

Strategies for meaningful learning in higher education

José G. Vargas-Hernández^{1,*}, Omar C. Vargas-González²

¹Instituto Tecnológico Mario Molina, Mexico

²Instituto Tecnológico Nacional de México, Mexico

Abstract: This work aims to analyze and explain the didactic strategies used to achieve meaningful learning. The problem addressed here is the need to change traditional didactic teaching in higher education programs toward more meaningful learning-oriented approaches. It begins under the assumption that meaningful learning is created if students are given freedom and confidence, they can find their own answers and developing their knowledge, both in the classroom and in practical life. The method used is the analytical-descriptive one of the reviews of the literature of the main authors who have given rise to this approach, its elements and the didactic strategies used. The result of the analysis shows the need to move from traditional didactic teaching in higher education programs toward more meaningful learning-oriented strategies. It is concluded that the design and implementation of didactic strategies focused on meaningful learning with the application of active didactic methodologies and strategies in meaningful learning processes depending on the context in which it takes place, obtains better results in the training of professionals. It is recommended that teaching in higher education should abandon traditional didactics and embrace more meaningful oriented teaching strategies.

Keywords: Meaningful learning, active learning, teaching strategies

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Abstrak: Karya ini bertujuan untuk menganalisis dan menjelaskan strategi didaktis yang digunakan untuk mencapai pembelajaran yang bermakna. Masalah yang dibahas di sini adalah kebutuhan untuk mengubah pengajaran didaktik tradisional dalam program pendidikan tinggi menuju pendekatan berorientasi pembelajaran yang lebih bermakna. Dimulai dengan asumsi bahwa pembelajaran bermakna tercipta jika siswa diberi kebebasan dan kepercayaan diri, mereka dapat menemukan jawaban mereka sendiri dan mengembangkan pengetahuan mereka, baik di kelas maupun dalam kehidupan praktis. Metode yang digunakan adalah analitis-deskriptif salah satu tinjauan literatur dari penulis utama yang telah memunculkan pendekatan ini, unsur-unsurnya dan strategi didaktik yang digunakan. Hasil analisis menunjukkan kebutuhan untuk beralih dari pengajaran didaktik tradisional di program pendidikan tinggi menuju strategi berorientasi pembelajaran yang lebih bermakna. Disimpulkan bahwa desain dan implementasi strategi didaktik yang berfokus pada pembelajaran bermakna dengan penerapan metodologi dan strategi didaktik aktif dalam proses pembelajaran yang bermakna tergantung pada konteks di mana hal itu terjadi, memperoleh hasil yang lebih baik dalam pelatihan profesional. Direkomendasikan bahwa pengajaran di pendidikan tinggi harus meninggalkan didaktik tradisional dan merangkul strategi pengajaran yang berorientasi lebih bermakna.

Kata Kunci: Pembelajaran bermakna, pembelajaran aktif, strategi mengajar

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*Corresponding author: jvargas2006@gmail.com

INTRODUCTION

Changes in the historical evolutionary process of education are relevant factors that influence the economic, social, political, and environmental development of peoples. In the evolution of educational models, the constant is the characterization of the need to give meaning to values and attitudes that guide the generation and development of ideas, projects, strategies, and programs that allow the reproduction and preservation of the material and social conditions that they facilitate the contemplation and incorporation of the human being to his concrete reality from a comprehensive perspective of inclusive and meaningful learning.

The dynamic forms and processes of learning have undergone transformations over time at the service of human development (Apodaca-Orozco et al., 2017) that have resulted in significant learning advances that attribute responsibilities in a shared way for the achievement of goals based on the self-care of people and with a clear tendency of protagonist recognition of the beneficiaries of these processes (Lillo, 2014). The rote learning of disciplinary concepts with traditional approaches have been exceeded by the expectations that students have, and the demands made by the economic, labor, social, political, cultural reality, etc.

The methodological approaches that support the didactic strategies applied in learning have always been under the traditional approaches to teaching as absolute models in university systems, which, to be implemented, repress culture, language, history, traditions, customs, and the practices of the peoples. These types of learning have not been significant because there is no correspondence with the cultural traits of the peoples (Arnold & Yapita, 2000). Some of the strategies for meaningful learning are the practice testing, distributed brainstorming, practice interleaved practice elaborative interrogation and self-explanation etc.

Over time, the development of higher education has been perfected in all fields of knowledge, but mainly in health, with the implementation of curricular reforms based on pedagogy and science related to education that are necessary and indispensable to confront the paradigms. In meaningful learning, different paradigms are presented because the teacher goes from being the person in charge and protagonist of the students' learning to whom their process is planned and organized in the form of self-regulation so that they choose and decide on their behavior, as promoters and architects of their own learning (Garrote Rojas et al., 2016). Through essential changes in study plans and programs, progress is made in achieving curricular flexibility, meaningful learning, the incorporation of new ethical values and new technologies (Vergara et al., 2014).

The different pedagogical and didactic models are relevant to the extent that they promote a vision in which the student is considered the center of active and meaningful learning (Espejo Leupin, 2016). There are various models of meaningful learning that make use of creative learning, and these models specify all different kinds of learning approaches that include students in meaningful teaching and learning processes (Bonwell & Eison, 1991). For meaningful learning to be guaranteed with the significant results of the experiences that students have that requires their motivations, interests, and actions as a subject with their own content, a permanent relationship with the content of previous knowledge and the link with new knowledge in their environment connected with local problems and global trends, in such a way that opportunities and solutions to problems are

identified (Beck et al., 2015). Part of the meaningful learning experiences are the involvement of students in discursive and disciplinary activities instead of just being receptive (Almulla, 2020).

There are few studies focused on strengthening the training processes of teachers, to improve the teaching-learning processes through the design and implementation of didactic strategies in environments focused on meaningful learning. In this work, the objective of which is to analyze and explain the didactic strategies used to achieve significant learning, first a conceptualization is carried out and then the elements or components are analyzed and finally a detailed analysis is made in the delimitation and design of the didactic strategies that are implemented for the achievement of the best results in meaningful learning.

CONCEPTUALIZATION

Meaningful learning is a strategy for the implementation of teaching-learning processes based on the reality of practice that promotes student autonomy to achieve the maximum result. Quality education implies prioritizing the understanding and use of new learning content based on the reality of the context (Galdames et al., 2011). Knowledge and experiences that are identified and related to community activities such as actions, images and use of objects that help to develop meanings and concepts, contribute to generating significant learning (Julca, 2000).

