aforementioned study focuses on the structure of research articles. For their part, Eckstein et al. (2011) confirm the findings of the present research, regarding the structuring of text in L2, although these authors do not apply ICTs. Finally, the findings for the three variables in L1 of the present study corroborate the results of the research of Arroyo, Fernández-Lancho, & Maldonado (2021) and Arroyo, Fernández-Lancho, & Martínez (in press), applying a multilingual technological process.

In short, the results of this research expand the possibilities of ICTs at university by demonstrating the potential of ICTs integrated in a web-based didactic design and shared in different languages, for writing metacognitive learning, argumentative self-efficacy, and argumentative writing structuring in L1 and L2.

On the other hand, the significant differences (greater in the argumentative structuring of the text and in writing metacognition and less in argumentative self-efficacy, both in L1 and L2) show a similar effect of ECM on argumentative writing learning in L1 and L2. In a way, these findings contradict part of Wilby’s (2020), findings, who examined the changes in a writing course in L2. The results show that self-regulation (metacognitive component) remains stable over time while self-efficacy increases significantly. However, ICTs are not applied and it is not multilingual, thus the learning context may be conditioning the results. The present study highlights the advantages of ICTs, integrated in a multilingual didactic design, over the learning of metacognitive writing in L1 and L2.

The present research, in addition, confirms a negative effect size in all the learning measured in the control group (Table 4), except in argumentative self-efficacy in English and in the structuring of the text in Spanish. This finding reinforces the need to teach writing at university (Amin, 2019; Teng & Zhang, 2020; Wilby, 2020), given the evidence that the absence of didactic interventions can reduce writing and metacognitive skills in L1 and L2, argumentative self-efficacy in L1 and argumentative structuring in L2.

Regarding the second question – does the technological context of the ECM stimulate the associations between the variables: writing metacognition, self-efficacy in written argumentation, and the structuring of the argumentative essay in L1 and L2? The results of correlations presented in Tables 6 and 7 show the evidence as follows.

Firstly, both writing metacognition and argumentative self-efficacy significantly correlate with each other, in L1 and L2, and between both languages. These data confirm the association between the metacognitive and motivational dimension of writing in L1 (Bruning & Kauffman, 2017; Csizér & Tankó, 2017). But the present research also confirms these associations in L2.

Secondly, the absence of association of the aforementioned variables with the argumentative structuring in L1 and L2 is confirmed; that is, confirming the downward trend in the correlations between self-efficacy and the scores awarded to argumentative essays, both in L1 (Arroyo et al., 2020; Limpo & Alves, 2013; MacArthur et al., 2016; Sanders-Reio et al., 2014) and in L2 (Teng et al., 2018) in the university context.

Thirdly, the increased correlation between writing metacognition and argumentative self-efficacy, both in L1 and L2, after applying the ECM shows that it strengthens the association between these

variables. These findings are confirmed by Wilby, (2020), although this latest study only shows correlations in L2.

Finally, writing metacognition and argumentative self-efficacy are not associated with argumentative structuring either in L1 or in L2, nor are they before or after applying the ECM, and the association is more negative with argumentative self-efficacy and with argumentative structuring in L2. This evidence is reinforced by verifying that the significant differences are smaller in argumentative writing self-efficacy in L2. The aforementioned findings highlight the need to integrate didactic strategies in the ECM that enhance associations between the learning of the different writing dimensions in L2.

Regarding the third question: is there a correlation between the measured variables and the shared didactic-technological procedures in L1 and L2? The significant correlations (Table 8) show, firstly, the association of the Lesson tool with the argumentative structuring in L2. That is, the didactic-technological procedure of metacognitive-writing comprehension in different languages is associated with the argumentative structuring in L2. Furthermore, this procedure may explain why the size of the effect in the argumentative structuring scores in L2 is greater than in L1. This association is reinforced when verifying that the correlation of the Lesson with the other variables decreases or is even negative.

