

EDUCATIONAL DESIGN AND EVALUATION MODELS OF THE LEARNING EFFECTIVENESS IN E-LEARNING PROCESS: A SYSTEMATIC REVIEW

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ABSTRACT

Educational Design and Evaluation Models are important factors in e-learning as they provide guidance information for proper strategy organization pursuing both specific learning outcomes and ensuring the main elements of e-learning, such as self-regulation and collaborative learning. The examined educational models of ADDIE, Bloom, and Kirkpatrick are widely known and recognized as models for design and measuring the effectiveness of learning in order to achieve the best possible learning outcomes based on the needs of a specific target group in a specific educational context whether traditional or digital. Specifically, the ADDIE Model is a widely known learning design model used by many educational designers and training programmers to develop education and training programs. The Bloom Taxonomy is a method of building learning goals that follows the process of cognition. The Kirkpatrick Model is a method of evaluating the effectiveness of e-learning and educational programs in general, both in terms of training and business performance of learners. The purpose of this paper was both the investigation of the academic performance, the self-regulated learning and the collaborative learning in relation to the models of ADDIE, Kirkpatrick and Bloom in distance online environments and their effectiveness to the learning process. Meta-analysis was applied for research methodology. After a systematic literature review, we found that only 37 articles were appropriate for meta-analysis. Especially, 23 articles were on the ADDIE model, 9 articles were on the Kirkpatrick model and 5 articles were on the Bloom model. According to the results of this study, we found that all models apply to online process and meet different learning requirements. Regarding the cognitive performance of the trainees, all models supported the effectiveness of distance education. Moreover, the self-regulated learning and the collaborative learning, as factors inextricably linked to the effectiveness of the distance education, were examined in a small number studies in the above models. Finally, all three examined models reinforced students' positive attitudes and perceptions, even while transferring the acquired knowledge to the workplace.

Keywords: ADDIE model, Bloom taxonomy, Kirkpatrick model, instructional design, e-learning, distance education.

INTRODUCTION

In constantly evolving modern globalized society, e-learning is an internationally recognized alternative method of education that aims to enrich learning qualitatively with respect for the learning particularities of the “other” (Keengwe et al., 2014). Not only that but also, the demand for e-learning has been growing rapidly with factors directly related to its many effects (Amiti, 2020; Azevedo & Jacobson, 2008; Trivella, 2017; Troussas et al., 2022), such as learning effectiveness, its use for professional development and its cost efficiency and measurable return on investment in education (Castro & Tumibay (2019)). There is the growing demand for e-courses but does not keep pace with proper pedagogical planning and the necessary skills required as a prerequisite for such learning environments (Khalil & Elkhider, 2016; Puzziferro & Shelton, 2008). Due to the multifaceted and complex characteristics of e-learning, such as self-learning, all participants’ interaction, educational resources and distance learning (Aparicio et al., 2016), there is a need for the application of different models not only as guidelines of the design thinking process pursuing specific learning outcomes (Papazisis, 2020) but also as a “guardian” of e-learning features, enhancing the work of educators, instructional designers, and training developers (Castro & Tumibay, 2019; Hess & Greer, 2016).

Given that the research on educational models in the context of distance education is limited (Abernathy, 2019), there is a wide research scope. The present study refers to the investigation of the academic performance, the self-regulation and the collaborative learning in relation to the educational models of ADDIE, Kirkpatrick and Bloom in distance online environments, factors which play an important role in e-learning and are directly related to the transfer of knowledge in the work environment. Taking into account the fact that the continuous interaction of three main elements in theories and models of learning, teaching methods and learning technologies contribute to the improvement of the learning process (Barari et al., 2020) offering adaptability and personalization (Lameras & Arnab, 2022), the selection of the subject under review was constructed.

Although the specific models are well-known and recognized models inextricably linked to the effectiveness of the learning process (Hubalovsky et al., 2018; Reio et al, 2017; Trust & Pektas, 2018), a limited number of such systematic reviews or meta-analyses can be found in the relevant literature (Abdull Mutalib et al., 2022; Castro & Tumibay, 2019; Crompton et al., 2018). Some of these studies are about one of the specific models and the effectiveness of e-learning compared to traditional training (Castro & Tumibay, 2019; Santos et al., 2016; Zafar et al., 2014) focusing, mainly, on the academic performance and the lack of interaction (Abdull Mutalib et al., 2022). Although most researches emphasize the importance of pedagogical design (Barari et al., 2020; Samia et al., 2019), few of them acknowledge the existence of well-designed e-courses today (Castro & Tumibay, 2019; Crompton et al., 2018). Also, Crompton et al., 2018 claim that trainees are forced to work at lower levels of knowledge even though advanced technological systems and applications are highly designed. E-learning is approached as an alternative effective way of training (Santos et al., 2016), but without appropriate pedagogical planning (Adnan & Ritzhaupt, 2017; Khalil & Elkhider, 2016).

To the best of our knowledge no systematic reviews of distance education have been done by meta-analytic methods related to at least one of the three specific models and the particular variables with all their components. The purpose of this research is, initially, to investigate the effectiveness of the aforementioned models in distance education (Hanafi et al., 2020) and then, their contribution to the cultivation of mental and emotional functions (Hess & Greer, 2016). The ultimate goal is to highlight good suggestions for improving the specific teaching and learning systems, i.e. synchronous and asynchronous online environments, through the investigation of these educational design and evaluation models (Chang & Chen, 2014; Yu et al., 2021).

THE APPLICATION OF E-LEARNING IN EDUCATIONAL MODELS

The design of the educational process that will be implemented during the creation of an e-learning must follow the most appropriate educational strategies for specified learners in a certain learning environment focusing on the achievement of educational pre-planned results (Hess & Greer, 2016; Papazisis, 2020; Hatziroufa, 2019). Regardless of the type of e-learning (synchronous or asynchronous), the pedagogical strategies inextricably linked to the needs of the target group must derive from learning theories and models that provide general principles for the learning facilitation (Gelameris, 2015; Gros & Garcia-

Penalvo, 2016). Therefore, an important guide of the pedagogical design process in e-learning is the use of an educational model that provides guiding information for proper strategy organization pursuing both specific learning outcomes and ensuring the main elements of e-learning which include self-learning, an interactive process of all participants, educational resources and distance learning (Aparicio et al., 2016; Zampelis, 2020).

However, in recent years, systematic strategy for e-learning is almost absent and several studies (Abernathy, 2019; Barari et al., 2020; Khalil & Elkhider, 2016) highlight the low performance of most e-learning applications in motivating learners to learn, which later reflects in their work environment. According to Ballera et al. (2014), Battle (2019) and Song et al. (2004), a reliable indicator of learning quality and an essential component of online learning to ensure the important elements of distance learning is educational planning. Barari et al. (2020) point out the interaction of three basic elements in theories of learning, teaching methods and learning technologies, for the acquisition of essential knowledge while Ballera and Elssaedi (2013), Song et al. (2004) and Zampelis (2020) focus on the use of an educational model as a fundamental feature of the design thinking process in e-learning. In addition, according to Sharif & Cho (2015) there is no fixed model to be followed, but different models to meet different teaching and learning requirements in an evolving field. A similar approach is also adopted by Kennedy et al. (2014) and Paull et al. (2016). However, several researchers have found that the demand for online courses does not go hand in hand with appropriate pedagogical planning (Adnan & Ritzhaupt, 2017; Song, et al., 2004). This imbalance of statements is expanding when taking into account both the rapid growth of e-learning (Amiti, 2020) and the abundance of many technological means and tools (Spatiotis et al., 2020).

In the last two decades, according to literature review (Fernandes et al., 2020; Soto, 2013), there are various educational models, such as ADDIE, ASSURE, Dick & Carey, Gagne for e-learning, many of which are based on the ADDIE. In addition, the frequent use, mainly, of the ADDIE model and less of the Kirkpatrick model is considered as a basis for the application of expanding models, such as PeRSIVA and IDEA (Chrysaftadi & Virvou, 2013; Mullins, 2014). Even less the Bloom model is considered as a basis for an extended model (Gil-Jaurena & Kucina Softic, 2016). Nevertheless, there is a limited number of surveys which explore the ADDIE model (Hess & Greer, 2016; Trust & Pektas, 2018) and even less which examine the applications of Kirkpatrick and Bloom model in the context of distance learning (Hubalovsky et al., 2018; Lin & Cantoni, 2018). Moreover, even less are the studies which refer to the relation of factors - which are, also, the key features of e-learning - such as the self-regulation, the collaborative learning and learners' attitudes in distance online environments.

In the learning process, the emphasis is placed on the student's abilities and educational strategies for undertaking learning tasks. In particular, the attention is focused on their cognitive or behavioral performance with comparatively less attention to emotional issues, such as self-regulated learning, collaboration, motivations and factors which affect the motivation of learners (Ozdileka & Robeck, 2009). This fact happens, even though learners' characteristics, such as abilities or skills, motivation, and personality play an important role in e-learning and they are directly related to the transfer of knowledge in the work environment (Santiari, 2015). Learning is a process which is active, based on prior knowledge and which occurs in a validated social environment and requires motivation and cognitive, meta-cognitive, behavioral and emotional involvement of the student focusing on the object of learning (Gowda & Suma, 2017). The motivations of the learners include, mainly, the achievement of personal and professional development, with the main components being the learning needs and the self-realization (Greene et al., 2014). Santiari (2015) identifies knowledge and skills as two of the three fields that contribute to "behavior change". The third element is attitude. In particular, educators are responsible for developing and improving e-learning courses and educational resources that can foster positive student behavior and, therefore, better learning outcomes. In this manner, students' attitudes and perceptions about e-learning are inextricably linked to their needs and characteristics (Eiriemiokhale & Idiedo, 2020). These must be taken into account in order to fully evaluate the effectiveness of an online course (Svirko & Mellanby, 2009). All the above are mentioned in greater detail below.