Non-arbitrary substantive integration of new ideas, propositions, and information into the non-arbitrary cognitive framework is characterized as "meaningful learning" under this definition. Meaningful learning goes beyond the realm of cognition, due to contextualization supported by the possibilities of sharing meaning. The meaningful learning design has as specification the significance of learning with the creation of cognitive-constructivist conceptual activities based on real-live problems of the students and using the natural world as a learning resource (Suyatno, 2009). The meaningful learning process implies that the learner understands the meanings of the new learning content, connecting with the new concepts and propositions, expanding, reorganizing, and reconstructing the existing cognitive structure (Ausubel, 1963; Ausubel et al., 1978).

Meaningful learning is described as learning that has the purpose of building knowledge based on students' experiences, feelings, and interactions with other students (Friesen & Scott, 2013; Rumalolas et al., 2021). Deep meaningful learning is of a high level of thought and development that is carried out through intellectual involvement in questioning, critical thinking, problem solving and metacognitive skills that are oriented to the construction of meanings through patterns of recognition and association concepts (Mystakidis, 2019; Pambudi et al., 2022).

The idea of meaningful learning is aligned with constructivism, which asserts that students should develop their knowledge through their experiences and should do so by drawing meaningful connections between new experiences and stuff they have previously gained. Students use what they already know to discover new ideas and concepts, as well as to find solutions to issues, and they transfer the information they've gained to new settings and challenges. Students make real progress in their education when they connect

newly acquired information to prior knowledge. It is a process that involves linking newly acquired information to ideas that are already present in the cognitive framework (Dahar, 2011). For meaningful learning to occur, new concepts must be integrated into the existing knowledge structure, connecting existing concepts with the new knowledge (Bao & Koenig, 2019; Fletcher & Ní Chróinín, 2021).

Humanistic constructivism is the learning theory and philosophy that supports meaningful learning. Constructivism, which is a blend of human learning psychology and knowledge production epistemology, has a stronger integration with the idea of meaningful learning than any other educational philosophy (Mintzes & Wandersee, 2000; Novak, 1993). Meaningful learning is a process for the acquisition of new meaning, and the cognitive learning theory serves as the foundation for establishing meaningful learning as a process. This theory also assumes a collection of instruments possibly for meaningful learning assignments. (Ausubel, 1968).

To be meaningful, the content to be studied is assimilated and related to the previously acquired knowledge, which is why it is a process that is associated with the new information in relevant concepts contained in the cognitive structure and connects them to produce the understanding of the environment. Students must understand the situation to solve the problem in a way that is meaningful to them (Ausubel, 1968; Sriraman, 2010). Meaningful learning is achieved with the theoretical-practical aspects can carry out simultaneously. Meaningful learning provides skills to be creative and innovative. Students have access to knowledge, skills, and attitudes to solve problems. For teachers, understanding meaningful learning is valuable to apply to all levels of education.

As a theory, meaningful learning accommodates the demand for teaching-learning processes achieved through the application of knowledge in authentic contexts. Meaningful learning is tied to the acquisition of contextual knowledge, which is supported by events and challenges. It is necessary to make connections between what is being learned and the issues that are occurring in the situation. In order for students to find a solution that will result in meaningful learning, it is necessary for them to comprehend the circumstance (Sriraman, 2010). Therefore, having activities, creativity and innovation are relevant factors to create meaningful learning outcomes. The assimilation of learning theory describes meaningful learning as the integration of new information or ideas into the cognitive structure's hierarchical frame of reference (Ausubel, 1963, 1968). Student learning must be a meaningful assimilation, with potentially significant materials and content, with logical meanings relevant to the cognitive structure and where the main objective is to have the intention to learn meaningfully.

The concept of meaningful learning is polysemic and inserted in the socio-cultural reality and with a future perspective proposed by the same society. This conception of meaningful learning is related to the educational practices of the teaching-learning processes that have migrated from approaches that focus on transmitting disciplinary theoretical knowledge to more dynamic practices where the student adopts a more autonomous role of meaningful learning. The construction of meaningful learning is the mark of higher education achieved through sustained critical discourse (Ausubel, 1961) linked with teaching methods that result in the ability to identify and analyze the structure to connect existing concepts with new ones (Jonassen, 2003; Mystakidis et al., 2019).

Ausubel developed the theory of cognitive psychology as a branch of psychology to include scientific research on mental phenomena in the acquisition of knowledge by means of humans acquiring knowledge, the way in which new information is assimilated and assumes that the knowledge is the product of human construction. If students connect information with the knowledge they already have, they get a meaningful learning which turns out to have many advantages over learning by heart. That's why it's possible for students to learn in several ways: from memorizing facts and identifying, selecting, and learning from the discoveries themselves (Novak & Gowin, 2006). There is no homogeneous, uniform approach to teaching and learning that has been nurtured with complementary theories and their applications that provide a rationale for the promotion of academic and social skills that contribute to meaningful learning, such as the development of social cooperation and communication (Sharan, 2015). Hanani, (2020) explores the meaningful learning of the millennial generation that provides students with the formation of creative, critical, and innovative thinking skills and that can be achieved by various methods, including collaborative and active learning, problem-based learning, cooperative learning, etc.

Meaningful learning for millennials is a process that adds experiences through their problems contained in their environments that makes students understand and relate the content according to Gowin, (1990) the process is significant when there is interaction between students, educators and content that enables understanding of learning by sharing meanings. Meaningful learning is the interaction of students, educators, and content with innovative concepts and without eliminating scientific values (Moreira, 2011). Meaningful learning prepares millennials to respond appropriately to the competition of the information age. Meaningful teaching-learning processes encourage the student to compare the new knowledge they acquire with that previously acquired and support students in the construction of personal knowledge structures Wang et al., 2014). The quality and quantity of the student's previous knowledge allows different types of associations to be made with the new content, which gives rise to different levels of meaningful learning (Wang et al., 2020).

The concept of meaningful learning varies among students who can understand what is learned in daily experiences and teachers use different contexts such as activation, connection to reality and the creation of intercultural contexts to apply the learning contents in the school. Teachers have different concepts of meaningful learning that can be inspired by the educational aligned with theoretical notions to create the contexts and environments establishing the objectives for or with their students, even though their practices are not always clearly linked to the concepts and theories, so it is not possible to find consistent patterns. Meaningful learning takes place in contexts that are recognized to create learning environments in which students can interact (Lui & Bonner, 2016; Bert Van Oers, 1998; Verschaffel & Greer, 2014). Practices such as dialogue, collaboration, independent work, and experiential learning support meaningful learning (Polman et al., 2021). Collaborative processing promotes meaningful learning because the student understands the meaning of each concept and discovers its similarities, dependencies, and contrasts.

