

Article

A Simple Approach to Relating the Optimal Learning and the Meaningful Learning Experience in Students Age 14–16

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Abstract: Using a questionnaire applied in real time to students in stages 14–16 during a distance class, the authors appraise whether they experience feelings that lead to a central experience of flow, according to the flow theory of positive psychology. Students are exposed to a planned session that considers the moments of the training sequence and consciously integrates technological tools to support learning. A formal evaluation system, which includes formative and summative evaluations, determines if students build meaningful learning. This research contributes to understanding that an optimal learning experience characterized by the pedagogical principles of curiosity, concentration, challenge, and enjoyment, favor the construction of meaningful learning. Furthermore, the simplicity of the proposed experimental design suggests a direct way to replicate the study in later learning stages and assess the efficiency of new technology-based pedagogies within the distance education paradigm imposed by the 2020 pandemic crisis.

Keywords: optimal learning experience; distance education; training sequence; technological education tools; meaningful learning; educative innovation



Citation: Díaz de León-López, M.G.; Velázquez-Sánchez, M.d.L.; Sánchez-Madrid, S.; Olais-Govea, J.M. A Simple Approach to Relating the Optimal Learning and the Meaningful Learning Experience in Students Age 14–16. *Information* **2021**, *12*, 276. <https://doi.org/10.3390/info12070276>

Academic Editor: Gennady Agre

Received: 22 April 2021

Accepted: 25 May 2021

Published: 5 July 2021

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1. Introduction

The post-COVID educational order has forced educational institutions and teachers to reevaluate the teaching–learning process [1]. In this process of resignification and adaptation, the integration of new educational technology tools to the planning of pedagogical intervention stands out. Considering that this new teaching process is characterized by being aimed at large groups of students, having a non-face-to-face nature, and being inevitably mediated by technology, it is legitimate to ask ourselves how to help students build meaningful learning? According to flow theory [2], meaningful learning is achieved when the student experiences an optimal learning experience (OLE) [3]. This condition favors student learning when they experience feelings of commitment, challenge, enjoyment, and curiosity. Teachers must ensure that non-face learning environments include these pedagogical principles through the correct use of Educational Technology Tools (ETT). In its reflective and intentional nature, the design of a lesson plan must select, organize, and correlate the educational applications (apps) so that they are aligned with the moments of the session and with the specific objectives within the discipline that is taught [4]. Considering the characteristics of each moment of the class [5] and the specific role of teachers, students, the object of knowledge, and the different ETTs used during the session, it is possible to manage the pedagogical principles that lead to a flow of learning.

The online teaching paradigm has created opportunities for institutions to reinvent their educational approach, betting on new pedagogies focused on forming academic

communities or natural critical learning environments [6] that favor authentic scenarios of active learning [7]. In these learning environments, the teacher controls the object of study, the didactic transposition mediated by technologies, a specific pedagogy dictated by the nature of knowledge, and the evaluation process. Therefore, online teaching should aim to adapt and improve how the contents are released and maximize the interactions between the subjects of the teaching–learning process with educational technologies and with the object of study to generate significant learning.

The state of flow to optimize learning cannot occur if any pedagogical principles (or sensations of flow) are not considered (or experienced). Previously, we determined that the challenge imposed by using the ETTs in the new distance education scheme broke the state of learning flow because the qualification in the use of educational technologies was insufficient for both students and teachers, regardless of the area of study, at the baccalaureate and undergraduate educational levels. In the present study, this motivated an exploratory analysis on the use and management of TTEs within the moments of the formative sequence planned by the teacher to verify if intentional and reflective planning promotes an OLE and, in turn, this condition favors significant learning in students. A key in this proposal lies in using validated evaluation instruments to ensure that this last statement is fulfilled. In the present investigation, we designed a simple experiment with first-year high school students, whom we asked directly during the course of a planned class whether or not they experienced the sensations of flow that allow us to ascertain whether an OLE occurs during the class. Subsequently, through a formative and summative evaluation scheme, it is concluded on the generation of significant learning in a specific discipline and with ETTs aligned with the objectives and moments of the class.

The present manuscript is organized as follows. Section 2 summarizes the previous findings of this research and the conceptual elements that guided the construction of this work. Section 3 establishes the research proposal, highlighting the objectives and questions that make up this proposal. In Section 4, we describe the validation of the defined methodological design, while in Section 5, we deposit the results and discussion of the educational experiment carried out. Finally, Section 6 contains the relevant conclusions and perspectives of this contribution within a broader and more general context that envisions traces of future work within this investigation.

2. Conceptual Framework

According to Belén Mesurado [8], the concept of Optimal Learning Experience (OLE) is closely linked to the theory of flow, which constitutes an abstract and complex construct made up of several characteristics that “can be grouped into three factors: perception of achievement, cognitive activation and affective quality”, which are elements that correlate with psycho-pedagogical theories that explain the foundations and processes of knowledge construction.

The flow theory [9] describes the autotelic state of an individual when he performs a certain activity. The general conditions for the flow state to occur are balancing challenges and skills and setting short-term goals with an immediate feedback system. These conditions transcend a state of mind characterized by an intense concentration that fuses consciousness with action, decentralizing the individual from the social system in which he is immersed, generating a feeling of control over the tasks performed until reaching the established objectives [10]. As intrinsic motivation [11], he considers self-motivated learning to be the best way to learn. However, this experience is subjective, since it depends on the balance between challenges and perceived skills (variables not easy to measure).

A central flow experience characteristics are feeling in control, focusing attention, curiosity, and intrinsic interest [12]. The perception of skill and challenge, the ability to choose, and the importance of the task for students’ goals affect their sense of success, meet their expectations, allow the perception of control, and generate a sense of well-being. Optimal learning is facilitated when educational opportunities respond to people’s interests, abilities, and differences and expand their prior knowledge [11]. In [13], Whalen postulates

that teachers can transmit fluency to their students. For his part, Csikszentmihalyi [9] states that if educators spent more time encouraging students to enjoy learning instead of transmitting knowledge, they would obtain better results.

Formative Sequence and Its Relationship with ETTs

The term education constitutes a dynamic and methodical process through which learning is socially constructed. Educational practices are intentional and occur within formal educational spaces [14]. A didactic sequence or formative sequence [15] can be understood as the set of planned, ordered, structured, and coherently articulated activities to achieve and build specific educational objectives that are structured from the learning perspective. This intentional and formal educational process “has a design or planning phase; an active phase, of interaction between educators and students; and a subsequent review phase” [5] (p. 14). On many occasions, the lack of teacher training (pedagogical and didactic) can cause these spaces to be generated intuitively. All educators have some didactic referents, although on many occasions, “they are not sufficiently conscious or reflexively assumed” [5] (p. 10).

The interaction phase represents a central moment in the educational process. It is when the educator guides the learning process, applies what is planned, faces situations that affect it, and makes decisions (about methodologies, organization, resources, intentions, and evaluation) [15]. This phase comprises three moments, and with some adjustments, it applies both to face-to-face and mixed models and distance education models. In the initial phase (initiation), students are placed in a learning situation. The educational environment is established, and the foundations of the training process are laid during the class. The subject is introduced, and the work dynamics are explained, motivating the student, awakening his interest in generating positive expectations. During the development phase, activities are carried out to build learning; it tends to be the longest moment in the sequence. During its planning, those activities that facilitate meaningful learning and promote autonomy, social interrelation, and self-regulation should be privileged. This phase must be flexible to allow adaptation and decision-making to regulate and adjust processes. During the closing phase, learning is consolidated. This phase is due to a moment of synthesis, recapitulation, and interrelation of the contents that have been built throughout the class. Summative assessment activities and strategies [16] are applied to determine learning progress. Its usefulness lies in the possibility of evaluating progress and results. It favors the students’ metacognition and allows them to relate the contents to generate awareness about their learning.