SELF-REGULATED LEARNING

As mentioned above, although the e-learning facilitates participants' learning, its effectiveness is directly related to self-learning (Evans et al., 2014; Rabak & Cleveland-Innes, 2006). More specifically, the degree of effectiveness of e-learning is directly related to the degree of self-improvement that each learner seeks (Pange, 2014; Wang, 2011). Previous studies have shown the difficulties in regulating learning in digital environments (Azevedo et al., 2008). The large volume of information in combination with the various learning processes in digital environments makes it imperative to adopt self-regulatory processes (Greene et al., 2014). The challenge of the self-regulation, also, arises during online interactions and collaborative processes in virtual learning teams (Donelan & Kear, 2018). Empirical studies investigating, in general, online learning in relation to the development of skills in training programs do not almost appear in the studies we examine (DeRouin et al., 2005), although more positive learning outcomes are achieved when they are based on skills than cognitive material (Hatziroufa, 2019). In addition, well-designed courses, suitable instructors and stable technology with understanding the learning preferences have a direct effect on the involvement of learners in e-learning (Hatziroufa, 2019). Consequently, the self-regulated learning is a complex process (Pange, 2014) consisting of four components: a) *cognitive regulation*, b) *regulation of behavior*, c) *regulation of motivations and emotions* and d) *regulation of social conditions* (Greene et al., 2014). The Figure 1 below exhibits them more graphically.

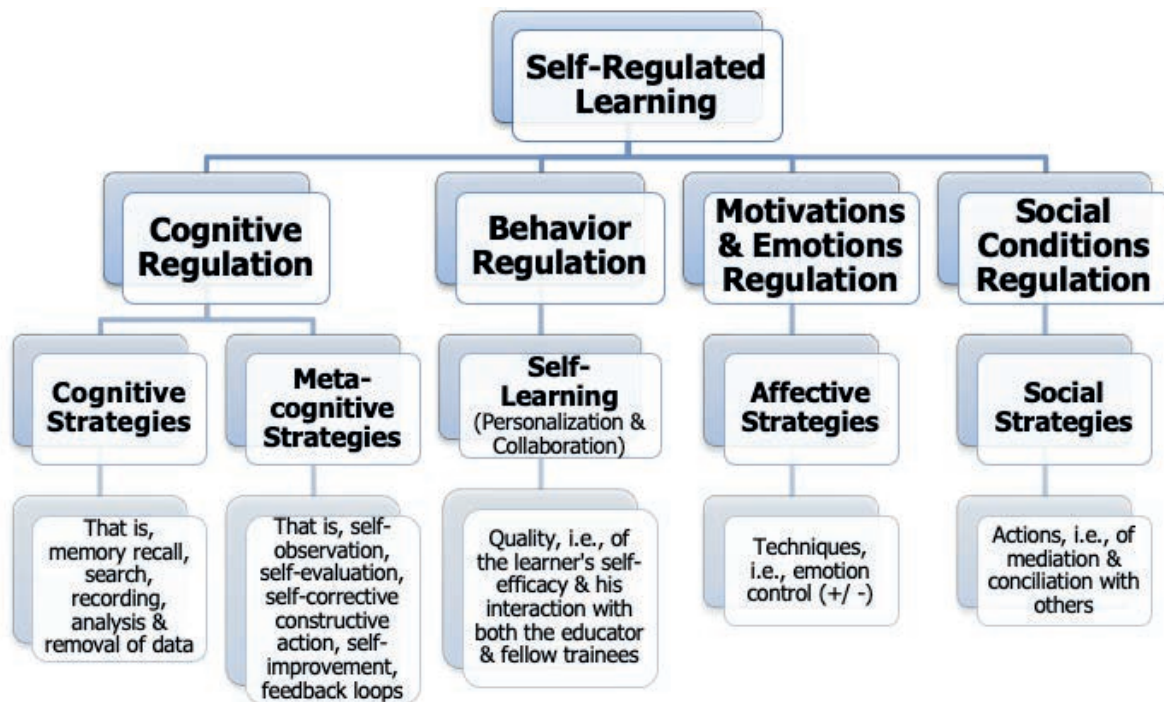


Figure 1. The main components of the self-regulated learning

COLLABORATIVE LEARNING

One of the most important characteristics of e-learning includes an interactive process of all participants, (Aparicio et al., 2016) and alternative methodologies, such as collaborative learning, are adopted in the implementation of e-learning (Gelameris, 2015), as previously mentioned. The context of the collaborative learning includes learners working in teams on a task or a project under certain conditions in which certain criteria are met, including that each individual as a team member should be held individually responsible for full content of the project (Johnson & Johnson, 2011). Therefore, in the collaborative learning, learners work in groups to pursue a common goal. The following five elements: a) *positive interdependence*, b) *individual accountability*, c) *promotional interaction*, d) *use of appropriate collaborative skills* and e) *group development of common goals* (Mabrouk, 2007) which are a prerequisite for

collaborative learning, contribute to increase the motivation of learners for active participation in their learning process (Gambrari et al., 2015). The Figure 2 below exhibits them more graphically. According to Zemelman et al. (2005) the phrase good practices includes a number of aspects which make the teaching personalized, collaborative, and challenging by enabling an active, experiential, authentic, and democratic approach.

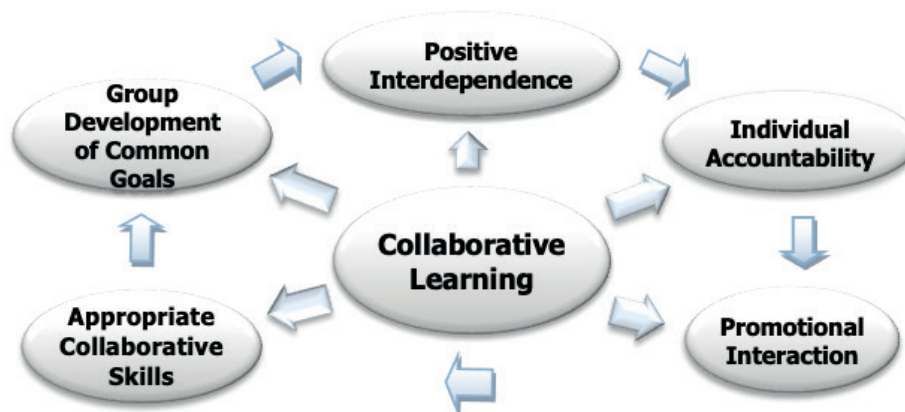


Figure 2. The main components of the collaborative learning

LEARNERS' PERCEPTIONS AND ATTITUDES

Perceptions and attitudes are important as e-learning is considered successful when a positive attitude is achieved and fully successful when a positive workplace attitude is also acquired (Santiari 2015). Specifically, educators have the “mission” to design and improve an e-learning course or educational resources in order to foster positive student behaviors and consequently, better learning outcomes. Therefore, students’ attitudes and perceptions are inextricably linked to students’ needs and characteristics (Eiriemiokhale & Idiedo, 2020). A positive attitude of a learner in the e-learning means adaptation to the new form of education while a negative attitude means non-adaptation to the new system due to the learner’s lack of the necessary characteristics. Moreover, Kisanga and Ireson (2016) take a broader approach to the process of attitude as a “behavioral mood”. In particular, it is taken as a positive or negative evaluative judgment of an object or a process based on emotional, cognitive and behavioral experience. In other words, the attitude depends on the way the student feels (*emotional assessment*), the knowledge of the object or the situation being judged (*cognitive assessment*) and finally, on the way he has acted towards something similar in the past (*behavioral assessment*). According to Santiari (2015), attitude is one of the fields that compose the type of “behavior change”. The other two elements are knowledge and skills. These must be taken into account in order to fully evaluate the effectiveness of an online course (Svirko & Mellanby, 2009).

THE CONSIDERED EDUCATIONAL MODELS

The ADDIE, Bloom, Kirkpatrick models are widely known and recognized as models for design and assessing the effectiveness of learning. These models emphasize the educational design and the evaluation of the learning process for learners and educators order to examine and achieve the best possible learning outcomes based on the needs of a specific target group in a specific educational context whether traditional or digital (Hubalovsky et al., 2018; Reio et al, 2017; Trust & Pektas, 2018). Specifically, the ADDIE Model is an educational or instructional design model (Lau et al., 2017). The Bloom model (Bloom Taxonomy) is called as a cognitive domain design, namely, a method of design and building learning goals that follows the *process of knowledge* or other words, the *process of cognition* (Farhat, 2021). Finally, the Kirkpatrick Model is a method of planning and evaluating the effectiveness of learning and educational programs in general both in terms of educational training and the business performance of learners (Khare & Kumar, 2015).

Even though these models are applied for different purposes, they aim at the best possible learning design and evaluation of the learning experiences, courses and educational content. Therefore, the phases of analysis, application & evaluation are found in all three models having a different way of their implementation, but serving the needs and learning goals of a specific target group. Moreover, the analysis phase of the ADDIE model can be aligned with the four levels of the Kirkpatrick model. The Kirkpatrick evaluation model is used to evaluate the effectiveness of a training program in terms of meeting the needs of both learners and the organization (Reio et al, 2017), as previously mentioned. Therefore, individual needs are linked to the response and the motivation. The needs of the target group for training are related to learning. Work performance needs in the case of employee training programs are related to the behavior and while the business needs are related to the results. Thus, all three models focus on the effectiveness of learning.