Cultural and social assumptions about the nature of responsible learning imply that students authentically participate in the activities of the teaching-learning process (Hammer et al., 2012). The assumption that learning takes place in meaningful learning environments considers that students' motivation and understanding is shared by different theoretical approaches to meaningful learning (Loyens & Gijbels, 2008; Mayer, 2004; Wardekker et al., 2012). Meaningful learning is created under the assumption that, if students are given freedom and confidence, they can find their own answers and develop their knowledge, both in the classroom and in practical life.

Meaningful learning is a characteristic of education (Oostdam et al., 2007), but little is known what teachers do to achieve it in their students, how they interpret and establish it depending on their personal points of view, but it is also reflected of the educational concept that creates meaningful learning environments in accordance with its pedagogical concept and philosophy. This develops the context to create meaningful learning environments. The concept of meaningful learning has different meanings in practice. In relation to the teaching-learning processes, this goes beyond the mere application of knowledge and practice within a context that gives meaning to students, but little is known about teachers what practices they do in their meaningful learning process for the students. Teachers have different perceptions of what is meaningful learning based on different theoretical-conceptual notions and pedagogical practices that contribute and with varied objectives depending on what students understand that must be learned creating an oriented inter-curricular context.

The inclusive concepts are entities of the cognitive structure that allow meaningful learning with new elements that form categories through systems of representation of reality that integrate knowledge into the structure of the subject (Ausubel, 1968). The model of human cognitive architecture based on the theory of cognitive load of instruction in an intrinsic, extrinsic, and pertinent way of the elements of interactive information and the time required for meaningful learning (Romero Juárez, 2020). The notion that emphasizes the cognitive processes by which students incorporate knowledge into their existing knowledge structures is meaningful learning, despite the context to be performed, cognitive, socio-constructivist and sociocultural learning theories differ in the types of context meanings emerging. The cognitive approach emphasizes the existence of a cognitive structure in which the learner learns, meaning that meaningful learning emerges in the context of what he already knows, in such a way that teachers need to prepare the environment in such a way that it offers relationships to the structures. preexisting cognitive structures that are used as anchors to deliver new content in the cognitive structure (Ausubel, 1968).

In socio-constructivist approaches they emphasize social interaction, communication, and collaboration to create meaningful learning contexts (Roelofs et al., 2003). Sociocultural approaches define social learning as the participation of students in social practices (Bert Van Oers, 1998), rather than in contexts focused on tasks in solving specific problems but in participation in social practices (Volman & Ten Dam, 2015). The teacher enables significant learning in his students by producing relationships between

previous organizers that, as cognitive bridges, establish inclusive concepts and new materials organized so that relationships with prior knowledge and what should be learned are produced. Machine learning is different from meaningful learning because it only involves memorization by repetition without recognition of meaning and little contributes to modifying the cognitive structure of students, who have different backgrounds of prior knowledge, in quality and quantity to make associations between the old and new knowledge giving rise to the occurrence of different levels of meaningful learning (Novak, 1993).

Meaningful learning makes it possible to solve the challenges of the environment with the recognition of a new world order by the new generations that demand quality education and pedagogical innovation, training spaces, didactics, curricular content, evaluation, teacher training, etc. (Vincent-Lancrin et al., 2019). The promotion of inclusive education in the entire academic community must be done from a participation of meaningful learning, close to the integral quality approaches of the educational system that is valued by society as a right in relation to people and the type of society that you want to achieve (Santiago, 2007). Inclusive education requires a conceptual resignification of creation and development of common learning spaces delimited by special conditions under models of teaching and evaluation of significant learning, from humanistic perspectives that respond to the socio-cultural historical complexity to train quality students, capable of develop all their human potential, which remains and culminates in their training (Rosano, 2007).

Meaningful learning is globalizing learning, which relates through knowledge construction schemes, sequence the use of previous learning to provoke the significant generation of knowledge. For meaningful learning, the conditions must be met that the curricular contents of studies lead to meaningful learning based on psych pedagogical bases and that the student has interest and an attitude of motivation for the attitudes, abilities, skills, competencies, and capacities of the subject. that learns. Compliance with the acquisition of significant learning corresponds to the development of analysis and synthesis skills and abilities. Constructivism is a theoretical current that considers knowledge as an active process of transformation of the human being that is integrated into their own structures of knowledge (Aznar, 1992) in an emotional-affective and semantic that give meaning to learning.

ELEMENTS OF MEANINGFUL LEARNING

Among the elements of the construction of an inclusive education with significant learning is the sensitization of the actors directly more involved in the teaching-learning processes, teachers, and students, who carry out the substantive functions of teaching, research and socio-economic projection validated by the results (Arizabaleta & Ochoa, 2016). Teachers have new roles as facilitators, advisers, and administrators rather than as teachers. The teacher is conceived as a learner in the process of their own training with the support of historical-cultural components and content that are essential to promote meaningful learning. Create and maintain learning environments that involve students in meaningful learning activities that have social presence, learning presence and cognitive

presence as components (Arbaugh, 2013; Joksimovic et al., 2014; Thomas et al., 2017; Valverde-Berrocoso et al., 2020; Zhan & Mei, 2013).

The role of the teacher is to adapt the teaching-learning processes to the educational profile of the students to empower their will and action in the generation of meaningful learning. In the meaningful teaching-learning process, the teacher ceases to be the protagonist and responsible according to the behaviorist theory to become the planner and organizer of the work of his students, whom he must motivate in their interest in the subject.

Meaningful learning uses processes of organization, elaboration, and introduces critical concepts and principles of content. Learning experiences that use thinking skills with prior structures have been associated with deep understanding of content and long-term retention of meaningful learning (Kay & Kibble, 2016). Transformative learning implies the construction of learning processes through meaningful, integrative, and democratic interaction and active involvement in the construction of meaningful knowledge processes that facilitate positive attitudes and skills. The meaningful learning process is facilitated with collaborative, interactive, investigative, and high-level thinking activities (Tsimane & Downing, 2020).

Teachers who offer meaningful learning experiences to their students consider constructive, active, intentional, cooperative, authentic, and relational as attributes for their design (Howland et al., 2011; Mystakidis, 2019). Meaningful learning requires tasks linked to authentic experiences. It is cooperative and relational because they occur naturally in knowledge-building communities, emotionally involving learners in designs that link theory and practice with experiences where teachers and students express themselves (Kostiainen et al., 2018).