Although they seem very limited, in practice, these phases are highly variable. They can be cyclical, and, in many cases, their limits are not precise. A question logically arises: what activities are the most appropriate for each of these phases? This depends on several factors, among which the educational intentions and the pedagogical perspectives of the teacher stand out. Given the conditions generated by distance education, technological tools and applications are vital to give an effective answer to the previous question. Teachers should be administered and used by teachers in the appropriate phase of the intervention and according to the learning objectives [17]. The achievement of this objective depends, mainly, on the teaching capacity to generate scenarios that favor learning, promote and maintain the students’ attention and motivation, and plan, develop, and apply learning and evaluation activities. A vital part of this scenario depends, in this new virtual educational paradigm, on the management, use, and application of technological tools and applications, since they constitute invaluable allies in the possibility of developing an OLE that leads to the efficient construction of competencies and educational objectives. How can students perceive the achievement, cognitive activation, and affective quality required for an OLE? First, it should be considered that in non-face-to-face classes, one of the main challenges is achieving and maintaining effective student attention during class.

The theory of flow in educational settings can guide the teacher in this challenge, since its pedagogical principles start from the possibility of generating intrinsic motivation

in students, which contributes to generating and maintaining levels of challenge and enthusiasm. However, the technological tools or applications used by the teacher in educational spaces and activities must be consistent with the moments of the training sequence. The virtuality of the new educational paradigm does not necessarily have to be translated into classes in which an endless parade of technological applications or tools is presented. This can cause disinterest or lose the meaning by not serving a specific and determined objective. The task should focus on searching for applications and technological tools that enhance and trigger optimal learning experiences to generate sensations that allow a true state of fluency and make their application present at the appropriate moments in the didactic sequence. Figure 1 outlines the conceptual elements that this research uses to define a theoretical frame of reference.

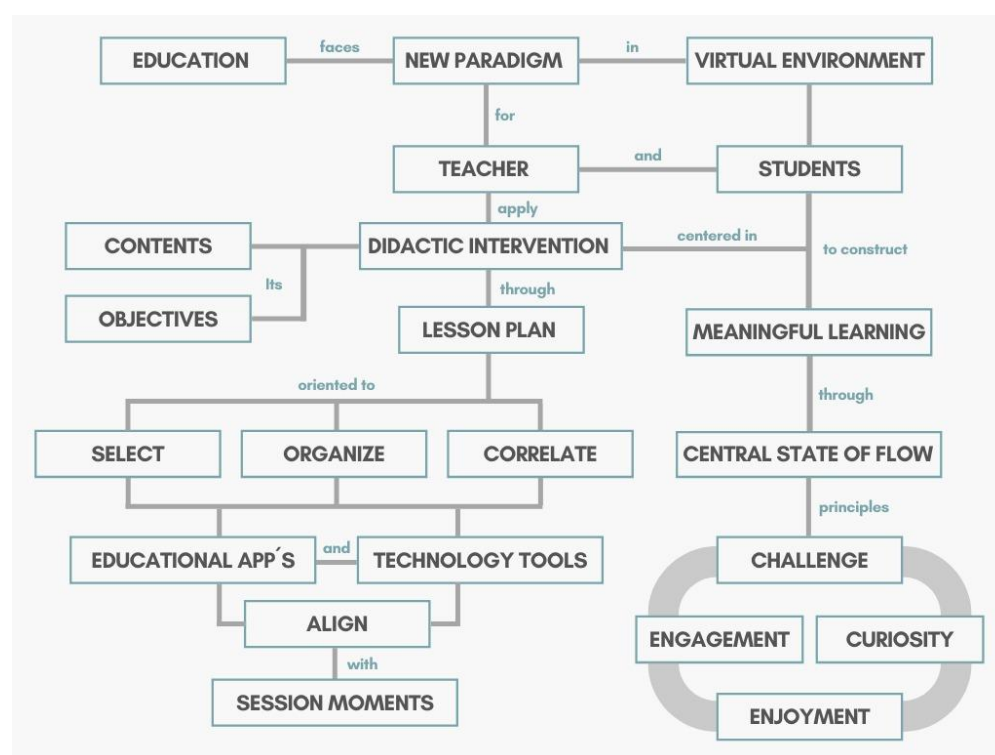


Figure 1. Relation of theoretical and conceptual elements that define an interpretative and design frame of reference in this research.

3. Related Work

A Systematic Literature Review (SLR) is a controlled methodology that aims to synthesize available evidence in the state of knowledge of a specific area of research. Usually, during the development of this methodology, a review of quantitative and qualitative aspects of primary studies is carried out to summarize the existing information regarding a particular topic. Our previous studies [18] of the OLE described from flow theory show that the adequate management of TTEs within a planned training sequence directly impacts the quality of the learning acquired by the students. However, within the new paradigm of distance education, the perception of control and the existing balance between the new types of activities and tasks assigned by teachers is decisive for the rest of the pedagogical principles to be achieved within a distance class. In this way, we find that keywords such as flow, OLE, training sequence, meaningful learning, and distance education constitute a conceptual, theoretical cluster whose internal relationships are of interest for this research. For this reason, we have established an SLR whose phases are illustrated in Figure 2. We will establish conceptual links between our previous research and recent literature that investigates issues related to it. Details on how we approach the SLR protocol are shown in Appendix A.

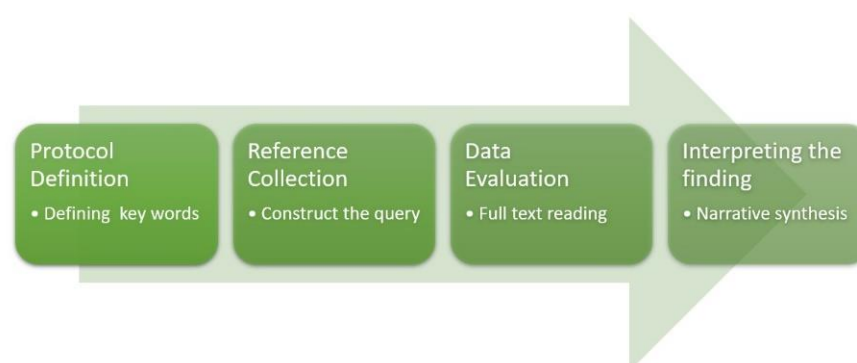


Figure 2. Phases of the SLR protocol followed to find links between previous work reported in [18], recent educational literature, and the present research proposal. Details of the SLR can be reviewed in Appendix A.

4. Proposal

The synthesis (see Table A1) of information provided by the SLR indicates that working within the new paradigm of distance education implies re-signifying and innovating an intervention pedagogy characterized by the permanent mediation of the ETTs (for example, the Tec21 educational model [19]). The inclusion of this pedagogical element has generated teacher–ETT and student–ETT interactions that characterize the dynamism of this new pedagogy. However, how this interactivity is regulated within a class depends on the organization that dictates the teacher’s reflection on her lesson plan. This reflection on the teaching practice generates selection criteria for the ETTs to be used appropriately at each moment of the training sequence. Being clear about the characteristics of the moments in class suggests a way of coupling the technological elements to promote maximum interactivity between the subjects of the learning environment without losing sight of the session’s objectives. This dynamism defines the conditions that produce curiosity, concentration, and enjoyment of the student, which are key pedagogical principles to favor an OLE. Therefore, it is necessary to adapt teaching interventions that include curiosity, challenge, concentration, and enjoyment, incorporating the ETTs in which distance education gravitates. This implies a reformulation of the role of the teacher as an expert user of the educational technologies that they use to recreate a class. In addition to the teacher’s expertise in the use of the ETTs, her educational intervention must include feedback processes for the student and the evaluation of learning. Finally, an OLE can only occur when the dynamics of adaptation of institutions, teachers, and students are aligned with the new virtual teaching formats.