Approaching in more detail their educational characteristics concerning teaching and learning, several similarities and differences can be distinguished. They could be categorized based on certain criteria, some of which were defined according to the guidelines, as presented in Diamantopoulou (2017) as follows: a) *Basic elements of the educational models by Branch and Merrill (2011)*, b) *Basic theoretical and philosophical characteristics*, c) *Their structure and function* and d) *Time data and constraints*. All the aforementioned characteristics are presented in greater detail below while the Figure 3 below exhibits them more graphically.

All three examined models are accompanied by the basic elements of the educational models, which are identified by Branch and Merrill (2011). These are (a) *clearly defined steps*; (b) *clearly defined objectives based on the needs of the trainees*; (c) *evaluation* related to the desired learning outcomes (measurable, reliable, and valid); (d) *common stages* (analysis, implementation, and evaluation) with considerable divergences in how they are implemented; (e) *team effort of educational designers*, keeping the fundamental data empirically; and (f) *development of real-life behaviors* as a guarantee for connecting the learning and business needs.

According to their basic theoretical and philosophical characteristics, the specific models are widely known and recognized as models for designing and evaluating the learning experiences, courses and educational content (Trust & Pektas, 2018) and they are based on pedagogical scenarios. In particular, the ADDIE model and the Kirkpatrick model are based on the general systems theory/ analysis which ensures that the analysis of tasks will follow a logical and smooth process (Diamantopoulou, 2017). In contrast, the Bloom model is based on a Learning Theory. Also, the underlying theory for the ADDIE model is the Theory of Behaviorism while for the Bloom model is the theory of Constructivism. Regarding the type of knowledge, the ADDIE model approaches the procedural knowledge while the other two models adopt the procedural & metacognitive knowledge.

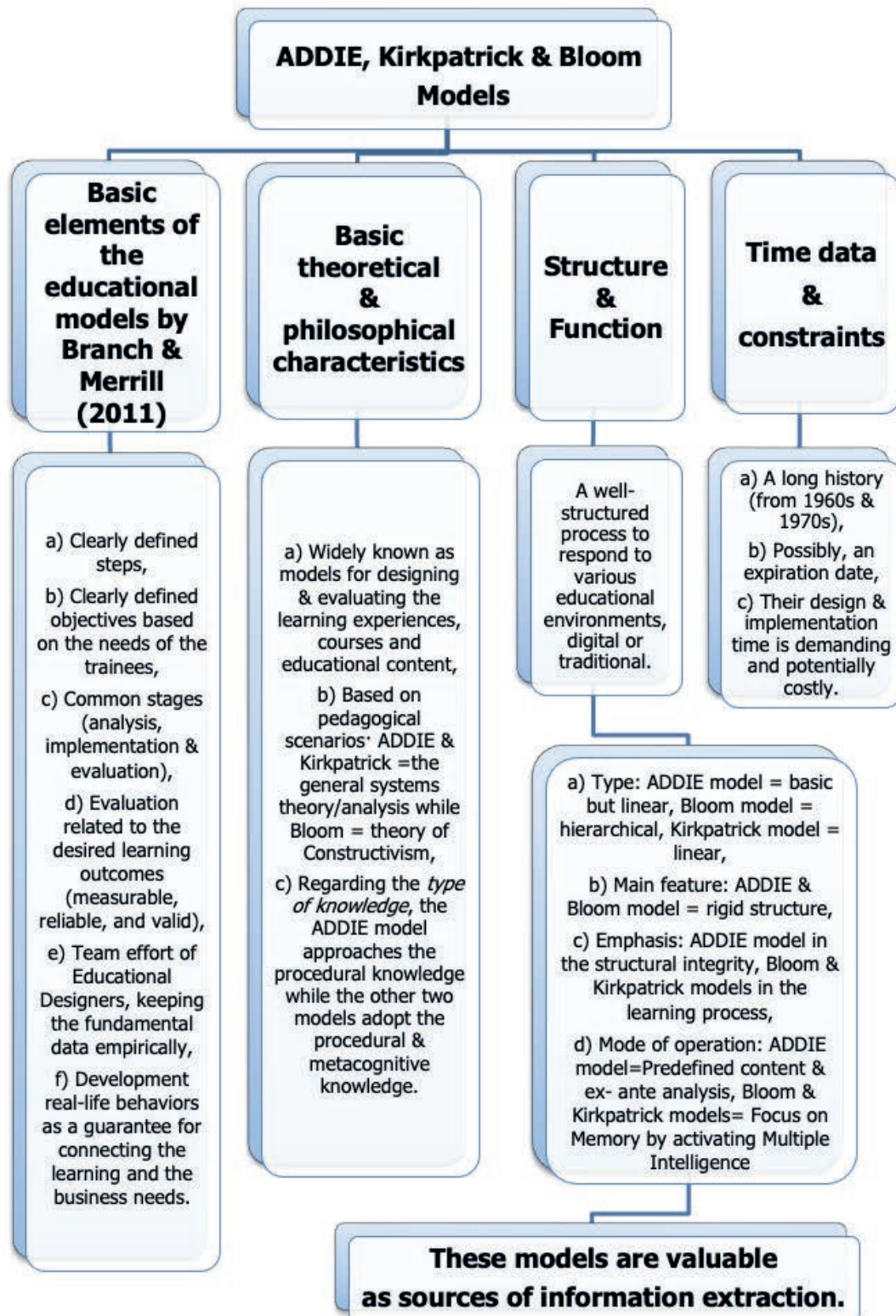


Figure 3. The main characteristics of the educational models

In terms of their structure and the way they work, it is observed that they ensure a well-structured process to respond to various educational environments, whether digital or traditional (Turker, 2016). Also, the ADDIE model and the Bloom model are characterized by their almost rigid structure, potentially limiting the creativity of educators and programmers. In particular, the ADDIE model has a strict linear structure with wide phases, but with the dominance of each simplest stage being considered a prerequisite for the conquest of the next stage. It is a limitation if the design team follows a rigid workflow (Lahti et al., 2014). This means that the movement from one stage to another is flexible, but the movement is strictly circular. Therefore, it does not work well without predefined content and without complete prior analysis. However, its structural integrity, its flexibility and its simplicity make it one of the most popular of all design models, most of which are spin-offs or its variations, inspiring even those trying to create a different model (Jusas et al., 2021; Mullins, 2014). For this reason, even the most experienced designers define it as a model for Instructional Systems Design (ISD).

Similarly, Bloom identified six cognitive levels, which are hierarchically classified from the simplest level to the most complex and from the specific to the abstract, with the dominance of each simplest stage being considered a prerequisite for the conquest of the next stage (Lopez-Zambrano et al., 2022). It creates restrictions especially for educators who do not consider that learners must follow strict steps in order to achieve effectiveness in their learning. In contrast to the structural integrity that the ADDIE model imposes, the other two models - Bloom and Kirkpatrick - prioritize the learning process of all participants. In particular, Bloom's Taxonomy through a specific cognitive process aims to develop critical thinking and transferable skills in learners (Ballera & Elssaedi, 2013). Both of the last two models mentioned above focus on the importance of memory by activating multiple intelligence and maintaining the involvement of the learners. Therefore, for the process of selecting one of the two models as the most appropriate to serve a specific learning situation, it is required to take into account the type and the needs of the trainees and the type of subject to be taught.

ADDIE, Kirkpatrick, and Bloom are three well-known educational models that have been associated with learning effectiveness (Hubalovsky et al., 2018; Reio et al, 2017; Trust & Pektas, 2018), as mentioned above. Nevertheless, there have not been sufficient systematic reviews of distance education conducted using meta-analytic methods in relation to the specific models and factors (Abdull Mutalib et al., 2022; Castro & Tumibay, 2019; Crompton et al., 2018). Some of them are about one of the specific models and the effectiveness of e-learning in general compared to traditional training (Castro & Tumibay, 2019; Santos et al., 2016; Zafar et al., 2014). To the best of our knowledge no systematic reviews of distance education have been done by meta-analytic methods related to the three specific models and the particular variables with their components. Therefore, it is important to focus on the investigation of the important factors of distance education, such as the academic performance, the self-regulated learning, the collaborative learning and learners' attitudes in relation to the examined models in distance online environments and their effectiveness to the learning process.

PURPOSE OF THE STUDY

Based on the bibliographic review (Abdull Mutalib et al., 2022; Castro & Tumibay, 2019; Crompton et al., 2018), there have not been enough systematic reviews of distance education done by meta-analytic methods related to the ADDIE, Kirkpatrick or Bloom models and the important factors of distance education, such as the academic performance, the self-regulated learning, the collaborative learning and learners' attitudes. Some of these systematic reviews and meta-analyses are about one of the specific models and the effectiveness of e-learning in general compared to traditional training by focusing on cognitive achievement (Castro & Tumibay, 2019; Santos et al., 2016; Zafar et al., 2014). To the best of our knowledge no systematic reviews of distance education have been done by meta-analytic methods related to the three specific models or only to one of them and the particular variables with their components. Therefore, it is important to focus on the investigation of the particular factors of distance education in relation to the specific educational models (Hubalovsky et al., 2018; Paull et al., 2016).