The cultural identity of the teacher in her community is inherent because it is the mediator between the knowledge, knowledge, traditions, and customs that are integrated with the new knowledge to generate meaningful and quality learning. Cultures have a large amount of knowledge, know-how, experiences and practices on certain trades and issues that can be used in the socio-intercultural teaching-learning processes for the development of community identity and meaningful learning. The committed teacher is always up to date with new knowledge in all fields of human knowledge.

The teacher is responsible for the development of his class, the maker of pedagogical knowledge and his own teaching practice; his professional academic training must promote critical, reflective, and innovative teaching-learning processes for meaningful learning in students (Araujo & Campos, 2006). Greater involvement in reflecting on the relationships between knowledge concepts increases the meaningful learning generation (Nesbit & Adesope, 2013).

Responsibility for the complex functions of the teacher requires more than the simple transmission of information, the use of affective and cognitive processes that contribute to the meaningful learning of students. The teacher must have the ability to integrate technology, pedagogy, and disciplinary content, to build knowledge and facilitate meaningful learning. These activities contribute to self-assessment processes to

identify the appropriation of new knowledge and changes in skills as strategies for evaluating the meaningful teaching-learning process, to improve (Delgado García & Oliver Cuello, 2009). This model aims to make the student competent with capacities to face current demands with the acquisition of significant knowledge in accordance with the different contexts in which they will have their professional development. The use of capacities based on multiple intelligences with an axiological approach contributes to the development of meaningful learning.

Motivation and learning attitude are two factors to consider in creating meaningful learning. Making learning meaningful improves students' motivation to learn. Meaningful learning improves student motivation and achievement (van Rijk et al., 2017). Evaluative judgments of self-efficacy such as capacity to perform a function demonstrate significant changes in learning and self-efficacy after instruction. Pedagogical and didactic interventions that are more connected to the individual needs of students have a greater chance of achieving better performance in meaningful learning.

Meaningful learning environments relate students' needs and interests to their learning and make their experience worthwhile beyond school (Roelofs & Terwel, 1999; Van Oers, 2009). The operational and differentiated educational planning allows the extrapolation in different dimensions of the realization of didactic activities with significant learning proposed in the study program with the vision of turning them into innovative, creative, and fair actors. Selecting the topic by coupling the contents to the socioeconomic context and establishing the learning objectives of knowledge, attitudes, skills, and capacities that one wishes to develop, are necessary elements for a more meaningful learning. The essential elements for the meaningful learning of a specific topic are its multidimensional reality, its historical-cultural background, its socioeconomic environment, characteristics, approaches, values, principles, material, and didactic strategies, etc.

Knowledge of a broad vocabulary by teachers and students facilitates the understanding of readings, learning materials, communications in the classroom, and promotes meaningful learning (Pun & Jin, 2021). The experience that results from the need to learn to review academic works provides the opportunity for teachers and students about the characteristics of effective writing as meaningful instructional learning (Chen et al., 2021). The command of the language used in the teaching-learning processes is critical to conduct oneself in academic activities and achieve good performance in meaningful learning, and cognitive differences should be considered based on individual characteristics and differences, such as gender (Chen et al., 2019). In classes, teachers put into practice active and participatory methodologies for students to reflect and use the knowledge learned as knowledge-generating subjects through meaningful learning. Thus, the variables that most influence the generation of meaningful knowledge are the role of the teacher and practical activities.

The correct use of technological tools and knowledge of active methodologies allow the construction and consolidation of meaningful learning, such as problem-based learning, the flipped classroom and case studies, among other methodologies. For example, teachers must demonstrate a broad conceptual mastery of the flipped classroom, its implementation

process in the classroom, accompanying students in the different stages of the teaching-learning process, considering that the student is the protagonist of the educational model.

DIDACTIC STRATEGIES FOR MEANINGFUL LEARNING

Teachers introduce learning strategies in accordance with instructional objectives for the achievement of meaningful learning. The stimulation, motivation, development, and promotion of academic and scientific activities at an early age, based on a diagnosis, the interventions and participation of teachers are determined, and didactic strategies are formulated to strengthen meaningful learning in research. The participation and interventions of teachers in the activities of the teaching-learning process through didactic strategies must be aimed at achieving meaningful learning. The meaningful learning approach requires a teacher who, beyond the traditional approach, uses the most proactive, creative, and innovative teaching strategies, ethically committed in his or her guiding performance that assumes changes in the environment, understands reality and visualizes the challenges of opportunities. In this way, the implementation of innovative didactic strategies that transform pedagogical and didactic practices aimed at building meaningful learning is relevant.

Different teaching strategies can be used to increase the quality of teaching-learning processes with significant results. The didactic material to be used in the strategies of a meaningful teaching-learning process must motivate considering the learning styles, the aesthetics of the design, the style, the purpose of the communication (Valverde-Berrocoso et al., 2020). The contents of the subjects that students consider complex require, in addition to mastery of the subject, the training of teachers in educational strategies that aim to promote meaningful learning to effectively transmit knowledge. The interaction in collective works as a didactic strategy between people who are the same facilitates the construction and the natural acquisition of knowledge, abilities and skills that give rise to meaningful learning. The blended and blended learning model is a strategy that provides students with opportunities that help them obtain deeper and more complex levels of meaningful learning (Patrick & Sturgis, 2015; Şentürk, 2021).

The design of virtual education didactic strategies with B-learning modality tools to strengthen meaningful learning with the support of active learning methods in training close to the reality of practice and with an increase in student autonomy. Virtual education with the use of information and communication technologies facilitates the use of tools in the educational process that favor the development of meaningful learning (Guerrero Castañeda et al., 2019). Information and communication technologies as part of a didactic strategy have a positive impact on meaningful teaching-learning processes where the more the use of ICTs is used in learning, the better the learning results of the students (Al-Ansi et al., 2019). The development of skills and knowledge of didactic strategies to be implemented through information and communication technologies through communication platforms is essential for students to achieve meaningful learning (Aladesusi & Akindiya, 2021; Flores et al., 2020). Interactive learning activities (Wu et al., 2017) as didactic strategies contribute to improving meaningful teaching-learning processes with the development of skills through the creation of online learning communities from home and with the practice of authentic tasks in face-to-face sessions, discussion groups, presentations and with direct questions to the instructor online.