Secondly, it was discovered that the extension of writing tasks is associated with argumentative self-efficacy in L1; however, this association is negative with self-efficacy in L2 (although it is not significant). Nor does the extent of the tasks performed seem to be associated with the structuring of the essay, either in L1 or in L2. This leads us to think that students who write a lot when doing writing tasks feel effective, not in structuring argumentative texts, but in dealing with writing tasks in L1. This does not happen in L2. It can be deduced, then, that writing many words in the tasks that guide the process of construction of the text does not improve either the writing self-efficacy or the structural quality of the text, either in L1 or in L2. This finding seems to contradict the use of the number of words as a quality index of the text (Van Weijen et al., 2019), although in this study the extension refers to the text that is finally written.

Another trend revealed by the data is that the performance of the activities increases its correlation with all the variables except with the argumentative self-efficacy in L2, which allows us to interpret that the proposed writing tasks in ECM do not promote the association with the argumentative self-efficacy in L2. Besides this, the use of different languages when carrying out such tasks is positively associated with all the measures but not so with the scores in argumentative structuring, either in L1 or in L2.

Participation in the Forums is negatively associated with all the learning measured or decreases in the post-test. These results seem to contradict the findings of other investigations that show the didactic effects of the use of forums (Castro et al., 2016; Olarte et al., 2008). However, in the aforementioned cases, the Forums are not integrated into a didactic-technological system of multilingual argumentative writing, such as the ECM, and, furthermore, the number of Forums is much smaller.

Finally, it is important to highlight that the validity of all these findings is supported by (see Table 5) the absence of significant differences between the pre-test measurements of the control group and the experimental group, both in L1 and L2. This result shows that the control and experimental groups start from homogeneous positions in relation to writing metacognition, self-efficacy, and argumentative structuring, in L1 and L2. In addition, the significant differences in the post-test between the measurements of the control and experimental groups in L1 and L2 prove that the significant differences found in the experimental group are due to the effect of the ECM. This conclusion is reinforced by the application of data collection and analysis instruments validated in other research.

## CONCLUSION

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At the international level, the creation of a culture of peace and cooperation is proposed that makes sustainable global development possible. This aim requires promoting quality education, understood as guides and supports for the learning of communication competences that respect social and ecological development. More specifically, quality in higher education assumes the challenge of developing in all citizens of the 21st century communication competences for the dissemination of sustainable scientific knowledge using TICs.

To this end, learning to write in L1 is promoted and a sufficient level of L2 writing is required from the first year of university (Bychkovska & Lee, 2017; Karnal, 2013). In this regard, Eckstein and Ferris (2018), highlight that argumentative writing in L2 presents more needs for attention than in L1 and, therefore, Ranalli et al. (2018) insist on the potential of ICTs to help students to manage and acquire better writing competences in different languages. Finally, shared scenarios are proposed for teaching in L1 and L2 (Costino & Hyon, 2011).

In this research framework on the quality of teaching for university written communication, this study provides the following conclusions. Firstly, it can be stated that the ECM creates a shared didactic-technological space in different languages (multilingual), producing similar effects in L1 and L2, both on writing metacognition and on self-efficacy and argumentative structuring. Therefore, the ECM is foreshadowed as a context for learning argumentative writing for sustainability, capable of compensating for the differences between L1 and L2, identified in various studies such as those by Eckstein and Ferris (2018), and Van Waes and Leijten (2015). In other words, the ECM promotes the transferability of knowledge and motivations (Zimmermann, 2000) about argumentative writing between L1 and L2. Secondly, the ECM enhances the association of writing metacognition with argumentative self-efficacy in L1 and L2. However, these dimensions are not associated with the structuring of argumentative essays, either in L1, or in L2, so they are demanded didactic-technological improvements of the ECM that reinforce the association between the three dimensions. Furthermore, it is verified that the described variables are associated with the didactic-technological procedures integrated in the ECM in the following ways: (i) the procedure to promote writing metacognition (through the Lesson tool) is associated with argumentative structuring in L2; (ii) the extent of writing activities is associated only with argumentative self-efficacy in L1; and (iii) participation in the Forums presents a very low association with all the variables measured.

All this evidence follows changes in the didactic-technological procedures of the ECM, although it is important to point out that the exposed findings are established for the natural groups described, due to the impossibility of a random selection. Under these conditions, no generalisations can be made from the evidence found; however, this evidence points in the didactic-technological direction of the ECM that is described below.