More specifically, the purpose of the research is, initially, to investigate the effectiveness of the ADDIE, Kirkpatrick and Bloom models in distance education and especially, in synchronous and asynchronous electronic environments (Crompton et al., 2018; Hanafi et al., 2020; Hess & Greer, 2016). Then, the purpose of the research is to investigate the contribution of the aforementioned educational models to the cultivation of mental and emotional functions, such as cognitive performance, self-regulated learning and collaborative learning. Considering the fact that there is a lack of such researches in the literature review (Abdull Mutalib et al., 2022), the ultimate goal of the present study is as best as possible to highlight quality suggestions for improving the specific way of education, i.e. synchronous and asynchronous distance education through the investigation of the considered educational design and evaluation models of the learning process (Chang & Chen, 2014).

In order to achieve this purpose, the following two research questions were formulated as well as four other sub-questions of second research question. Namely:

1. How effective are the application of the educational models ADDIE, Kirkpatrick and Bloom in online distance learning as presented in the different researches in online distance learning?
2. Additionally, we would investigate whether these educational models to synchronous and asynchronous e-learning:
 - a) promote the cognitive performance,
 - b) cultivate the development of self-regulated learning,
 - c) develop collaborative learning,
 - d) enhance learners' perceptions and attitudes.

METHODOLOGY

Research Process

For the need of this study, a literature review was carried out on relevant studies of the last time period (2010-2022) and the process of meta-analysis of the most appropriate studies is considered. Researchers usually look for the most recent studies so that the references are up-to-date. However, a limited number of relevant studies were initially identified for the specific models of distance education. As a result, the time period has been extended to 2010. Then, a process of systematic review was followed to extract appropriate information for our study. A meta-analysis was applied and conclusions of the meta-analysis were implemented, followed by highlighting the ways of application and good practices of the above models for e-learning. Meta-analysis is "a mathematical process that statistically combines the results of studies selected after a systematic review of the literature" (Galanis, 2009). Therefore, meta-analysis is a process inextricably linked to systematic review and in combination, safe conclusions can be drawn.

Data Collection Technique

Selective bibliography from international research journals was searched. Specifically, using systematic review, databases were used, such as ERIC, Science Direct-Elsevier, Springer Link, SCOPUS and Greek research journals. The specific databases were chosen as they are among the largest bibliographic databases that cover scientific bibliography from almost every discipline and especially, from the field of education to which the subject of this research belongs. Moreover, data were extracted using the web quest process in order to be used to strengthen the bibliographic framework of the work and not to use them as basic data of the meta-analysis process. The collected scientific articles had as main subject the Distance Education and Technology in Education and more specifically, we collected those articles which refer to educational models in synchronous and asynchronous digital learning environments. Appropriate keywords such as "ADDIE model", "Kirkpatrick model", "Bloom taxonomy", "educational design", "e-learning", "online learning", "distance learning", "meta-analysis" and various combinations of these words were used to search for the above information material.

Reliability and Validity

In order to ensure the quality of the surveys, appropriate instructions were taken into account regarding the evaluation of the online sources searched and extracted from the specified databases, as presented in a relevant source of the University of Cyprus (Research initiatives, n.d) and the educational material (Cohen & Manion, 1994; Creswell, 2016). Then, for the extraction of the aggregate result, the process of meta-analysis was applied (Galani, 2009), during which a combined conclusion was calculated, guided by the results of the individual appropriate empirical articles. Specifically, the basic stages of the methodological research were followed, as mentioned by Pellas et al. (2018), part of which was the process of defining the certain inclusion and exclusion criteria (Pellas et al., 2016). In addition, the PRISMA recommendation (Moher et al., 2009) was applied for the systematic reviews and meta-analyses as it is considered as one of the most appropriate protocols to highlight the advantages and disadvantages of any research review (Liberati et al., 2009). The aim of the whole process was to carry out a centralized result with the utmost precision, reliability and validity.

Detailed Planning of the Research Process

The meta-analysis process was based on the following classified transitional procedures proposed by Kitchenham (2007, as cited in Pellas et al., 2019). As shown in the Figure 4, the literature review carried out the stages as follows:

Stage 1: *Design of the bibliographic review:* a) Selection of appropriate journals and databases, b) definition of criteria for inclusion and exclusion of articles and c) definition categories for analysis.

Stage 2: *Conducting the literature review:* a) Study selection, (b) Data extraction (content analysis methods were applied), (c) Data synthesis and (d) Data coding.

Stage 3: *Evaluation report:* Analysis of results and discussion of findings, trends and conclusions following the principles of the PRISMA (Preferred Reported Items for Systematic Reviews and Meta-Analyses) statement (Moher et al., 2009).

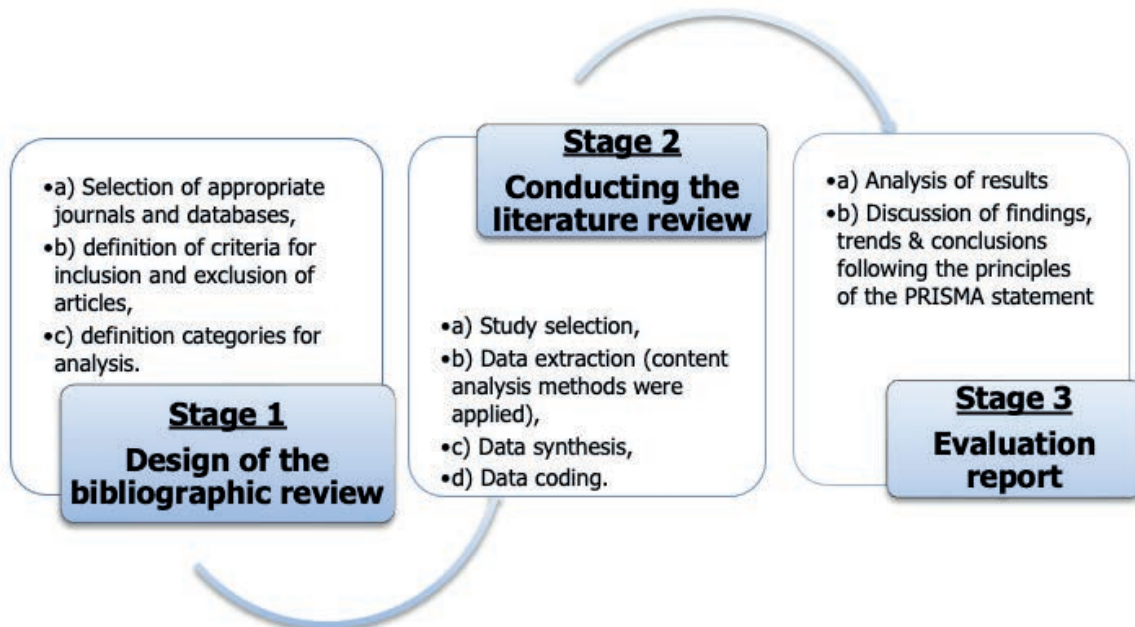


Figure 4. The design stages of the research process

In the step [Stage 1st (b)], the criteria for inclusion and exclusion of appropriate research (Pellas et al., 2016) were determined based on the research questions of the present research, the time frame of the literature review and type of research as follows:

Inclusion criteria: General criteria: (a) Studies published during the period 2010 to 2022 ·(b) Conceptual articles or studies that they provided evidence of educational potential based on a research method ·(c) Articles whose summary and the complete document was prepared in English or Greek. Specific criteria: (a) Studies which have an experimental application stating the advantages, the disadvantages, the educational benefits and the effectiveness of the models - ADDIE, Bloom, Kirkpatrick - in the online distance education·(b) Studies describing the application of the specific teaching models ·(c) Studies describing the application of the specific models to be explored in online training courses for trainees in their professional career (nurses, company employees, librarians, etc.).

Exclusion criteria: (a) Studies which were either before 2010 or after 2022 ·(b) Studies which were not written in English or Greek·(c) Studies which are not recognized as “articles” in selected journals (e.g. books, book reviews / chapters, editorial information, etc.) ·(d) All articles which did not present evaluation data or did not follow a well-structured research process ·(e) Studies which did not provide sufficient data to calculate the magnitude of the results or did not have clear summaries or aggregated findings from their qualitative data · (f) Studies which mentioned one of the terms “ADDIE model”, “Kirkpatrick model”, “Bloom taxonomy” in online learning and related to either blended learning, mobile learning or virtual reality learning, or in a multimedia classroom but they were not examined in a distance environment, in which the subject of the present research is mentioned ·(g) Also, studies have not been included which, although based on the above-mentioned models as to their theoretical framework, their research methodology subsequently concerned an expanding educational model.

The Figure 5 illustrates these criteria for inclusion and exclusion of appropriate research more graphically.