Some of the strategies for meaningful learning are the practice testing, distributed brainstorming, practice interleaved, practice elaborative interrogation and self-explanation etc. The practice testing is an informal examination that is taken as preparation for an actual or formal examination. A distributed brainstorming is a meeting conducted by users at different locations using an Internet-connected system. Interleaving is a technique to facilitate learning that involves mixing different topics or forms of practice. The elaborative interrogation and self-explanation enhance learning by integrating in learning new information with existing prior knowledge, connecting learning material to other concepts, experiences, memories, explaining and describing concepts in greater detail. The acquisition of methodologies and didactics for the creation of e-learning and blended learning (b-learning) strategies, facilitate the generation of virtual learning modalities that allow metacognition and meaningful learning. The use of augmented reality and neuro-didactics as recreational tools allow the design and optimization of the use of didactic strategies for significant learning processes through brain and sensory stimulation of emotions and imagination, which affect meaningful learning from a motivating perspective.

Meaningful learning, reception and discovery environments, and individual differences influence prior knowledge on learning effectiveness. The environment integrates discovery learning to encourage active engagement in meaningful learning. Using a framework of the meaningful learning environment using a machine-guided ontology, Wang et al., (2017) develop a visualization support system that helps the e-book user to identify and understand the concepts and relate them to their cognitive structure, which results in a better environment for receiving meaningful learning. In the receiving learning environment, relationships are explicitly provided on the map for transmission to the student, while, in the discovery learning environment type, relationships between knowledge are identified student autonomy (Ausubel et al., 1978). To encourage meaningful learning, cognitive maps and connections help students organize and structure their own frames of reference (Novak & Cañas, 2008).

In the meaningful learning environment, conceptual maps, knowledge, and knowledge topics are provided to the student so that they associate the content elements, definitions, and explanations of knowledge, with the provided structure (Chu et al., 2011; Lee & Segev, 2012; Obielodan et al., 2021). Concept maps are an effective learning tool and because it provides an additional resource to make it meaningful, it allows feedback to students and offers a means of evaluating the performance of meaningful learning (Baliga et al., 2021; Daley & Torre, 2010). The development of foreign language skills in the inverted room, the group of students working with the platform including the learning strategies, contribute to the achievement of cognitive learning results, obtain more significant learning in grammar, speaking, reading, and writing. In the same way, Kostaris et al., (2017) have revealed that meaningful learning in the inverted room contributes to greater involvement and motivation in information and communication. Self-regulated meaningful learning strategies affect the performance of abilities, skills, and abilities in favor of groups working in the inverted room model (Öztürk & Çakıroğlu, 2021).

However, the research results are not conclusive in terms of improving students' meaningful learning in such a way that allows them better knowledge and autonomy in their professional training, although it was shown that in virtual education, as much or more is

learned than in the traditional way. In virtual learning, students do not always have prior experience, but it is more effective than with traditional learning. The achievement of meaningful learning depends on the student's experience in the use of virtuality after carrying out training activities in any type of technological tool. In contrast, other research results show that students have learning difficulties to achieve meaning in computer courses taught under the inverted room strategy compared to traditional methods, due to time constraints and that they soon become angry (Cabi, 2018).

Active engagement prevents the degradation of interest and readiness to investigate, as in the meaningful intake learning environment, which also acts as an evaluation tool that promotes the development of learning via the use of meaningful learning strategies. The broad connections made between learning tasks, instruction, and assessment feedback support students in achieving meaningful learning. Connective feedback helps students navigate through blended and blended learning that connects new learning tasks and different instructional modules that helps make sense of assessment results (Wang et al., 2021)

CONCLUSION

Traditional learning styles centered on the teacher and through memorization are only replaced by meaningful learning that focuses more on student participation. The application of active didactic methodologies and strategies that achieve the implementation of significant learning processes depending on the context in which it takes place, obtains better results in the training of professionals. It is in this sense that no didactic method and strategy is adequate for all contexts. For example, case studies in which students analyze specific situations presented to arrive at an experiential conceptualization and find effective solutions, allows content and learning to be more meaningful.

The results of academic performance as indicators of the significant learning achieved by students in virtual environments are favorable even though they are not always optimal due to multiple factors. The generation of meaningful teaching-learning processes is subject to the complexity of the subject, to the design of the virtual didactic strategy. The advantages of meaningful learning design are that it eliminates the tendency to passive learning because students organize their learning activities, improves collaboration in the group, working together to stimulate the ability to think and the ability to understand the content.

The results of research on the impact of information and communication technologies on meaningful learning are not entirely conclusive, although it has been shown that, in virtual learning, although students do not have previous experiences and knowledge, they achieve greater effectiveness than with the traditional learning system. The student's previous experience and knowledge about the use of virtual education is related to their meaningful learning.

Questions are being opened to carry out future lines of research on the cognitive capacities of recovery, understanding, analysis and application of knowledge (Marzano & Kendall, 2007) should be applied for each specific competence and to assess the profile of the teacher in the achievement of meaningful learning. In future research on

meaningful learning, conceptualization must consider the diversity of practices with which teachers attempt to create environments.