Undoubtedly, the conclusions of the present study promote the application of the ECM by introducing changes in the procedures to improve its effectiveness in argumentative writing learning of a scientific nature, in L1 and L2. In this sense, it is proposed (i) to adapt and implement the genre-based writing instructions methodology (Hsu & Liu, 2019; Kuiper et al., 2017; Wingate, 2012) to the technological context of the ECM in order to improve the results in argumentative structuring, in both L1 and L2; (ii) incorporate collaborative technologies in the construction of the text such as the wiki (Chu et al., 2017; Yim & Warschauer, 2017) in order to enhance the associations of argumentative writing self-efficacy with argumentative structuring, especially in L2; (iii) reduce the number of forums and replace the extensive activities with micro-tasks (Salinas & Marín, 2015) to offer more agility to the didactic-technological procedures of the ECM, seeking an optimisation of self-efficacy and argumentative structuring in L1 and argumentative structuring in L2; and (iv) present the ECM in an open mode that allows access to international students and, thus, to be able to validate the instruments in different languages, checking its effects with a diversity of groups.

Finally, another line of research that is being developed is the adaptation of the ECM to the teaching of other genres and educational levels, as well as for the integration of people with functional diversity and immigrants.

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## APPENDIX A: STUDY GUIDE IN SCORM PACKAGES

# GUÍA DE ESTUDIOS / STUDY GUIDE / STUDIENORDNUNG / GUIDA DI STUDIO / GUIDA D'ESTUDI

Volver a: General ↗

Modo Revisión

### Guía de Estudios

- 1. Presentación
- 2. Cómo estudiar de f...
- 3. Finalidad Educativa ...
- 4. Competencias del C...
- 5. Objetivos específico...
- 6. Contenidos Específi...
- 7. Metodología Didácti...
- 8. Recursos
- 9. Evaluación de los a...
- BIBLIOGRAFÍA ESPECÍ...

## Guía de Estudios

### 1. Presentación

Bienvenidos al Curso el Ensayo Científico Multilingüe (ECM). Para superar con éxito este curso se recomienda leer detenidamente la siguiente Guía de Estudio, ya que esta proporciona toda la información necesaria para seguir el programa de este Curso Virtual.

Se espera que se aproveche al máximo este acercamiento a la enseñanza vía Internet y se logren todos los conocimientos y habilidades para desarrollar textos argumentativos científicos en diferentes idiomas. Además, este curso permite familiarizar al estudiante con las herramientas de la Plataforma Moodle y descubrir sus posibles aplicaciones en la docencia, con lo que se desarrollan competencias profesionales didácticas-tecnológicas. Ser estudiante virtual aportará una experiencia fundamental si se quiere ampliar la trayectoria docente al campo de la formación en línea, tanto en el papel de tutor como de autor de contenidos.

### 1. Introduction

Welcome to the Multilingual Scientific Writing Course (ECM). To successfully complete this Course, please read carefully the following Study Guide, which provides all the necessary information to follow the program for this Webinar.

- iii. Students are expected to take advantage of this approach thanks to virtual learning via Internet and are also expected to achieve all the necessary knowledge and skills to develop scientific argumentative texts in different languages. In addition, this Course will familiarize students with the Moodle Platform and will find out its usefulness for teaching, so that students develop their educational and technological professional skills. The experience of being a virtual student will be fundamental to expand the teaching career to the field of online training, both in the role of tutor as content author.

### 1. Einleitung

Willkommen zum Kurs für multilinguistisches und wissenschaftliches Schreiben (ECM). Um den Kurs erfolgreich zu bestehen, lesen Sie die folgende Studienordnung bitte aufmerksam, die alle erforderlichen Informationen für dieses Webseminar beinhaltet.

Es wird erwartet, dass der Student dieses Online-Angebot ernst- und wahrnimmt um maximalen Erfolg zu garantieren und um sich alles Wissen und die nötigen Fertigkeiten anzueignen, die es ihm ermöglichen wissenschaftliche Texte

## APPENDIX B: PART OF THE TABLE IN HTML TO TEMPORARILY ORGANISE THE ACTIVITIES

### TEMPORALIZACIÓN / TIMING / PHASEN / SINCRONIZZAZIONE/ TEMPORALITZACIÓ

[Volver a: General](#)