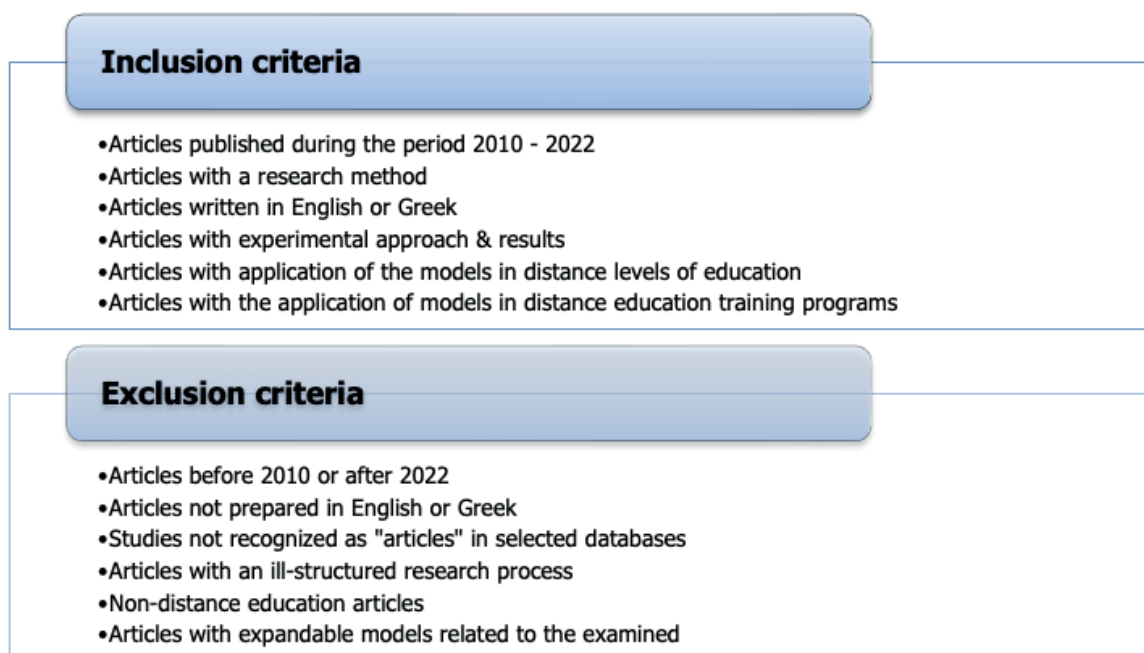


Figure 5. Criteria for inclusion and exclusion of articles

For the analysis of the results, thematic analysis of the collected data was used. Specifically, detection of repetitive patterns of meaning (topics) based on the aforementioned literature review and rendering of interpretive codes, conceptual definitions in the various data sections were applied (Tsiolis, 2017). Then, the presentation of the results was done using *Microsoft Office Professional Plus 2019, Excel Version 2206*.

Conduct and Analysis of the Relevant Literature Review through a Flow Chart

The Figure 6 below depicts a flow chart regarding the process of selecting the appropriate articles followed using instructions from Liberati et al. (2009), the analysis of which is presented as follows:

Identification: In order to find and identify suitable articles for subsequent inclusion in critical editing, a search was made in certain databases during the period of three consecutive months, January, February and March 2022. The search for appropriate articles was defined based on the topic of this research and their scope was defined based on the framework “The Models of ADDIE, Bloom, Kirkpatrick in online distance learning”.

Screening: During the bibliographic review process, 103 articles were extracted and after removing 12 duplicates, 91 articles were checked by reading their titles and their abstracts based on criteria which had already been defined.

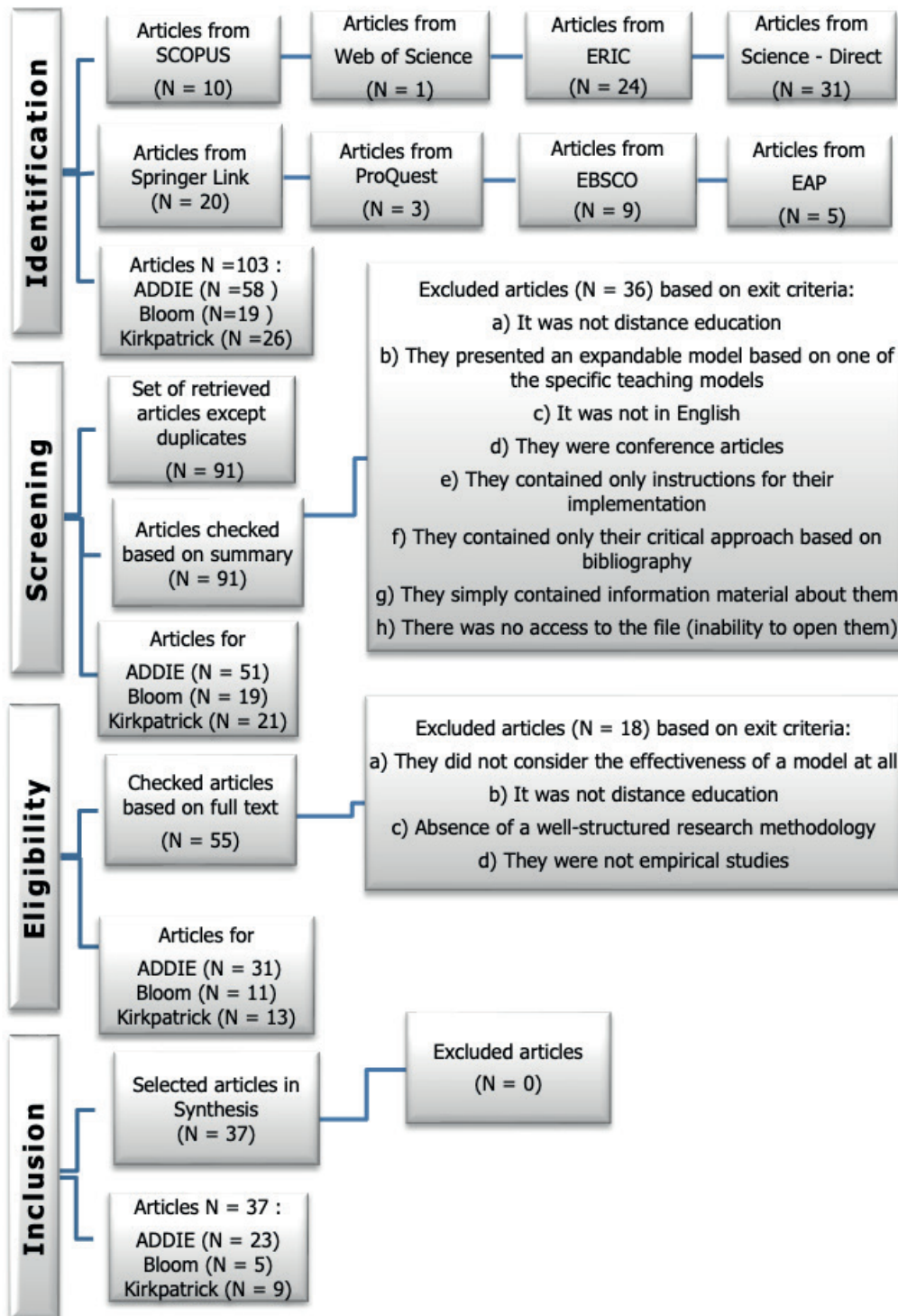


Figure 6. The flowchart for the article selection process

During the screening process, 36 articles were rejected, while in the next phase, 55 articles were selected to be thoroughly reviewed. During the screening process, of the 36 rejected articles, 9 articles were not distance education, 7 articles were conference papers while 5 articles presented an expanding model based on one of the specific models. 6 articles contained instructions for the correct application of the specific models or in general, for the educational design, 4 articles contained a critical approach of the models based on the literature and 5 articles contained simply information material about them and 1 article could not be opened.

Eligibility: During the selection phase, full text analysis is required. For this reason, the 55 articles were thoroughly studied following specific eligibility criteria or otherwise, entry criteria. The eligibility criteria were as shown in Figure 6.

At this stage “*Eligibility*”, 18 articles underwent the exclusion procedure as ineligible while 37 articles were deemed appropriate for data extraction. In particular, of the 18 rejected articles, 7 articles did not examine the effectiveness of the specific models at all, although during the methodological process, they emphasized the development of the specific models. The 6 articles were not distance education, although they referred to virtual reality environments, multimedia classrooms and mobile learning or TV programs without being specified in the summary in order to be rejected in previous stage of checking their suitability (*screening phase*). 5 articles were not empirical studies, of which 2 articles were comparative studies of ADDIE and Agile or SAM models based on relevant literature.

Inclusion: For this stage, as mentioned above, 37 articles were deemed appropriate, which were classified separately based on the examined models, ADDIE, Bloom, Kirkpatrick. Thus, 23 articles referring to the ADDIE model, 5 articles referring to the Bloom model and 9 articles referring to the Kirkpatrick model were found.

FINDINGS

All the above articles were processed to extract results and conclusions based on parameters, as defined in the detailed design of the research process. Regarding Stage 2 (a), after a manual search in the selected databases, 37 suitable journal articles were selected applying the defined inclusion and exclusion criteria. Stage 2 (b) and 2 (c) were performed by carefully reading the appropriate articles and the data coding process was performed according to the categories defined in Stage 1 (c). The results were presented according to the research questions.

The control variables results for each relevant article separately and per model are illustrated with symbols in Tables 1, 2 and 3. Specifically, the control variables were cognitive performance, self-regulated learning, collaborative learning and perceptions/attitudes. The self-regulated learning as a complex variable was approached with all four of its components a) cognitive regulation, b) regulation of behavior, c) regulation of motivations and emotions and d) regulation of social conditions.