REFERENCES

- Al-Ansi, A. M., Suprayogo, I., & Abidin, M. (2019). Impact of Information and Communication Technology (ICT) on Different Settings of Learning Process in Developing Countries. *Science and Technology*, 9(2), 19–28. <https://doi.org/10.5923/j.scit.20190902.01>
- Aladesusi, G. A., & Akindiya, F. O. (2021). Development and evaluation of an instructional LiveBinders for learning selected computer studies concept in Ilorin Metropolis. *Journal of Research in Instructional*, 1(2), 109–122. <https://doi.org/10.30862/jri.v1i2.13>
- Almulla, M. A. (2020). The Effectiveness of the Project-Based Learning (PBL) Approach as a Way to Engage Students in Learning. *SAGE Open*, 10(3). <https://doi.org/10.1177/2158244020938702>
- Apodaca-Orozco, G. U. G., Ortega-Pipper, L. P., Verdugo-Blanco, L. E., & y Reyes-Barribas, L. E. (2017). Modelos educativos: un reto para la educación en salud. *Ra Ximhai*, 13(2), 77–86. <https://www.redalyc.org/pdf/461/46154510006.pdf>
- Araujo, M., & Campos, M. (2006). La praxis pedagógica en la educación física y los estilos de enseñanza predominantes en los docentes de educación básica. *Educare*, 10(3), 1–32. <https://revistas.upel.edu.ve/index.php/educare/article/view/144>
- Arbaugh, J. B. (2013). Does academic discipline moderate CoI-course outcomes relationships in online MBA courses? *The Internet and Higher Education*, 17, 16–28. <https://doi.org/10.1016/j.iheduc.2012.10.002>
- Arizabaleta, S. L., & Ochoa, A. F. (2016). Hacia una educación superior inclusiva en Colombia. *Pedagogía y Saberes*, 45, 41–52.
- Arnold, D. Y., & Yapita, J. D. (2000). *El rincón de las cabezas: Luchas textuales, educacion y Tierras en los Andes*. Instituto de Lengua y Cultura Aymara IICA.
- Ausubel, D. P. (1963). *The psychology of meaningful verbal learning*. Grune & Stratton.
- Ausubel, D. P. (1968). *Educational psychology: A cognitive view*. Rinehart and Winston, Inc.
- Ausubel, D. P., Novak, J. D., & Hanesian, H. (1978). *Educational Psychology: A Cognitive View (2nd ed.)*. Holt, Rinehart & Winston.
- Ausubel, DAVID P. (1961). In defense of verbal learning. *Educational Theory*, 11(1), 15–25. <https://doi.org/10.1111/j.1741-5446.1961.tb00038.x>
- Aznar, P. (1992). *Constructivismo y educación*. Tirant lo Blanch.
- Baliga, S., Walvekar, P., & Mahantshetti, G. (2021). Concept map as a teaching and learning tool for medical students. *Journal of Education and Health Promotion*, 10(1), 35. https://doi.org/10.4103/jehp.jehp_146_20
- Bao, L., & Koenig, K. (2019). Physics education research for 21st century learning. *Disciplinary and Interdisciplinary Science Education Research*, 1(1), 2. <https://doi.org/10.1186/s43031-019-0007-8>
- Beck, E. E., Solbrekke, T. D., Sutphen, M., & Fremstad, E. (2015). When mere knowledge is not enough: the potential of bildung as self-determination, co-determination and solidarity. *Higher Education Research & Development*, 34(3), 445–457. <https://doi.org/10.1080/07294360.2014.973373>
- Bonwell, C. C., & Eison, J. A. (1991). *Active Learning: Creating excitement in the classroom*.

- ASHEERIC Higher Education Report, 1(1).
<https://files.eric.ed.gov/fulltext/ED336049.pdf>
- Cabi, E. (2018). The Impact of the Flipped Classroom Model on Students' Academic Achievement. *The International Review of Research in Open and Distributed Learning*, 19(3), 204–221. <https://doi.org/10.19173/irrodl.v19i3.3482>
- Chen, J., Zhang, L. J., Wang, X., & Zhang, T. (2021). Impacts of Self-Regulated Strategy Development-Based Revision Instruction on English-as-a-Foreign-Language Students' Self-Efficacy for Text Revision: A Mixed-Methods Study. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.670100>
- Chen, M.-P., Wang, L.-C., Zou, D., Lin, S.-Y., & Xie, H. (2019). Effects of caption and gender on junior high students' EFL learning from iMap-enhanced contextualized learning. *Computers & Education*, 140, 103602. <https://doi.org/10.1016/j.compedu.2019.103602>
- Chu, K.-K., Lee, C.-I., & Tsai, R.-S. (2011). Ontology technology to assist learners' navigation in the concept map learning system. *Expert Systems with Applications*, 38(9), 11293–11299. <https://doi.org/10.1016/j.eswa.2011.02.178>
- Dahar, R. W. (2011). *Teori-teori Belajar dan Pembelajaran*. Erlangga.
- Daley, B. J., & Torre, D. M. (2010). Concept maps in medical education: an analytical literature review. *Medical Education*, 44(5), 440–448. <https://doi.org/10.1111/j.1365-2923.2010.03628.x>
- Delgado García, A. M., & Oliver Cuello, R. (2009). Interacción entre la evaluación continua y la autoevaluación formativa: La potenciación del aprendizaje autónomo. *REDU. Revista de Docencia Universitaria*, 7(4), 2–13. <https://doi.org/10.4995/redu.2009.6234>
- Espejo Leupin, R. M. (2016). ¿Pedagogía activa o métodos activos? El caso del aprendizaje activo en la universidad. *Revista Digital de Investigación En Docencia Universitaria*, 10(1), 16. <https://doi.org/10.19083/ridu.10.456>
- Fletcher, T., & Ní Chróinín, D. (2021). Pedagogical principles that support the prioritisation of meaningful experiences in physical education: conceptual and practical considerations. *Physical Education and Sport Pedagogy*, 1–12. <https://doi.org/10.1080/17408989.2021.1884672>
- Flores, G., De Alba, R., & Caicedo, E. (2020). Recomendaciones básicas de competencias docentes para la modalidad no escolarizada en tiempos de la pandemia. *Humanidades, Tecnología y Ciencia, Del Instituto Politécnico Nacional*, 22(25), 1–6. http://revistaelectronica-ipn.org/ResourcesFiles/Contenido/23/HUMANIDADES_23_000877.pdf
- Friesen, S., & Scott, D. (2013). Inquiry-based learning: A review of the research literature. *Alberta Education*, 1, 1–29.
- Galdames, V., Walqui, A., & Gustafson, B. (2011). *Enseñanza de la lengua indígena como Lengua Materna*. PROEIB Andes.
- Garrote Rojas, D., Garrote Rojas, C., & Jiménez Fernández, S. (2016). Factores influyentes en motivación y estrategias de aprendizaje en los alumnos de grado. *REICE. Revista Iberoamericana Sobre Calidad, Eficacia y Cambio En Educación*, 14.2(2016). <https://doi.org/10.15366/reice2016.14.2.002>
- Gowin, D. B. (1990). *Educating*. Cornell University Press.
- Guerrero Castañeda, A., Rojas Morales, C., & Villafañe Aguilar, C. (2019). *Impacto de la*