Considering the previous approach, the main question in this research is: How to get students to build meaningful learning? In addition, the objective is determining if a training sequence mediated by the appropriate use of ETTs in a specific class induces the generation of OLE, and in turn, this condition promotes the generation of meaningful learning. Particularly, this article does not pretend to state that something as risky as the COVID-19 pandemic has led teachers to reinvent education. Still, it is undeniable that it positioned them before a new educational paradigm that presents numerous challenges. Although many of these were already present in the traditional face-to-face educational model, others have grown and become more evident and relevant. However, we are interested in (at least) partially respond specific questions such as how can students perceive achievement, cognitive activation, and affective quality required for an OLE? Moreover, is there any specific way to encourage the enjoyment, commitment to the activity, challenge (in an adequate and constant balance with the student’s ability), and curiosity in the students?

5. Proposal’s Validation

This research deals with using the formative sequence as an intellectual tool to induce states of flow that favor significant learning in students 14–16 through the appropriate

use of ETTs. To do this, we first carried out a structured survey of the group of teachers described in Section 5.1 to understand their use of educational apps within their instructional classroom designs. Subsequently, we chose a group of students 14–16 to analyze whether they experience concentration, curiosity, challenge, and enjoyment, leading to an OLE when they take a Language, Art, and Culture class. Once we determine if students experience a state of central flow, we look to see if there is a direct relationship with their school performance, through formative and summative assessments, and in turn, with the construction of meaningful learning.

5.1. Phase 1: Structured Survey

This research addresses using the formative sequence as an intellectual tool to induce states of flow that favor significant learning in students aged 14–16 through the appropriate use of ETTs. To do this, we first conducted a structured survey of a random sample of 95 teachers, which was taken from a group of 206 teachers from various areas and specialties. Considering a 99% confidence level with a 10% margin of error, statistical significance is ensured with 92 teachers and assuming that the sample behaves according to a standard normal distribution $N(0,1)$. The survey applied was designed to know which ETTs are used by teachers, according to the moments of the training sequences of their lesson plans, according to their area of specialization, and according to the teaching strategies during their online session. The questions were formulated as follows:

- (i) What apps or technological tools do you use in your classes?
- (ii) What apps or technological tools do you use to teach specialty topics within your teaching area?
- (iii) At what point in the formative sequence do you use the apps you mentioned in the previous question?
- (iv) What didactic-technological strategy do you use during the classes?

The teachers freely responded to these questions indicating which educational applications they use according to the specific moment of the training sequence, as shown in Figure 3. In the column labeled “not clear”, a wide variety of specialized applications are not used at specific times in the sequence. From the point of view of instructional design, this strongly weakens the pedagogical intervention, blurring the relationship between the training sequence and the administration of the temporary work agencies. This indicates that their teaching intervention is dominated by an intuition of the teaching–learning process and not by knowing theoretical and conceptual elements that allow them to establish a thoughtful and intentional lesson plan. On the other hand, it is clear to observe how generic applications mainly occupy the beginning and closing moments of the session, either as a prelude or synthesis of the moment of development, where it can be inferred that the practice is still dominated by a traditional approach through the remote connection to an educational platform and not due to the correct handling of a combination of specialized applications for the development of the session.

Regarding questions (i) and (ii) of this brief survey, we observe that the applications that the teaching community said it uses can be classified into two types: those generics that support the different moments of the training sequence and that are the technological scaffolding of the class, and those that are used to promote learning in specific subjects of a discipline or specialty. Table 1 shows all the applications mentioned by the surveyed teaching group, separating the generic from the specialized, according to the area of knowledge to which the teachers belong.



Figure 3. Apps distribution according to the moments of the formative sequence.

Table 1. Generic and specialty apps collected in the structured survey, questions (i), and (ii) mentioned in the Section 5.1. The super index in each app indicates the frequency of mentions according to the surveyed teachers.

Area	Generic Apps	Specialized Apps
Science	(6) Canvas, (3) EdPuzzle, (3) Genially, (3) Jeopardy, (3) Kahoot, (6) Mentimeter, (6) Padlet, (3) Quizlet, (5) Socrative	(4) Aleks, (3) Desmos, (1) Google Expeditions, (1) Boards, (1) Audio and video editing programs, (5) WebAssign
IT	(3) EdPuzzle, (8) Flipgrid, (6) Nearpod, (8) Remind	(1) Audacity, (4) TinkerCAD (1) Wevideo
Social Studies	(12) Canvas, (3) Genially, (6) Google Classroom, (3) Kahoot, (3) Padlet, (3) PPT	(1) Google Earth, (6) Youtube
Languages	(12) Canvas, (3) EdPuzzle, (12) Kahoot, (3) Quizlet, (3) Socrative	(2) Bookwidgets, (3) Google Forms, (1) Liveworksheets, (4) MyEnglishLab, (3) Wordwall
Life, Mentoring	(12) Canva, (12) Padlet, (3) PPT, (6) Zoom	(5) ELumen, (1) Institutional web pages

In addition to knowing the applications used by the teachers of the different areas, through the answers to questions (iii) and (iv), it was possible to assess the knowledge they possess about the training sequence and the didactic-technological strategies they

used during their courses. A brief content analysis (not shown in this report) indicates that teaching practice is dominated by intuition. Still, there is a clear lack of theoretical elements on didactics and disciplinary pedagogies. Undoubtedly, this implies that the teaching practice carried out is neither intentional nor reflective. In other words, it is not easy to build communication channels (mediated by technology) between the teacher and his students to try to understand the questions that must be derived from the teacher's epistemological and ontological position. In the absence of these positions, it is not impossible to develop an intervention methodology. Therefore, the learning process can be vague, does not generate meaningful knowledge, and avoids flow states that lead to OLE. This analysis allowed us to establish a simple experimental design where we could elaborate a lesson plan that intentionally organized the use of apps according to the moments of the training sequence. It was possible to determine if the students experienced flow states during the session and if that condition favors significant learning in students.

5.2. Phase 2: System to Assess OLE and Significant Learning

During the second phase of this investigation, the data collected came from the subset ($N = 79$) of students aged 14 to 16 from the sample reported in [18]. This group of students is in the first year of high school at the Tecnológico de Monterrey (Tec de Monterrey), San Luis Potosí campus, and corresponds to a generation of students began their high school studies in a distance education modality. Considering that under these conditions, the universe of students considered (the total of first-year students) is equal to 300, the sample of our study must contain at least 73 elements, considering the heterogeneity of 50%, a margin of 10% error, and 95% confidence level. As with the sample of teachers, we assume that the population attends the behavior of a normal distribution $N(0,1)$. It is important to consider that Tec de Monterrey offers an education based on competencies oriented to the solution of challenges (knowledge of execution) to train students whose graduation profile responds efficiently to the various scenarios and needs of the information society [1,20]. In addition to this, Tec de Monterrey enabled the HyFlex + Tec program as its own response to the educational paradigm of distance education in 2020 [18].