Temporalización / Timing / Phasen / Sincronizzazione / Temporalització		
1ª Semana / Week / Woche / Settimana/ Setmana	<ul style="list-style-type: none"> <li>• Sesión 1: Presentación del Curso</li> <li>• Session 1: Presentation of the Course</li> <li>• Session 1: Präsentation des Kurses</li> <li>• Sessione 1: Presentazione del Corso</li> <li>• Sessió 1: Presentació del Curs</li> </ul>	<ul style="list-style-type: none"> <li>• Sesión 2: Texto en inglés y alemán o italiano o catalán</li> <li>• Session 2: Text in English and German or Italian or Catalan</li> <li>• Session 2: Text in Englisch und Deutsch oder Italienisch oder Katalanisch</li> <li>• Sessione 2: Testo in inglese e in tedesco o italiano o catalano</li> <li>• Sessió 2: Text en anglès i alemany o italià o català</li> </ul>
2ª Semana / Week / Woche / Settimana / Setmana	<ul style="list-style-type: none"> <li>• Sesión 3: Cuestionario en inglés y alemán</li> <li>• Session 3: Questionnaire in English and German</li> <li>• Session 3: Fragebogen in Englisch und Deutsch</li> <li>• Sessione 3: Questionario in inglese e tedesco</li> <li>• Sessió 3: Qüestionari en anglès i alemany</li> </ul>	<ul style="list-style-type: none"> <li>• Sesión 4: Texto en español</li> <li>• Session 4: Text in Spanish</li> <li>• Session 4: Text in spanish</li> <li>• Sessione 4: Testo in spagnolo</li> <li>• Sessió 4: Text en espanyol</li> </ul>
3ª Semana / Week / Woche / Settimana / Setmana	<ul style="list-style-type: none"> <li>• Sesión 5: Cuestionario en español y italiano o catalán</li> <li>• Session 5: Questionnaire in Spanish and Italian or Catalan</li> <li>• Session 5: Fragebogen in Spanisch und Italienisch oder katalanisch</li> <li>• Sessione 5: Questionario in spagnolo e in italiano o catalano</li> <li>• Sessió 5: Qüestionari en espanyol i italià o català</li> </ul>	<ul style="list-style-type: none"> <li>• Sesión 6: Escala en español, inglés, alemán, italiano y catalán</li> <li>• Session 6: Scale in Spanish, English and German or Italian or Catalan</li> <li>• Session 6: Skala in Spanisch, English und Deutsch oder italienisch oder katalanisch</li> <li>• Sessione 6: Scala in spagnolo, inglese e tedesco o italiano o catalano</li> <li>• Sessió 6: Escala en espanyol, anglès i alemany o italià o català</li> </ul>
4ª Semana / Week / Woche / Settimana / Setmana	<ul style="list-style-type: none"> <li>• Sesión 7: Texto científico</li> <li>• Session 7: Scientific Text</li> <li>• Session 7: Wissenschaftlicher Text</li> <li>• Sessione 7: Testo scientifico</li> <li>• Sessió 7: Text científic</li> </ul>	<ul style="list-style-type: none"> <li>• Sesión 8: Estrategia IPAC/IPAK</li> <li>• Session 8: IPAC/IPAK Strategy</li> <li>• Session 8: IPAC/IPAK-Strategie</li> <li>• Sessione 8: Strategia IPAC/IPAK</li> <li>• Sessió 8: Estratègia IPAC/IPAK</li> </ul>
5ª Semana / Week / Woche / Settimana / Setmana	<ul style="list-style-type: none"> <li>• Sesión 9: Codificar la Estrategia IPAC/IPAK</li> <li>• Session 9: Code the IPAC/IPAK Strategy</li> <li>• Session 9: Die IPAC/IPAK-Strategie verschlüsseln</li> <li>• Sessione 9: Codificare la strategia IPAC/IPAK</li> <li>• Sessió 9: Codificar l'Estratègia IPAC/IPAK</li> </ul>	<ul style="list-style-type: none"> <li>• Sesión 10: Aplicar la Estrategia IPAC/IPAK a un texto en español e ingles</li> <li>• Session 10: Applying the IPAC/IPAK Strategy in an Spanish and English text</li> <li>• Session 10: Die IPAC/IPAK-Strategie anwenden auf einen Spanischen und Englischen Text</li> </ul>

## AUTHORS

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