- Educación Virtual en Carreras de Pregrado del Área de Ciencias de la Salud. Una Mirada de las Tecnologías Frente a la Educación.* Universidad Cooperativa de Colombia.
- Hammer, D., Goldberg, F., & Fargason, S. (2012). Responsive teaching and the beginnings of energy in a third-grade classroom. *Review of Science, Mathematics and ICT Education*, 6(1), 51–72.
- Hanani, N. (2020). Meaningful Learning Reconstruction for Millennial: Facing competition in the information technology era. *IOP Conference Series: Earth and Environmental Science*, 469(1), 012107. <https://doi.org/10.1088/1755-1315/469/1/012107>
- Howland, J. L., Jonassen, D. H., & Marra, R. M. (2011). *Meaningful Learning with Technology*. Pearson.
- Joksimovic, S., Gasevic, D., Kovanovic, V., Adesope, O., & Hatala, M. (2014). Psychological characteristics in cognitive presence of communities of inquiry: A linguistic analysis of online discussions. *The Internet and Higher Education*, 22, 1–10. <https://doi.org/10.1016/j.iheduc.2014.03.001>
- Jonassen, D. H. (2003). *Learning to solve problems with technology: A constructivist perspective*. Merrill.
- Julca, F. (2000). *Uso de las lenguas quechua y castellano en la escuela urbana: un estudio de caso* [Master's Thesis, Universidad Mayor de San Simón]. UMSS Campus Repository http://biblioteca.proeibandes.org/wp-content/uploads/2016/11/1.Tesis_Felix_Julca.pdf
- Kay, D., & Kibble, J. (2016). Learning theories 101: application to everyday teaching and scholarship. *Advances in Physiology Education*, 40(1), 17–25. <https://doi.org/10.1152/advan.00132.2015>
- Kostaris, C., Sergis, S., Sampson, D. G., Giannakos, M. N., & Pelliccione, L. (2017). Investigating the Potential of the Flipped Classroom Model in K-12 ICT Teaching and Learning: *Educational Technology & Society*, 20(1), 261–273. <https://www.jstor.org/stable/jeductechsoci.20.1.261>
- Kostiainen, E., Ukskoski, T., Ruohotie-Lyhty, M., Kauppinen, M., Kainulainen, J., & Mäkinen, T. (2018). Meaningful learning in teacher education. *Teaching and Teacher Education*, 71, 66–77. <https://doi.org/10.1016/j.tate.2017.12.009>
- Lee, J. H., & Segev, A. (2012). Knowledge maps for e-learning. *Computers & Education*, 59(2), 353–364. <https://doi.org/10.1016/j.compedu.2012.01.017>
- Lillo, V. (2014). Salud y Educación: Dos Vocaciones Al Servicio De Los Derechos Humanos. *Rev. Med. Clin. Condes*, 25(2), 357–362.
- Loyens, S. M. M., & Gijbels, D. (2008). Understanding the effects of constructivist learning environments: introducing a multi-directional approach. *Instructional Science*, 36(5–6), 351–357. <https://doi.org/10.1007/s11251-008-9059-4>
- Lui, A. M., & Bonner, S. M. (2016). Preservice and inservice teachers' knowledge, beliefs, and instructional planning in primary school mathematics. *Teaching and Teacher Education*, 56, 1–13. <https://doi.org/10.1016/j.tate.2016.01.015>
- Marzano, R. J., & Kendall, J. S. (2007). *The New Taxonomy of Educational Objectives*. Corwin Press.
- Mayer, R. E. (2004). Should There be a three-strikes rule against pure discovery learning? the case for guided methods of instruction. *American Psychologist*, 59(1), 14–19. <https://doi.org/10.1037/0003-066X.59.1.14>

- Mintzes, J., & Wandersee, J. (2000). Reforma e Inovação no Ensino da Ciência: uma visão construtivista. In J. Mintzes, J. Wandersee, & J. Novak (Eds.), *Ensinando Ciência para a compreensão – uma visão construtivista* (pp. 44–67). Plátano Edições Técnicas.
- Moreira, M. A. (2011). Why concepts, why meaningful learning, why collaborative activities and why concept maps? *Aprendizagem Significativa Em Revista*, 6(3), 5. http://www.if.ufrgs.br/asr/artigos/Artigo_ID14/v1_n3_a2011.pdf
- Mystakidis, S. (2019). *Motivation Enhanced Deep and Meaningful Learning with Social Virtual Reality*. [Doctoral Dissertation, University of Jyväskylä]. UJ Campus Repository. <https://jyx.jyu.fi/handle/123456789/66667>
- Mystakidis, S., Berki, E., & Valtanen, J.-P. (2019). The patras blended strategy model for deep and meaningful learning in quality life-long distance education. *Electron. J. e-Learning*, 17, 66–78.
- Nesbit, J. C., & Adesope, O. O. (2013). Concept maps for learning: Theory, research, and design. In G. Schraw, M. T. McCrudden, & D. Robinson (Eds.), *Current perspectives on cognition, learning, and instruction* (pp. 303–328). Information Age Publishers.
- Novak, J. D., & Cañas, A. J. (2008). *The theory underlying concept maps and how to construct them*. Technical report IHMC CmapTools 2006-01 Rev 01-2008
- Novak, J. D., & Gowin, D. (2006). *Learning How to Learn*. Cambridge University Press.
- Novak, Joseph D. (1993). Human constructivism: A unification of psychological and epistemological phenomena in meaning making. *International Journal of Personal Construct Psychology*, 6(2), 167–193. <https://doi.org/10.1080/08936039308404338>
- Obielodan, O. O., Onojah, A. O., Onojah, A. A., Alabi, O. S., & Alimi, E. A. (2021). The teachers' extent of utilizing teaching methods for teaching basic technology. *Journal of Research in Instructional*, 1(2), 61–70. <https://doi.org/10.30862/jri.v1i2.14>
- Oostdam, R. J., Peetsma, T. T. D., & Blok, H. (2007). *Het nieuwe leren in basisonderwijs en voortgezet onderwijs nader beschouwd*. SCO-Kohnstamm Instituut.
- Öztürk, M., & Çakıroğlu, Ü. (2021). Flipped learning design in EFL classrooms: implementing self-regulated learning strategies to develop language skills. *Smart Learning Environments*, 8(1), 2. <https://doi.org/10.1186/s40561-021-00146-x>
- Pambudi, G. D., Winangsih, F., Nunaki, J. H., Nusantari, E., & Damopolii, I. (2022). Encouraging students' metacognitive skills through inquiry learning. *Inornatus: Biology Education Journal*, 2(1), 43–52. <https://doi.org/10.30862/inornatus.v2i1.272>
- Patrick, S., & Sturgis, C. (2015). *Maximizing competency education and blended learning: Insights from experts*. iNACOL.
- Polman, J., Hornstra, L., & Volman, M. (2021). The meaning of meaningful learning in mathematics in upper-primary education. *Learning Environments Research*, 24(3), 469–486. <https://doi.org/10.1007/s10984-020-09337-8>
- Pun, J., & Jin, X. (2021). Student challenges and learning strategies at Hong Kong EMI universities. *PLOS ONE*, 16(5), e0251564. <https://doi.org/10.1371/journal.pone.0251564>
- Roelofs, E., & Terwel, J. (1999). Constructivism and authentic pedagogy: State of the art and recent developments in the Dutch national curriculum in secondary education. *Journal of Curriculum Studies*, 31(2), 201–227. <https://doi.org/10.1080/002202799183232>
- Roelofs, E., Visser, J., & Terwel, J. (2003). Preferences for Various Learning Environments: Teachers' and Parents' Perceptions. *Learning Environments Research*, 6(1), 77–110.