To confirm whether an OLE favors the construction of meaningful learning, we designed a method that would allow us to know the states of flow that students experienced during a structured session according to an intentional and reflective class plan. The class plan (see Table 2) was chosen randomly within the Language area, specifically, in the subject of Spanish, Art, and Culture. Figure 4 shows the experiment's general approach and the most relevant elements during its execution.

According to Figure 4, it is necessary to measure the impact in class, through the pedagogical principles of flow, through an intentional and reflective lesson plan that considers the moments of a training sequence and the organization of educational apps around these. To do this, a didactic sequence consisting of two interventions with second-semester high school students (age 14–16) was applied in the subject of Spanish Language, Art, and Culture. The topic addressed in this sequence is the Greco-Latin etymologies, particularly the etymologies of the philosophy area. The objective of this sequence can be broken down into two parts:

- (a) Students will know, identify, and relate various particles (prefixes and suffixes) and Greek terms with their meaning in Spanish. They will recognize and understand how these particles integrate words that are used in the Spanish language.
- (b) Students will use this knowledge to incorporate it into their understanding of the language and use of vocabulary.

Table 2. Distribution of surveyed teachers according to the level or area in which they teach.

Session 1	Session 2
<p>Begin. The class content will be mentioned, and a brief description of the work dynamics will be made. Students will be invited to keep their attention as well as their cameras on throughout the class.</p> <p>Develop. A PowerPoint presentation will be used to integrate text and images to expose and explain the main Greek particles and terms in the philosophical area. Each of the particles will be illustrated with examples and images to demonstrate how they form words in the Spanish language. Various examples of using these words in sentences and statements will be presented in familiar and familiar contexts for the students. The presentation will complement annotations made on the presentation itself using the digital whiteboard of the Zoom platform.</p> <p>Application of the first survey. At the end of the Zoom presentation and expository part of the class, a four-question questionnaire will be applied (using the Zoom tool for online voting) that the students will answer anonymously and seek to identify their perception of the state of flow reached during and after the presentation of the theoretical contents of the class. The questions to be asked are the following:</p> <ol style="list-style-type: none"> 1. Are you enjoying the class? 2. Do you feel hooked on the class? 3. Do you feel that the class is challenging? 4. Are you curious about the class you are taking? <p>Closure and formative assessment. A didactic gamification strategy will be used to verify and evaluate (formatively, not summatively) the class results and determine to what degree and level. After the presentation, the students can remember, recognize, and identify the etymological particles studied during class. Using the Kahoot App, a game will be developed in the form of a questionnaire, with 10 multiple-choice and true/false questions, with which students must remember and identify the meaning, way of use, and integration of words and terms in Spanish, of some of the etymological particles seen in class. After each question, the correct result will be projected, and both correct and incorrect answers will be given feedback and explained to reinforce understanding of the terms. At the end of the game, the winners' podium will be screened with the five best results in the class, congratulated.</p> <p>Application of the second survey. At the end of the Kahoot game, the students will be asked again to answer anonymously (using the Zoom tool for online voting), the same four questions asked in the first survey, to identify the perception of the students regarding the state of flux achieved during the Kahoot gamification activity. Students will be appreciated for their attention to the class and their participation in it.</p> <p><i>Aspects to evaluate.</i> The activity is evaluated on a total of 100%, considering the following aspects to evaluate.</p> <ul style="list-style-type: none"> - At least five words are used that contain Greek particles related to the field of philosophy. - The five words used have meaning in Spanish, according to the dictionary of the RAE. - Words are used in an appropriate grammatical context, in sentences or phrases with congruent and coherent meaning. 	<p>Begin. The class content will be mentioned, and a brief description of the work dynamics of that day will be made. Students will be invited to maintain their attention and their cameras throughout the class.</p> <p>Development. The Youtube video "9 things about Philosophy that you have to know, yes or yes!" [21] and some additional comments and explanations will be made during the screening. At the end of the screening, some additional comments will be made, and open questions will be asked to some students to verify the understanding of some of the concepts, topics, and examples presented in the video. The objective, performance conditions, and observable behaviors to be evaluated during the summative assessment activity will be explained to the students.</p> <p>Closure and summative assessment. Individually, the students must (using the CANVAS platform) carry out the following activity. Individually, they will formulate and write a paragraph to express their understanding, opinion, concerns, doubts, or comments about the projected video. They must use and apply at least five words that contain Greek particles related to the field of philosophy that were reviewed and learned during the previous class. The formulated words must have meaning in Spanish (have an entry in the dictionary of the RAE) and must be used in a congruent and coherent syntactic and grammatical context and meaning. The text must not contain spelling mistakes, since each one will be penalized by subtracting one-tenth from the final grade.</p>

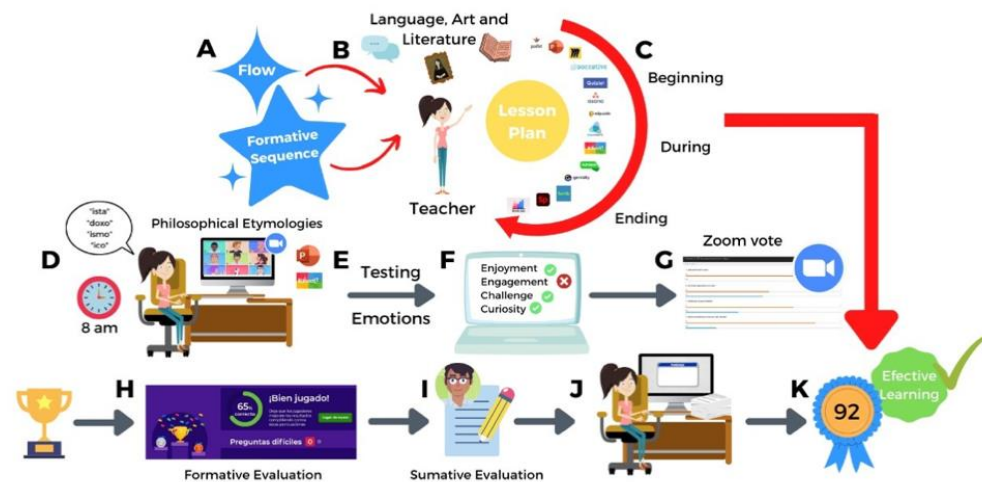


Figure 4. (A) The teacher considers the flow and the (B) formative sequence's theoretical and conceptual elements to integrate the instructional design of an online class session within his/her lesson plan. (C) The selection of the apps that he will use is organized so that their functionality corresponds to the start, development, and closing of the session, according to the specific planned objectives. (D) Students take this session on the zoom platform, and either during the start, development, or closure; the teacher uses various apps following the achievement of planned objectives. (E) In real time, students view on their screen a vote on whether they are experiencing (F) curiosity, enjoyment, challenge, and engagement due to the activities presented. (G) This voting system is launched twice in a 45-min period with the same questions. (H) In the end, as an evaluation system for feedback and synthesis of the learned knowledge, a rapid evaluation system is used that yields favorable results for learning within the development of the session. (I) Finally, to evaluate the students' learning in greater depth, a more complex task was designed within the original planning. (J) The students must show the application of the knowledge acquired in the session. (K) Both the rapid assessment results and those of the assigned task show a favorable performance by the students. This suggests that the implication ($OLE \geq$ significant learning) is true under the design shown.

The overall design of the sequence is justified as follows. The planning of the class and its didactic sequence, the determination and specific selection of contents, the didactic material to be used, the apps and technological resources that will be used, as well as the evaluation strategies (formative and summative), were designed considering, firstly, the objective of the subject, and the intention that students can maintain active attention for as long as possible in class.