Table 1. Results of control variables for the ADDIE model

Authors	Cognitive performance	Self-regulated learning			Collaborative learning	Perceptions & Attitudes
		Cognitive regulation	Regulation of behavior	Regulation of motivations & emotions		
Cheng (2011)	↑*	-**	↑	-	-	-
Mavroudi & Hadzilacos (2013)	↑	-	↑	-	-	↑
REINBOLD. (2013)	↑	-	↑	-	-	↑
Robinson & Dearmon (2013)	↑	-	↑	-	-	↑
Soto (2013)	↑	-	-	↑	-	↑
Hsu et al. (2014)	↑	-	-	-	-	↑
Santiari (2015)	↑	-	↑	↑	-	↑
Durak & Ataizi (2016)	↑	-	-	-	-	-
Hess & Greer (2016)	↑	-	↑	-	-	-
Nordin et al. (2016)	-	↑	↑	↑	-	↑
Turker (2016)	↑	-	-	-	-	-
Ismail et al. (2018)	↑	-	↑	-	-	↑
Patel et al. (2018)	↑	-	-	-	-	-
Trust & Pektas (2018)	-	-	↑	-	-	↑
Abernathy (2019)	↑	-	-	-	-	-
Hatziroufa (2019)	-	↑	↑	-	-	↑
Gournakis (2020)	↑	-	↑	-	-	-
Zampelis (2020)	↑	↑	↑	↑	↑	↑
Hanafi et al. (2020)	↑	-	↑	-	-	↑
KOC (2020)	↑	-	-	-	-	↑
Manitsara (2020)	↑	-	-	↑	-	-
Salas-Rueda et al. (2020)	↑	-	↑	-	-	-
Almelhi (2021)	↑	↑	↑	↑	↑	-

Note. *↑ = percentage increase, **- = the article does not examine the control variable

The Table 1 depicts the control variables results for each relevant article separately for the ADDIE model. The selected articles that examined the above variables point out a positive impact of the application of ADDIE model. More specifically, there are 19 articles out of the 23 selected articles examined its effectiveness in improving learning, i.e. the variable of cognitive performance. 16 articles out of the 23 selected articles related to the ADDIE model examined the self-regulatory factor, mainly some of its parameters, i.e. the involvement and motivation of the student. Moreover, 3 of them did not present the results in sufficient detail. In terms of the variable collaborative learning, 6 articles on the ADDIE model were included. Finally, 12 articles on the ADDIE model examined and pointed out the positive perspectives and attitudes.

Table 2. Results of control variables for the Kirkpatrick model

Authors	Cognitive performance	Self-regulated learning			Collaborative learning	Perceptions & Attitudes
		Cognitive regulation	Regulation of behavior	Regulation of motivations & emotions		
Edwards & Black (2012)	↑*	–**	–	–	–	↑
Lavender et al. (2013)	↑	–	–	–	–	–
Aluko & Shonubi (2014)	–	–	↑	–	–	↑
Chang & Chen (2014)	↑	↑	↑	↑	↑	↑
Lahti et al. (2014)	↑	↑	–	↑	–	↑
Lin & Cantoni (2017)	↑	–	–	–	↑	↑
Goh et al. (2018)	–	–	↑	↑	–	–
Moreira et al. (2019)	↑	–	–	↑	–	–
Fernandes et al. (2020)	↑	–	↑	↑	–	↑

Note. *↑ = percentage increase, **– = the article does not examine the control variable

The Table 2 illustrates the control variables results for each relevant article separately for the Kirkpatrick model. From the 9 articles, 7 articles were examined its effectiveness in improving learning, i.e. the variable of cognitive performance. The self-regulatory factor was examined in relation to, mainly with some of its parameters, the involvement and motivation of the student. From the 9 articles concerning the Kirkpatrick model, 6 articles related to the specific control variable were included. In terms of collaborative learning, 3 articles on the Kirkpatrick model were included. Finally, 5 articles on the Kirkpatrick model pointed out the positive perspectives and attitudes. The selected articles that examined the above variables point out a positive impact of the application of Kirkpatrick model.

Table 3. Results of control variables for the Bloom model

Authors	Cognitive Performance	Self-regulated learning				Collaborative learning	Perceptions & Attitudes
		Cognitive regulation	Regulation of behavior	Regulation of motivations & emotions	Regulation of social conditions		
Domun & Bahadur (2014)	↑*	↑	↑	↑	↑	↑	—***
Blau et al. (2017)	↑	↑	↓**	↓	↓	—	↑
Lau et al. (2017)	↑	—	↑	—	—	↑	—
Kumpas-Lenk, et al. (2018)	↑	—	↑	↑	—	—	↑
Barari et al. (2020)	↑	—	—	—	—	↑	↑

Note. **↑ = percentage increase, **↓ = percentage decrease, ***— = the article does not examine the control variable

The Table 3 shows the control variables results for each relevant article separately for the Bloom model. All articles refer exploratory to the improvement of learning examining the variable of cognitive performance. The self-regulatory factor was examined in relation to, mainly with some of its parameters, the involvement and motivation of the student. From the 5 articles concerning the Bloom model, 4 articles related to the specific control variable were included. In terms of collaborative learning, 3 articles on the Bloom model were included. Finally, 3 articles on the Bloom model pointed out the positive perspectives and attitudes. Almost all the selected articles that examined the above variables highlight a positive effect of applying the Bloom model. However, one of the selected articles pointed out a percentage reduction in parameters of the self-regulation variable.

The Tables 4 and 5 present the overall results regarding the aforementioned variables per model and per category (positive effects and limitations in synchronous and asynchronous online learning environments).

Table 4. Positive effects from the application of the models on the distance e-learning

Positive effects for the ADDIE model	Number of studies	Percentage
Better learning performance and / or learning benefit	19	83%
Development of self-regulatory factors	16	70%
Student interaction / socialization / collaboration	6	26%
Positive perceptions and attitudes of students	12	52%
Positive effects for the Kirkpatrick model	Number of studies	Percentage
Better learning performance and / or learning benefit	7	78%
Development of self-regulatory factors	6	67%
Student interaction / socialization / collaboration	3	33%
Positive perceptions and attitudes of students	5	56%
Positive effects for the Bloom model	Number of studies	Percentage
Better learning performance and / or learning benefit	5	100%
Development of self-regulatory factors	4	80%
Student interaction / socialization / collaboration	3	60%
Positive perceptions and attitudes of students	3	60%

According to Table 4, there are 19 articles out of the 23 selected articles related to the ADDIE model examined its effectiveness in improving learning (83%). Moreover, 5 of them did not present the results in sufficient detail. All articles related to the Bloom model refer exploratory to the improvement of learning by percentage (100%) while from the 9 articles concerning the Kirkpatrick model, 7 articles (78%) were included. The self-regulatory factor was examined in relation to, mainly with some of its parameters, the involvement and motivation of the student. 16 articles out of the 23 selected articles related to the ADDIE model examined the self-regulatory factor (70%). Moreover, 3 of them did not present the results in sufficient detail. From the 5 articles concerning the Bloom model, 4 articles refer to the self-regulatory factor (80%) while from the 9 articles concerning the Kirkpatrick model, 6 articles related to the specific control variable were included (67%). In terms of collaborative learning, 6 articles on the ADDIE model (26%), 3 articles on the Kirkpatrick model (33%) and 3 on the Bloom model (60%) were included. Finally, according to positive perspectives and attitudes, 12 articles on the ADDIE model (52%), 5 articles on the Kirkpatrick model (56%) and 3 on the Bloom model (60%) were included.

Table 5. Limitations in the application of the models in the distance e-learning

Limitations for the ADDIE model	Number of studies	Percentage
Key factors which contribute to the reduction of the motivation and the involvement of the student are the lack of the interaction with others & the lack of the quality of the educational material.	6	26%
The Educators must develop additional learning material exclusively for the needs of the distance learning.	5	22 %
The Educators, also, shoulder the burden of the planning e-courses, often in the absence of adequate training and skills.	5	22%
The lack of skills, the motivation and the support are factors which contribute to a lack of the commitment to the MOOC.	4	17%
Limitations for the Kirkpatrick model	Number of studies	Percentage
Further evaluation of the design, the multimedia, the technological learning tools is required in the distance e-learning	4	44%
Inability to transfer the acquired knowledge to the work environment due to educational policies or lack of resources	2	22%
The simulation of learning situations through virtual labs cannot replace face to face laboratory data.	2	22%
Limitations for the Bloom model	Number of studies	Percentage
Learning results, which correspond to the 3 lowest levels of Bloom, can negatively affect the non-involvement of the learners in the learning process resulting in dropout.	2	40%
The lack of the quality educational material implies the lack of the motivation.	2	40%
The stress factor acts as an obstacle in distance e-learning.	2	40%

The Table 5 shows the limitations in the context of the application of the examined models. For the ADDIE model, the limitations are a) the factors that contribute to the reduction of motivation and involvement of the student (namely, the lack of interaction with others & the lack of quality of educational material) (26%), b) the additional learning material that educators need to develop exclusively for distance learning needs (22%), c) the additional burden of designing the e-courses that the educators carry, often in the absence of adequate training and skills (22%) and finally, d) the factors that contribute to the lack of commitment to MOOCs (namely, the lack of skills, motivation and support) (17%). Regarding the Kirkpatrick model, the limitations are a) the need for further evaluation of design, multimedia, technological learning tools in the distance e-learning (44%), b) the impossibility of transferring the acquired knowledge to the work environment due to educational policies or lack of resources (22%) and c) the impossibility of replacing living laboratory conditions with virtual simulation laboratories (22%). For the Bloom model, the limitations are

a) the learning outcomes, which correspond to the three lowest levels of the Bloom taxonomy, can negatively affect the involvement of the learner in the learning process resulting in dropout (40%), b) the lack of quality of educational material implies a lack of motivation (40%) and c) the stress factor acts as an obstacle to distance e-learning (40%).

DISCUSSIONS AND CONCLUSIONS

The Effectiveness from the Application of the Examined Models in Distance Learning

According to our finding, the effectiveness of the educational models ADDIE, Kirkpatrick and Bloom in online distance learning appears in all learning environments. All models apply to online process but meet different learning requirements.