- <https://doi.org/10.1023/A:1022915910198>
- Romero Juárez, M. G. (2020). *Enseñanza de programación de estructuras de datos aplicando estrategias didácticas basadas en la teoría de carga cognitiva* [Master's Thesis, Universidad Autónoma De Aguascalientes]. UAA Campus Repository. <http://hdl.handle.net/11317/1857>
- Rosano, S. (2007). *La cultura de la diversidad y la educación inclusiva*. Universida de Cuenca
- Rumalolas, N., Rosely, M. S. Y., Nunaki, J. H., Damopolii, I., & Kandowangko, N. Y. (2021). The inquiry-based student book integrated with local resources: The impact on student science process skill. *Journal of Research in Instructional*, 1(2), 133–146. <https://doi.org/10.30862/jri.v1i2.17>
- Santiago, O. (2007). Documento base: El Derecho a una Educación de Calidad para Todos en América Latina y el Caribe. *REICE. Revista Iberoamericana Sobre Calidad, Eficacia Y Cambio En Educación*, 5(3). <https://revistas.uam.es/reice/article/view/10139%0A>
- Şentürk, C. (2021). Effects of the blended learning model on preservice teachers' academic achievements and twenty-first century skills. *Education and Information Technologies*, 26(1), 35–48. <https://doi.org/10.1007/s10639-020-10340-y>
- Sharan, Y. (2015). Meaningful learning in the cooperative classroom. *Education 3-13*, 43(1), 83–94. <https://doi.org/10.1080/03004279.2015.961723>
- Sriraman, B. (2010). *Theories of Mathematics Education*. Springer-Verlag Berlin Heidelberg.
- Suyatno. (2009). *Menjelajah pembelajaran inovatif*. Bumi Aksara.
- Thomas, R. A., West, R. E., & Borup, J. (2017). An analysis of instructor social presence in online text and asynchronous video feedback comments. *The Internet and Higher Education*, 33, 61–73. <https://doi.org/10.1016/j.iheduc.2017.01.003>
- Tsimane, T. A., & Downing, C. (2020). Transformative learning in nursing education: A concept analysis. *International Journal of Nursing Sciences*, 7(1), 91–98. <https://doi.org/10.1016/j.ijnss.2019.12.006>
- Valverde-Berrocoso, J., Garrido-Arroyo, M. del C., Burgos-Videla, C., & Morales-Cevallos, M. B. (2020). Trends in Educational Research about e-Learning: A Systematic Literature Review (2009–2018). *Sustainability*, 12(12), 5153. <https://doi.org/10.3390/su12125153>
- Van Oers, B. (2009). Developmental education: Improving participation in cultural practices. In M. Fleer, M. Hedegaard, & J. Tudge (Eds.), *Childhood studies and the impact of globalization: Policies and practices at global and local levels*. Routledge.
- Van Oers, Bert. (1998). From context to contextualizing. *Learning and Instruction*, 8(6), 473–488. [https://doi.org/10.1016/S0959-4752\(98\)00031-0](https://doi.org/10.1016/S0959-4752(98)00031-0)
- van Rijk, Y., Volman, M., de Haan, D., & van Oers, B. (2017). Maximising meaning: creating a learning environment for reading comprehension of informative texts from a Vygotskian perspective. *Learning Environments Research*, 20(1), 77–98. <https://doi.org/10.1007/s10984-016-9218-5>
- Vergara, I., Travieso, N., & Crespo, M. (2014). Dinámica del proceso enseñanza-aprendizaje de la Química en tecnología de la salud. *Educación Médica Superior*, 28(2), 272–281.
- Verschaffel, L., & Greer, B. (2014). Mathematics Education. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of Research on Educational Communications and Technology* (pp. 553–563). Springer New York. https://doi.org/10.1007/978-1-4614-3185-5_43

- Vincent-Lancrin, S., Urgel, J., Kar, S., & y Jacotin, G. (2019). *Measuring Innovation in Education 2019: What Has Changed in the Classroom? Educational Research and Innovation*. OECD Publishing.
- Volman, M., & Ten Dam, G. (2015). Critical thinking for educated citizenship. In M. Davies & R. Barnett (Eds.), *The Palgrave handbook of critical thinking in higher education* (pp. 593–603). Palgrave Macmillan.
- Wang, H., Tlili, A., Lehman, J. D., Lu, H., & Huang, R. (2021). Investigating feedback implemented by instructors to support online competency-based learning (CBL): a multiple case study. *International Journal of Educational Technology in Higher Education*, 18(1), 5. <https://doi.org/10.1186/s41239-021-00241-6>
- Wang, J., Mendori, T., & Xiong, J. (2014). A language learning support system using course-centered ontology and its evaluation. *Computers & Education*, 78, 278–293. <https://doi.org/10.1016/j.compedu.2014.06.009>
- Wang, J., Ogata, H., & Shimada, A. (2017). A meaningful discovery learning environment for e-book learners. *2017 IEEE Global Engineering Education Conference (EDUCON)*, 1158–1165. <https://doi.org/10.1109/EDUCON.2017.7942995>
- Wang, J., Shimada, A., Oi, M., Ogata, H., & Tabata, Y. (2020). Development and evaluation of a visualization system to support meaningful e-book learning. *Interactive Learning Environments*, 1–18. <https://doi.org/10.1080/10494820.2020.1813178>
- Wardekker, W., Boersma, A., Ten Dam, G., & Volman, M. (2012). Motivation for school learning: Enhancing the meaningfulness of learning in communities of learners. In M. Hedegaard, A. Edwards, & M. Fleer (Eds.), *Motives in children's development: Cultural–historical approaches* (pp. 153–170). Cambridge University Press.
- Wu, W.-C. V., Hsieh, J. S. C., & Yang, J. C. (2017). Creating an Online Learning Community in a Flipped Classroom to Enhance EFL Learners' Oral Proficiency. *Technology & Society*, 20(2), 142–157. <https://www.jstor.org/stable/90002170>
- Zhan, Z., & Mei, H. (2013). Academic self-concept and social presence in face-to-face and online learning: Perceptions and effects on students' learning achievement and satisfaction across environments. *Computers & Education*, 69(4), 131–138. <https://doi.org/10.1016/j.compedu.2013.07.002>