Once the teacher recognizes that the four pedagogical principles can promote an optimal flow of learning and identifies and understands the different moments of a training sequence, he/she is favorable to design a lesson plan in which the participants can reflect on the ETTs within the session. This means doing intentional and thoughtful handling of the applications that he/she will use to meet the specific objectives of his/her session. In this way, we assume that the use and management of the applications within the conduction of the designed class are not arbitrary. It becomes necessary to design the class to distinguish the type of application that can be used at each moment of the session, according to its functionality. This reflection leads us to understand (and even define) the limitations of the applications that we use in class based on the specific knowledge poured into the objectives of the class. Together with the reflection of teaching practice, the latter continues to be the compass that guides the teaching–learning process and allows the teacher to create a learning environment where students can build meaningful learning. Table 2 shows the detail of the formative sequence applied with 79 students 14–16 in the Spanish, Art, and Literature class.

6. Discussion

According to questions (i) and (ii) of the structured survey, the educational apps teachers use can be separated into generic apps, which do not strictly depend on the type of content used in class, and those of a specialized type that does depend on the disciplinary content, as shown in Table 1. It is important to note that generic apps have a much higher frequency of use than specialized apps, suggesting that the teaching strategies used during any class could be the same. It is mostly strategies to introduce or synthesize a particular topic, but not to develop it (see Figure 3).

Interactivity with ETTs is accentuated to a greater extent within the classroom instructional design when generic applications are considered rather than specialized applications. The latter are tools frequently used by the student, that is, adaptation such that there is no longer a problem within the learning environment. Therefore, it is interesting to know what type of didactic strategies teachers use within their lesson plans and what moments of the training sequence the apps indicated in Figure 3 are used. However, according to questions (iii) and (iv) from the applied survey, it happens that a good number of teachers do not recognize the moments of a formative sequence within their lesson plan. In this case, the teaching practice is guided by the mastery of knowledge about the discipline being taught and the intuition that comes from the teacher's own experience. Based on this, according to the survey, the activities used by teachers are limited to synthesizing information from a class through interactive, collaborative murals, reading mediated by interactive presentations (e.g., EdPuzzle) or the use of electronic whiteboards (e.g., Whiteboard), the creation of information capsules (e.g., Nearpod) and rapid assessments for knowledge retrieval (e.g., Kahoot). As it can be seen, although the student–ETTs interaction is promoted, the teacher–student and student–student interactions are not emphasized equally. This gave rise to a traditional reading mediated by ETTs and focused on transmitting knowledge rather than its construction or application.

Due to this observation and with the sole intention of accepting or rejecting the hypothesis that the learning and the construction of knowledge are favored when students experience states of flow during class time, we designed a class plan to monitor the pedagogical principles of concentration, curiosity, challenge, and enjoyment, during the execution of the class. The details of the didactic sequence applied are shown in Table 2 as well as the questions asked to the students in real time during the class. These questions were repeated in two moments of the class through the voting system of the zoom platform. Table 2 shows in **bold** the moments of the pedagogical intervention and, in *italics*, the specific use of the apps used during session 1 of 45 min. Likewise, the text that corresponds to the didactic strategies identified during the session is underlined.

During session 1 (see column 1 of Table 2), etymologies of the philosophical area were addressed. It is known that the teaching of philosophy in the common basic training of students requires a pedagogical and didactic challenge of great complexity [22]. This circumstance favors the conditions to carry out the experimentation described in Figure 4. The class was designed for the students to know, identify, and relate various particles (prefixes and suffixes) and Greek terms with their meaning in Spanish. They also had to recognize and understand how these particles make up words used in the Spanish language. In this way, students could better understand their first language and even more complex vocabulary.

Through the Zoom platform, the class dynamics consisted of a brief teacher–student interaction seeking a student's connection by the subject to study. Subsequently, in support of this intention, a PowerPoint presentation was used. Text and images were integrated to expose and explain the Greek particles and terms of the philosophical area. Each of the particles was illustrated with examples and images to show how they form words in the Spanish language. In this expository phase, debating among all characters involved in the teaching–learning process is common. Apart from these discussions, an electronic whiteboard was used so that both teachers and students could take notes and ask questions

about the discussion. After the first 20 min of the session, the first vote was launched to identify the flow status of the students after presenting the contents of the class.

At the end of the session, a didactic gamification technique was chosen, applying a questionnaire of 10 questions in which the students had to identify the meaning of the etymological particles and, in some cases, apply it to words and terms in Spanish. This synthesis of knowledge was carried out through the Kahoot application.

Once the Kahoot game was over, the second vote was taken to monitor, toward the close of the 45-min session, the flow states induced by the didactic gamification technique. The first vote monitored the same flow states after applying a dialogic-expository technique mediated by interactive visual elements. The results of both votes are shown in Figure 5. We concluded that the students experienced states of flow during class that led to an OLE from the narrated experiment. However, being in a state of flux should not necessarily imply meaningful learning.

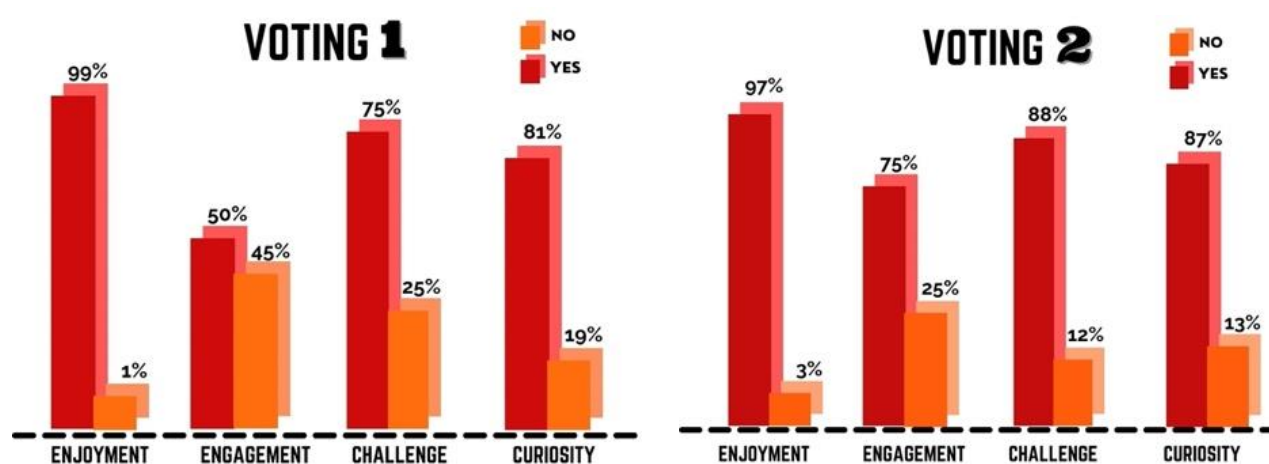


Figure 5. Result of the votes made on the Zoom platform, after the didactic technique of (voting 1) dialogic exposition and (voting 2) gamification, during the class of Greek prefixes and suffixes applied in Spanish words. In both cases, the students reported experiencing states of curiosity, challenge, engagement (concentration), and enjoyment. However, the achievement of these states after the gamification technique is more noticeable.