More specifically, the ADDIE model has a flexible structure which allows it to be applied in all learning environments (Almelhi, 2021; Turker, 2016). The educational planning process of the online learning with the ADDIE model is most often used for the design of massive online courses (MOOCs) and is considered effective although there is always a negligible percentage of students who drop out of massive online courses with abandonment factors, as indicated in the relevant literature (Nordin et al., 2016; Trust & Pektas, 2018; Zampelis, 2020), not related to the ADDIE model (e.g. difficulty due to lack of previous experience with MOOCs programs, time commitment and perceptions for the trainer). However, the lack of skills, the motivation and the support are factors that contribute to the lack of commitment in a MOOC (Nordin et al., 2016). Also, the ADDIE model is preferred for the development of virtual reality commands (Soto, 2013) and is considered suitable for the design and implementation of mobile learning by enhancing students' positive attitudes and perceptions regarding the adoption and the use of technology for educational purposes (Hanafi et al., 2020). The success of e-learning is considered complete when a positive workplace attitude has been achieved. The training planning through the ADDIE model enables creating a positive attitude for the learners, even while transferring the acquired knowledge to their workplace (Santiari, 2015) Therefore, the ADDIE model may offer educational designers and educators a flexible and systematic strategy for the development of a flexible and interactive multiform e-learning (Patel et al., 2018). Finally, many scientists (Ali & Esia-Donkoh, 2021; Soto 2013) emphasize the adaptation of existing model, such as the ADDIE model for virtual reality environments, as many of them achieve both constructive analysis of students' learning behaviors and provide corresponding targeted feedback for learners' improvement based on their needs (Yu et al., 2021). As well as, this model encourages the organization and creation of innovative, useful and creative spaces for online training context, thus contributing to the improvement of learners' academic performance, motivation and involvement (Salas-Rueda et al., 2020).

The findings of the present meta-analysis indicate that the Kirkpatrick model is mainly used to measure the effectiveness of training programs in relation to the first two levels, i.e. *reaction* and *learning* (Lavender et al., 2013) and less for the third level, which is behavior / transfer (Lahti et al., 2014; Moreira et al., 2019). Also, the fourth level, which is defined as *results*, is rarer (Chang & Chen, 2014; Goh et al., 2018; Lin & Cantoni, 2018). Also, the specific model is applied in massive online courses (MOOCs), which are offered in asynchronous online environments. Since the Kirkpatrick model is a popular framework for evaluating e-learning by assessing the knowledge transfer in the workplace (Galloway, 2005), it was expected to be used in employee training programs in the wider corporate environment and not, mainly, in relation to medical and nursing training programs, as the results of the present search highlight. Possibly, this is justifiable, since according to Galloway (2005), the Kirkpatrick model cannot keep up with the modern competitive entrepreneurship that requires cost efficiency and measurable return on investment in education, creating a way to determine the cost to benefit ratio of knowledge. That is why Galloway (2005) and Kennedy et al. (2014) propose a combination of the Kirkpatrick model with another model, such as the ROI models, which will include a method for assessing intellectual property in terms of expertise and employee skill levels, effectively helping an employer determine the value of an employee or a group of employees. After all, workplace evaluation requires more complex approaches and therefore additional support and infrastructure (Kennedy et al., 2014; Paull et al., 2016).

The Bloom model is mostly used as a basis for measuring the effectiveness of e-resources - mainly e-textbooks, collaborative learning activities on student cognitive quality and assessment exercises - for online learning specifying the context or not of distance education (Hubalovsky et al., 2018). Those who emphasized the context of the distance education were very few choosing the asynchronous online learning approach and the use of the Revised Bloom Taxonomy (Lahti et al., 2014). The lack of researches on the Bloom model but also, on the other two models, in general, can be equated with the finding that the demand for online courses is not harmonized with appropriate pedagogical design (Abernathy, 2019; Barari et al., 2020; Khalil & Elkhider, 2016; Song et al., 2004). Finally, during the application of the Bloom model, it was observed that factors such as personality characteristics (extroversion-introversion and emotional stability-neuroticism), the style and type of learning, the growing acquaintance among the participants and the learner's work rate influence the effectiveness of e-learning (Blau et al., 2017; Weiser et al., 2018). The Bloom model is proposed in combination of adaptive algorithm and software taking into account the above factors, while the research field of this is a challenge for cooperative learning in distance education and mobile learning (Domun & Bahadur, 2014; Hubalovsky et al., 2018). Finally, the design of learning outcomes is directly related to student perceptions, motivation, involvement and achievement of learning outcomes (Kumpas-Lenk et al., 2018).

The Importance of the Examined Models to E-Learning regarding the Learning Performance of Learners

The impact of application of the above models to synchronous and asynchronous e-learning shows that all three models are valuable as sources of information extraction by providing good learning benefits (Hsu et al., 2014; Patel et al., 2018; Reio et al., 2017). As indicated in the relevant researches, when designing the learning process, the attention is given to the learner's abilities and to educational strategies for undertaking learning tasks, focusing on cognitive performance with comparatively less attention to emotional issues (Hatziroufa, 2019; Hsu et al., 2014; Ismail et al., 2018; Robinson & Dearmon, 2013) and factors directly related to the learning effectiveness, such as self-regulation and collaborative learning (Almelhi, 2021; Barari et al., 2020; Koc, 2020; Lavender et al., 2013; Weiser et al., 2018). In addition to the above, we found that all three examined models reinforced students' positive attitudes and perceptions regarding the adoption of strategies for the acquisition and the application of knowledge (Fernandes et al., 2020; Hanafi et al., 2020; Moreira et al., 2019) even though these often face limitations (Kumpas-Lenk et al., 2018; Nordin et al., 2016). All the above are mentioned in more detail below.

Regarding the cognitive performance of the trainees, all models supported the effectiveness of online distance education. In the ADDIE model, this is achieved as the e-course focuses on the learner's learning needs - not teaching - and recognizes the student's involvement with the learning object while achieving superior learning outcomes (Alturkistani et al., 2018; Robinson & Dearmon, 2013; Turker, 2016). Nevertheless, several researches (Durak & Ataizi, 2016; Gournakis, 2020) required the return of the Educational Designers to any previous stage for improvement interventions and a more enjoyable approach to learning objectives through the attractiveness of design. As Abernathy (2019) and Reinbold (2013) pointed out, these interventions are not directly related to the effectiveness of the model itself but mainly, to the mistakes of educational designers in the analysis and design phases. During the interventions, the main form of teaching through short multimedia presentation and, in fact, with an adaptation to the local culture in combination with different interactive exercises was suitable for the acquisition of all levels of knowledge while meeting the different needs of the learners (Hadullo, 2021; Manitsara, 2020; Mavroudi & Hadzilacos, 2013). As for the Kirkpatrick model, there is an improvement in the learning process in the context of both academic and professional performance of the trainees, despite the fact that transfer of knowledge in the workplace faces limitations in the application of learning due to political beliefs or leadership strategies or the lack of resources (Edwards & Black, 2012; Lin & Cantoni, 2018). However, Aluko and Shonubi (2014) and Chang and Chen (2014) point out that for the acquisition and transfer of knowledge, the learners' characteristics, such as abilities or skills, motivation and personality, also, play an important role in distance education. Also, educational design specialists do not devote more time to activities which are decoded in a positive behavior change and corresponding results that reflect the levels 3 and 4 of the Kirkpatrick model (Goh et al., 2018; Moreira et al., 2019). According to the findings of the meta-analysis, only learning outcomes designed at higher levels of cognitive demand enhance the learning

process, as more complex ways of thinking are required (Kumpas-Lenk et al., 2018). Unfortunately, specialist educators are devoted to designing learning outcomes that reflect the lower levels of Bloom's taxonomy while ignoring the needs of the wider competitive contemporary reality that demands more complex ways of thinking (Barari et al., 2020). That is why this model suggests the use of multiple combinations of learning activities based on virtual discussion forums (Lau et al., 2017), external e-tools (Domun & Bahadur, 2014), interaction using of animated films, gamification simulation software, virtual augmented reality technology (Ballera et al., 2014; Barari et al., 2020) and adaptive e-learning exercises (Hubalovsky et al., 2018) as part of the teaching activity, meeting the different needs of learners in a more efficient way (Ischimura et al., 2020). Moreover, Blau et al. (2017) highlight that for the acquisition of knowledge, the style of synchronous e-learning (one-way or two-way) and the learners' traits play an important role in distance education.

Considering the fact that self-regulated learning is a complex process (Pange, 2014) consisting of four components (Greene et al., 2014), this factor was examined, mainly, regarding the regulation of motivation and involvement while in relation to the regulation of cognitive skills, the metacognitive skills were not tested at all, as neither did the regulation of social conditions. Although the motivations of the learners include personal and professional training, with key components the needs of learning & self-realization, e-learning based on the ADDIE model enhance the motivation of learners through an accessible, enjoyable and innovative online environment (Almelhi, 2021; Hanafi et al., 2020; Hatziroufa, 2019) encouraging active learning (Almelhi, 2021; Trust & Pektas, 2018). Although all of the above are achieved by emphasizing the analysis and design phase, the results of Gournakis (2020) and Mavroudi and Hadzilacos (2013) indicated that improvement interventions were also needed. Then, the maintenance of learners' attention was strengthened and their motivation increased (Durak & Ataizi, 2016; Hanafi et al., 2020; Reinbold, 2013; Salas-Rueda et al., 2020). Subsequently, the learners demonstrated better involvement in learning even compared to students taught in a traditional way of education (Dogra & Dutt, 2016). As Abernathy (2019) pointed out, during the analysis phase, no attention is paid to the dimension "Need" closely related to motivation to learn, namely, "why" "every" student must learn the material. According to the Kirkpatrick model, although it is emphasized that the self-directed learning increases the efficiency of time management (Alturkistani et al., 2018; Goh et al., 2018; Lavender et al., 2013), a combined learning strategy is suggested as a perfect method (Chang & Chen, 2014). That is why the self-learning is achieved through interaction with others (Lin & Cantoni, 2017; Fernandes et al., 2020) and the learner is activated to engage in the learning process with his personality traits playing an important role in it (Aluko & Shonubi, 2014; Chang & Chen, 2014; Gowda & Suma, 2017). After all, self-regulated learners have higher motivation and greater control over their learning behaviors and therefore, create better learning outcomes both individually and in groups (Wang, 2011). Finally, for the model Bloom, the learning lower-level results may be one of the reasons why students do not feel committed to their studies and can explain the steady and slightly increasing dropout rates (Kumpas-Lenk et al., 2018). Sometimes, the level of e-learning (mixed learning, one-way or two-way video conferencing, asynchronous learning, etc.) can enhance the cognitive aspect of learners and jeopardize their emotional and social aspects (Blau et al. 2017; Weiser et al., 2018).