Two assessments were chosen to measure this second aspect: the Kahoot activity (formative assessment) would give us a quick indicator of the recovery of learning acquired in the session. As shown in Figure 6, a concentration of 56% of the students obtained a score higher than 70% of correct answers in the activity (given that for the educational center in question, a passing score consists of 70% or more), which means that more than half of the students adequately meet the objective of the activity. Although this type of assessment has a factual tendency, it allows the teacher to give feedback in real time during the execution of the session. This is a crucial element for students to maintain the state of flow and close the session, have a sense of learning, and, above all, be satisfied with the processes carried out during the class. Although the session is short (45 min), the students perceive a certain disconnection from time due to a complete immersion in the activity. This motivation must prevail and be used to link the next class activity, which does not occur online. For this, an extra-class activity was designed that, as a task, would give us an indicator about the student's learning and the achievement of the objectives of the lesson plan (summative assessment). This task can be summarized as follows:

Individually, using the CANVAS platform, students will write a paragraph expressing their understanding, opinion, concerns, doubts, or comments about the projected video (see Table 2). They must use and apply at least five words that contain Greek particles related to the field of philosophy that were analyzed during the previous class. The formulated words must have meaning in Spanish (have an entry in the dictionary of the RAE) and

must be used in a congruent and coherent syntactic and grammatical context and meaning. The text should not contain spelling mistakes.

KAHOOT FORMATIVE ASSESSMENT

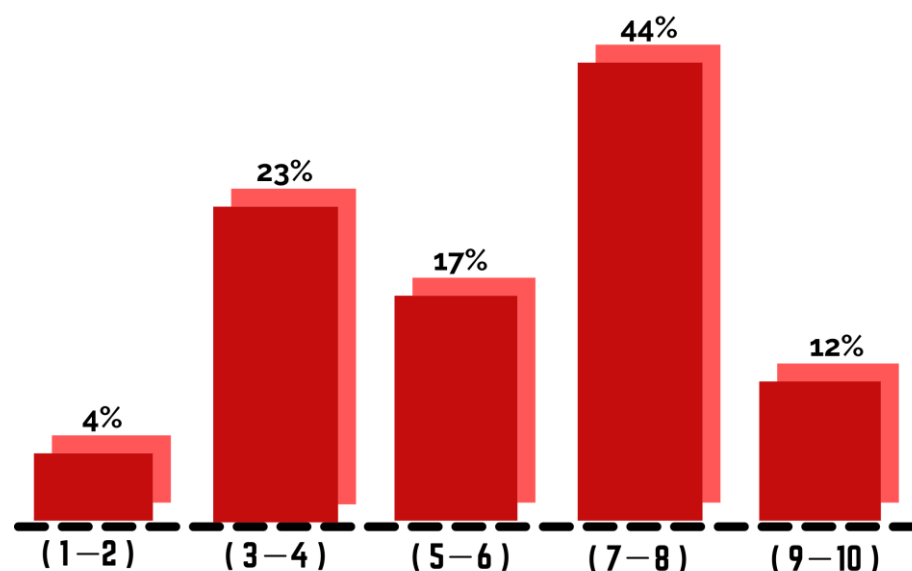


Figure 6. Table with the results obtained by the students in the formative evaluation activity integrated by the application of a 10-question questionnaire in Kahoot, in which the correct identification of the terms and etymological particles of the area of philosophy was verified.

The evaluation of this task was carried out with the help of a rubric (validated according to the statistical method show in Appendix B) that summarizes the aspects to be evaluated given in the lower part of Table 2. The writing exercise is an activity of superior cognitive complexity to the sole synthesis of acquired knowledge. In certain taxonomies [23], these cognitive processes fit within levels of analysis and application of knowledge. The paragraph must also be compatible with a specific context, contain a message in Spanish, and express a position regarding a given source of information. These elements make a complex intellectual activity that the student must carry out to demonstrate significant learning. If so, we could affirm that the state of flow is at least one of the elements necessary for meaningful learning to occur, verifying the study's initial hypothesis. The results of evaluating this production are shown in Table 3.

Table 3. Summative assessment's results. The formative sequence described in Table 2 was replicated in three different groups.

	At Least Five Greek Words Related to Philosophy Are Used	The Five Words Used Have a Meaning in the Spanish Language, According to RAE	The Five Words Are Used in a Good Grammatical Context, Sentences, or Phrases. These All Have a Meaning, Both Congruent and Coherent	Average Grade
Group 1 N ₁ = 29	93.60%	91.60%	92.40%	92.12%
Group 2 N ₂ = 29	95.20%	95%	94.40%	93.80%
Group 3 N ₁ = 21	90%	90%	89.75%	89.40%
All Groups	92.90%	92.20%	92.10%	91.77%

These grades were calculated taking in consideration only students submitted evidence. A proof of the validation of the rubric can be read in Appendix B.

As can be seen, all the indicators are, on a scale of 100 points, on average greater than 90 points. Without establishing the meaning of “good score”, we can affirm the good performance and the acquisition of significant learning (according to a standard method to evaluate) by the students when successfully solving problems that involve the use and application of knowledge in real contexts in which they are immersed.

Session two of the didactic approach discussed in this article aimed to apply a summative assessment activity that would allow recognizing and assessing in a concrete way the construction of learning objectives and the competencies that Greco-Latin etymologies contribute to development in the students. One of the core competencies the course is aimed at is developing written communication skills by learners. In this sense, the contribution made to this competence by knowing the Greek etymological roots that make up a considerable part of the Spanish-speaking vocabulary is invaluable and considerable.

It should be mentioned that although the subtopic that these reflections occupy is related to the Greek etymologies of the philosophical area, second-semester students have not had an approach to philosophy as such within high school studies. That is why the projection of an introductory video to the subject was used, seeking to make it accessible and easy to understand. In this sense, the students showed interest in its content and stated that they could address it. After the screening, relevant comments and contributions were made, showing understanding and curiosity about some of the topics covered in the video (the one related to ethical issues triggered particular interest).

The activity to be carried out consisted of writing a paragraph that evidenced the students’ written communication skills and competence. They had to show the handling of vocabulary terms that used Greek etymological particles related to philosophy. During the execution of the activity, a good state of attention and concentration could be perceived by most of the students. From the beginning, they expressed curiosity about the topics discussed in the video; the challenge of writing the paragraph was significant but never exceeded their skills to be completed. These three conditions (concentration, curiosity, and challenge) contribute to the feeling of enjoyment and, altogether, define a central state of flow. Then, it is possible to experience an OLE and, therefore, generate meaningful learning.

Beyond having focused on stages 14–16 or on a specific topic within a discipline, it is important to highlight that the implication [central state of flow] => [optimal learning experience] => [meaningful learning] has tremendous generality. Considering the pedagogical principles of concentration, curiosity, challenge, and enjoyment, the instructional design of the class notably favors school achievement and the construction of knowledge. On the other hand, the conceptual elements that characterize the phases of a training sequence are closely related to the type of educational applications that are likely to be used to sustain a central state of flow at each moment of the class. This entire teaching design and intervention process can only be regulated by reflection on educational practice, promoting teacher professionalization through the teaching construct in action. Whether in face-to-face or non-face-to-face classes, this grounded teaching exercise is crucial for improving and proper functioning of any teaching–learning process within formal educational spaces.

Flow states that lead to optimal learning experiences can be identified and measured through the perception of the individual who experiences them; this supposes an undeniable level of subjectivity in the data collected among the present study students. In this case, the fact that the teacher himself is the one who issues the final evaluations during and at the end of the course could influence the students’ bias when answering the survey (and rate the level of enjoyment of the class, for example). Intending to reduce these factors, the survey formulated was completely anonymous. Thus, each individual in the analyzed population was indistinguishable from another, taking into account the minimum indices of heterogeneity defined in the sample calculation. In addition, the survey carried out did not generate any repercussions on the contents, teaching or didactic strategies applied, class dynamics, exercises, activities, or its evaluation. In this way, the implemented experiment reduced the internal threats inherent to the study. On the other hand, the possibility of external threats generated by the selection of the sample is considerably limited when

segmenting the population into three groups of students composed exclusively of people located in the same age range, who study the same subject in the same educational system, level, grade, and institution. This also generates considerable homogeneity concerning the socioeconomic levels of the students, since the educational institution corresponds to the private sector.