The following control variable, namely, the collaborative learning, was examined in very few studies per examined model with a small deviation of numerical data. In particular, according to the relevant literature, the ADDIE model creates a common mutual process of learning pursuit for all participants (Almelhi, 2021; Hsu et al., 2014; Huang et al., 2010). With the specific redesign of the e-courses, higher levels of learning, autonomy and cooperation of learners are achieved through the well-chosen multimedia (Hatziroufa, 2019; Ismail et al. 2018; Trust & Pektas, 2018) and the process of immersive in virtual worlds thereby enabling learners to participate in their learning as "active agents of change" (Soto, 2013). This interaction can often increase learners' motivation and reduce the number of students who drop out of e-courses before they have been completed (Durak & Ataizi, 2016). Moreover, the frequent evaluation strengthened the researchers' work gaining an insight into the overall learners' involvement with the lesson and the concepts and assignments that either facilitate or fail to facilitate the desired levels of interaction (Battle, 2019; Hess & Greer, 2016; Hsu et al., 2014). In addition to the ADDIE model (Huang et al., 2010; Wang, 2011), in the other two examined models, namely in Bloom (Barari et al., 2020) and Kirkpatrick (Chang & Chen, 2014; Lin & Cantoni, 2018), a combined learning strategy (self-directed and collaborative) is suggested as a perfect method as it leads to the acquisition of skills and knowledge simultaneously (Fernandes et al., 2020). Also, interaction can often increase student motivation and reduce the number of students who drop out e-course

before it is completed (Alturkistani et al., 2018). Moreover, these models suggest the use of the social media tools (such as Facebook and Twitter) as educational resources to develop students' social participation in the learning process (Domun & Bahadur, 2014; Lau et al., 2017). After all, the connection of e-learning courses with external online tools facilitates the high level of knowledge within Bloom taxonomy (Lahti et al., 2014).

In addition to the above, we found that all three examined models reinforced students' positive attitudes and perceptions. In particular, the implementation of the ADDIE model could enhance the positive attitudes and perceptions of students regarding the acquisition of more learning experiences and the adoption and use of technology for educational purposes (Hanafi et al., 2020; Nordin et al., 2016). However, these attitudes and perceptions often face limitations either from factors directly related to the process of e-learning (Kumpas-Lenk et al., 2018; Nordin et al., 2016) or the process of the transfer of knowledge to the work environment (Edwards & Black, 2012; Galloway, 2005). The change of attitude which has an impact on the workplace is also underlined in the Kirkpatrick model (Chang & Chen, 2014; Fernandes et al., 2020; Lin & Cantoni, 2018; Moreira et al., 2019), but researchers argue that the learner's characteristics, such as skills or abilities, motivation and personality, also play an important role in e-learning (Aluko & Shonubi, 2014). The application of the Bloom model emphasizes the fact that achieving learning outcomes designed at higher levels of cognitive demand learners not only achieve a higher level of knowledge with a more complex way of thinking but increase their satisfaction, motivation and involvement (Kumpas-Lenk et al., 2018; Lahti et al., 2014). In combination with the interaction required by the higher levels of the Bloom taxonomy, learners acquire a positive attitude and a new perception (Barari et al., 2020).

In conclusion, our findings are consistent with the view of Sharif and Cho (2015) and Paull et al. (2016) who argue that there is no fixed model to follow, but different models to meet different teaching and learning requirements in an evolving field. Of course, in some cases learning models could be used interactively or extensively, such as the Kirkpatrick model (Galloway, 2005; Kennedy et al., 2014). Possibly, this is justifiable, since according to Galloway (2005), the Kirkpatrick model cannot keep up with the modern competitive entrepreneurship that requires cost-effectiveness and measurable return on investment in education by creating a way to determine the cost-benefit ratio of education. Similarly, although the ADDIE model is a good illustration of the basic steps in the educational process of designing and developing e-learning courses, it lacks basic elements which correspond to the specifics of e-learning projects (Kuciapski, 2010). Moreover, the percentage of appropriate articles referred to the ADDIE model is relatively not negligible compared to the other two models, the use of which are attenuated or almost non-existent, mainly the Bloom model in online distance environments. Therefore, in recent decades, these models have been strongly criticized (Adnan & Ritzhaupt, 2017; Draper-Rodi et al., 2018; Santally, et al., 2012).

Although the processes of self-regulation and collaborative learning are factors directly related to the effectiveness of e-learning (De la Fuente et al., 2015; Evans et al., 2014; Gambrari et al., 2015; Gowda & Suma, 2017; Johnson & Johnson, 2011; Ozdileka & Robeck, 2009; Rabak & Cleveland-Innes., 2006; Wang & Hong, 2018), they were examined in very few studies per examined model with a small deviation of numerical data, as opposed to the cognitive performance (Almelhi, 2021; Barari et al., 2020; Koc, 2020; Lavender et al., 2013; Weiser et al., 2018), a finding confirmed by wider literature (Abdull Mutalib et al., 2022; De Rouin et al., 2005; Santos et al., 2016; Zafar et al., 2014). Taking into account the view of de la Fuente et al. (2015) and Greene et al. (2014) that self-regulation is an important and complex variable in the fields of education, work and research and that, if there is a deficit in any of its components, the trainee's learning capacity is disrupted or impaired, then the inclusion of all its elements in the specific variable is considered necessary. However, this factor was examined, mainly, regarding two of four components. So, this control variable should be considered for e-learning as well as the use of the social media tools and multimedia presentations as educational resources to develop students' social participation in the learning process (Sypas & Pange, 2014). In addition to the above, we found that all three examined models reinforced students' positive attitudes and perceptions regarding the adoption of strategies for the acquisition and the application of knowledge (Fernandes et al., 2020; Hanafi et al., 2020; Moreira et al., 2019) as a key for the complete success of e-learning (Eiriemiokhale & Idiedo, 2020) even though these often face limitations either from factors directly related to the process of e-learning (Kumpas-Lenk et al., 2018; Nordin et al., 2016) or the process of the transfer of knowledge to the work environment (Edwards & Black, 2012; Galloway, 2005) or the learner's personality traits (Gowda & Suma, 2017).

The aforementioned findings and limitations are mostly inextricably linked with the mistakes of educational designers (Adnan & Ritzhaupt, 2017; Kumpas-Lenk et al., 2018), a finding confirmed by wider literature review (Abdull Mutalib et al., 2022; Castro & Tumibay, 2019; Crompton et al., 2018). That is, educators–designers use strategies that focus more on cognitive performances and the design of the learning outcomes reflect the lower levels of knowledge while ignoring the emotional and cooperative factors, the basic principle of effective and efficient educational intervention (Smith & Ragan, 2005). Not only that, but also, Crompton et al. (2018) claim that trainees are forced to work at lower levels of knowledge even though advanced technological systems and applications are highly designed. Moreover, the strategies are designed whilst ignoring the achievement of the goals in the shortest possible time, as well as the transfer of knowledge to the wider competitive reality (Van Rooij, 2010). After all, the Educators shoulder the burden of the planning e-courses, often in the absence of adequate training and skills (Koc, 2020; Sharif & Cho, 2015). Hence, although according our findings, the application of the ADDIE, Kirkpatrick and Bloom models in distance education is considered effective, these educational models are not alone a guarantee that education will succeed. The educators–designers can make a well-designed lesson succeed or fail (Reinbold, 2013).

All the above may be related to the wider problem of the imbalance between the demand for e-courses and appropriate pedagogical planning (Abernathy, 2019; Barari et al., 2020; Khalil & Elkhider, 2016; Song et al., 2004).

Suggestions for Researchers and Practitioners

The present study investigated the effectiveness of the ADDIE, Bloom and Kirkpatrick models in distance e-learning environments and their contribution to the cultivation of factors such as the academic performance, the self-regulation and the collaborative learning.

Given that the research on the specific models in the framework of the distance education is limited, there is a wide scope of their research, namely, either by verifying the aforementioned surveys in a larger sample, as highlighted in most surveys or by expanding to other thematic areas, such as Educational Programs in the Humanities. Also, the effectiveness of these models could be done separately for the factor of self-regulation, or for the stress factor and other personality traits of students (extroversion & introversion) or in relation to the level of e-learning (mixed learning, one-way or two-way teleconferencing, asynchronous e-learning) or in relation to the principle of effective and efficient educational intervention, in other words, the achievement of goals in the shortest possible time or in relation to limiting factors in the transfer of knowledge to the work environment. Finally, it could be researched the adaptation of the existing models, such as the ADDIE model for virtual reality environments or mobile learning.

The guidelines listed above are only small incentives to a wide field of research, which is already challenging due to multiple variables and hidden threats.

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