7. Conclusions

This work determined a possible relationship between the so-called “optimal learning experience” (a concept inherited from flow theory in positive psychology) and meaningful learning within the new paradigm of distance education. Undoubtedly, one of the most demanding elements within this new pedagogy is achieving students’ concentration as a pivot to build effective, efficient, and meaningful learning. It is undeniable that the processes of resignification and adaptation to this educational paradigm represent an opportunity to innovate teaching intervention. This work shows that when students experience flow patterns, the construction of meaningful learning and the satisfactory resolution of an assigned task is favored. Even though under the proposed experimental design, it is not possible to abolish subjective biases inherent in an individual’s perception, objective systems support the results obtained for evaluating learning. In addition to the fact that the monitoring system of the central state of flow (curiosity, concentration, challenge, and enjoyment) in students has an elegant simplicity, it suggests a strategy for monitoring perceptions (not sensations) in real time that can be as sweeping or small as desired. In this way, this prototype experiment can be scaled to a massive sample of students (at different educational stages, if desired) that allow us to conjecture with a higher degree of reliability that students experience flow states during any session. The second part of our design validates the results from a classical perspective in education, namely, the validated methodologies to assess the development of competencies. Finally, the results of these methodologies are those that allow us to postulate the validity of the implication [(central state of flow) \Leftrightarrow (optimal learning experience)] \Rightarrow (construction of meaningful learning). According to the results of the implemented SLR, no similar experiments have been reported to validate this implication. Likewise, the present investigation conceptually links the categories shown in Table A1, which are regularly studied non-simultaneously, as shown in the references [24–38]. Therefore, we consider that this work has an added value to the understanding of the teaching intervention phenomena that have taken place in post-COVID distance education. Under this paradigm, this proposal does not explicitly reflect on how to achieve an adequate alignment between the curricular elements (needs, objectives, purposes, contents, competencies, educational intentions, and teaching style, among others) and the technological tools that make up the virtual ecosystem of teaching and learning. Despite this, thanks to the survey that was applied to teachers, we recognize that the theoretical–educational understanding around the formative sequence that dictates the dynamics of a class is characterized by a notable lack of clarity between the relationships that underlie the use of a technological tool and the ideal moment of its applicability within a specific didactic sequence. This lack of clarity within the analyzed teaching population is exacerbated at higher educational levels (university), so the experiment presented was at the baccalaureate level. However, the overwhelming updating of teachers that is the product of the quasi-instantaneous transition to the paradigm of distance education does not seem to have significantly impacted teachers at all levels. This contrasts a reflection around the understanding of the teaching professionalization processes of the teachers who develop in the training paths of greater specialization (postgraduate studies), which is a topic of discussion on the borders of pedagogical studies.

Author Contributions: The original idea for this work was conceived by M.G.D.d.L.-L. and J.M.O.-G. and its methodological design. S.S.-M. performed the validation of results and formal analysis. M.d.L.V.-S. carried out the bibliographic review and documentary research of this work. The preparation and writing of the original draft were proposed by S.S.-M., M.d.L.V.-S. and M.G.D.d.L.-L., which was revised and edited by J.M.O.-G. General supervision of the submitted work was vested in J.M.O.-G. All authors have read and accepted the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Tecnologico de Monterrey.

Acknowledgments: The authors would like to acknowledge the financial and technical support of Writing Lab, TecLabs, Tecnológico de Monterrey, Mexico, in this work. JMO-G thanks Miguel Ángel González-Ávila for his careful reading and suggestions for this manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

The present research seeks to verify that an optimal learning experience (OLE) can favor significant learning. If we consider that an OLE is that circumstance associated with feelings of curiosity, concentration, challenge, and enjoyment. It is evident that it is impossible to assign objective metrics to these feelings that determine a central state of flow. On the other hand, meaningful learning within competency-based teaching approaches has some well-known metrics of varying complexity. Such is the case of rubrics, rating scales, or checklists, which allow reporting on the achievement of learning within educational processes. In the new paradigm of distance education imposed by our current pandemic situation, the generation of flow states within technology-mediated learning environments depends more than ever on correct educational planning and, particularly, on the planning of teaching intervention. This implies the correct administration and use of technological tools to support the teaching–learning process in any of its categories.

Based on the conceptual categories of flow, optimal learning experience, meaningful learning, distance education, and educational planning, we established a Systematic Literature Review (SLR) to approximate the state of knowledge produced around the possible relationships between the categories mentioned before. The databases used, together with the results obtained from the search, are shown in Figure A1. Via the SLR, we established an analysis that led to obtaining an overview of the contributions reported around the relationship between the optimal learning experience and the generation of meaningful learning.

Alternatively, the implemented SLR started from the combination of keywords (which we have called conceptual categories) as the basis for identifying relevant works, instead of a research question itself. Once we concluded the search for articles that contained any of the possible search combinations, we evaluated the set of articles collected to synthesize the data and interpret the findings. The results of this SLR heuristic are shown in Table A1, where we have organized the information according to the conceptual categories already mentioned. The theoretical–conceptual findings clearly and objectively show the relationship between the conceptual categories, which we have highlighted as links of interest and importance with our research approach, as described in Section 4. Thus, we consider the central axis in this work to understand how it is possible to generate pertinent educational scenarios so that our students build meaningful learning within the distance education scheme. These scenarios should start from educational sequences pedagogically adapted to tools and technological applications that enable the generation of central flow states that favor said learning. Verifying this last assertion constitutes the central objective in this work.

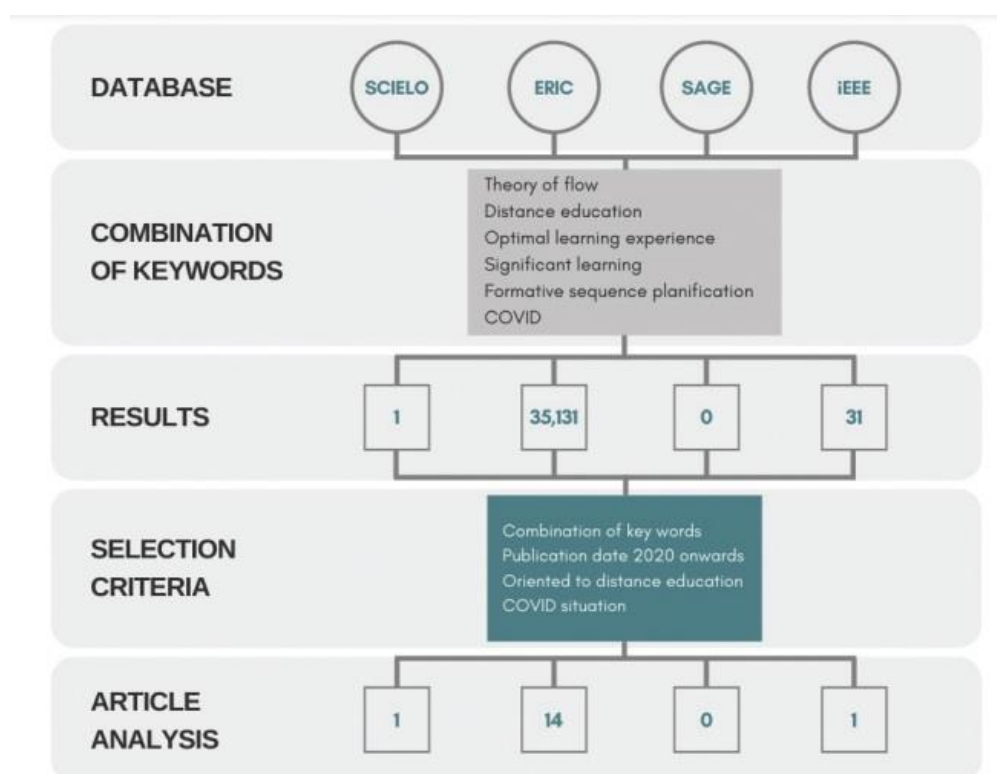


Figure A1. From a systematic literature review based on the educational databases SCIELO, ERIC, SAGE, and IEEE, we obtained a reduced set of 16 articles published since 2020, which report studies related to distance education, significant learning, and flow states in various school systems.

Table A1. Synthesis of the information collected in the SLR and the possible links with the present investigation.

Category	Findings
Flow [26,38] Link: the distance education format due to the corona health crisis complicates student flow states' achievement within the virtual teaching–learning process.	Flow is a psychological state that is predictive of subjective well-being and satisfaction with a subject's activities. The transition to distance education induced by the corona pandemic is characterized, to a large extent, by an absence of flow states due to underdeveloped learning independence, autonomy, and the frequent lack of internal motivation of students.
Optimal Learning Experience [26,27,29,30,32,33,35,38] Link: the readjustment of the learning environment to the virtual modality must always consider the needs of the students in such a way that it allows them to have a distance interaction with the teacher and their classmates while promoting trust in the continuous use of technological tools to support their learning.	A subject experiencing states of flux is characterized by absolute involvement in a particular activity that is highly gratifying. In school contexts, the teaching–learning process should promote positive developmental relationships characterized by coherence, emotional attachment, reciprocal interactions, and trust between subjects. This creates feelings of security, predictability, and trust within the learning environment that flow states make possible. To achieve this condition within the new paradigm of distance education, which prevents socialization and human contact, technological learning environments must promote active student participation and interaction with available technological resources. For this, it is important to consider and appeal to the affective perception of the student, assuming the challenge presented by the virtual relationship and non-face-to-face and immediate communication associated with states of isolation and depression. This imposes on the teacher the additional challenge of facilitating social and interpersonal interaction intentionally and in a virtual format. However, achieving an optimal learning experience entails in-depth teacher training in distance education methods and suitable technologies that promote appropriate interactions in a class.

Table A1. Cont.

Category	Findings
<p>Meaningful Learning [25,28,35–37]</p> <p>Link: the meaningful learning that occurs within the virtual learning environment depends, to a large extent, on adequate planning of technological resources and the alignment of these with the learning objectives. In this way, intentional and reflective planning should promote the student's active participation both with the technological resources and with the object of study.</p>	<p>When students are immersed in a session whose instructional basis is the game, they have greater participation in the knowledge and, as a result, they learn the objective content more effectively. This identified behavior could be used by faculty in distance education to improve student achievement goals and promote their development. Then, the learning process occurs through two channels: the content channel that falls on the planning of the distance session and the mediation channel that takes place in the technological learning space. This dynamic reveals a wide variety of learning behaviors, in which it would be necessary to understand, when is there evidence of learning? And followed by that, how can we help students find ways to overcome the current crisis shaken by the distance education format?</p>
<p>Formative sequence planification [24,26–30,33–35,37,38]</p> <p>Link: The administration and management of virtual learning objects must be correctly defined within the planning of the teaching intervention. A clear structure within its planning aligns the learning objectives and purposes with the technological resources used at specific moments of the pedagogical intervention. In addition to this, the teacher must have objective tools that allow him to account for his students' learning.</p>	<p>When clear thinking guides are offered, knowledge acquisition can be expedited regardless of the study area studied. To maximize the occurrences of flow in the classroom, the range of student's abilities and the favorable conditions to ensure their learning must be considered: learning environments and experiences designed to optimize their development, rich instructional experiences characterized by rigor, planned and personalized student-centered study, engaging instructional practices, and tiered support for content and skill acquisition. To do this, distance education courses must be planned and designed for a target group, using carefully selected online communication media and tools. These instructional tools require trained educators to be powerful and flexible to fully provide communication, collaboration, research, and information gathering capabilities. The main idea in a distance teaching and learning environment is to provide the teacher with professional pedagogical tools that help them when teaching in the learning space and thus enhance their role, placing them at the center of educational activity in the area of study. However, perhaps, the priority should have focused on achieving a curricular and content adaptation to a new educational scheme in a non-face-to-face mode. Teachers can develop appropriate learning materials according to the needs of the students. Thus, it is important to understand the relationship between institutional factors and preparation for online instruction, since both represent critical areas and factors in achieving success in any educational paradigm. However, due to the abrupt transition contracted by the health emergency, in terms of teacher training, many of the efforts were limited to informing teachers about using basic distance education tools and not training in the construction of the pedagogical skills that are necessary for a non-face-to-face educational paradigm.</p>
<p>Distance education [24,27,29,31,33–35,38]</p> <p>Link: It is essential to properly train the teacher in educational technologies that enable them to include in their class plan the technological tools that best correspond to the objectives and specific moments of the class.</p>	<p>Distance education is based on three fundamental elements: information and communication technologies, which allow its informative operation to be specified; learning and knowledge technologies stimulate technological literacy and meaningful learning; and technologies of empowerment and participation, which promote collaborative learning. Web-based learning and e-learning are the most used technologies for distance education and demand the following from the teacher: (i) efficiency in the management of technology, (ii) knowledge of the management of management systems and platforms online learning, (iii) being familiar with technological tools and (iv) being able to integrate class content in a multimedia format. Successful online instructors offer instructions that explicitly guide students in terms of where to go, what to do, and how to be successful at distance learning. In this way, the emergency generated by the pandemic only implied the possibility of presenting the curriculum (designed for a face-to-face modality) virtually through the use of technological tools. Distance education courses are usually planned, specially tailored for the target group, and use carefully selected online communication media and tools.</p>

Appendix B

The validity of the rubric is supported by the calculation of the coefficient known as Cronbach's alpha [39]. In this sense, what is being measured is an average of the correlations between pairs of items in the rubric. The expression that defines Cronbach's alpha is:

$$\alpha = kp/[1 + p(k - 1)] \quad (A1)$$

where k is the number of items and p is the average of correlations between pairs of items.

In this work, the rubric consisted of $k = 3$ items on a sample of 74 observations (total of students evaluated). Although the numerical demand is not excessive, we resorted to using the R software [39], which, employing the routine incorporated in the multilevel library, allows the numerical calculation of the parameter. For the data used in this work, we have a value of 0.9505. This last value implies that the average correlation between the items is very close to one, which means that the items have a very high correlation. If they were independent of each other, the value of the coefficient would tend to zero. Although indeed, the reliability of the calculation cannot be supported by a hypothesis test (as is the case with statistical parameters), it is empirically known that the closer this value is to 1, the items as a whole properly evaluate the objectives of teaching that are scattered across the rubric criteria. Typically, the value should be of the order of 0.8; in our case, 0.9505 allows us to conclude the validity of the rubric. In other words, the rubric is reliable and allows us to ensure that the learning it evaluates is significant within the limits of the parameter.

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