Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v13i25.1237

Artículos científicos

La transdisciplinariedad de los recursos educativos abiertos, una alternativa para generar metacognición a nivel posgrado

The Transdisciplinarity of Open Educational Resources, an Alternative to Generate Metacognition at Postgraduate Level

A transdisciplinaridade dos recursos educacionais abertos, uma alternativa para gerar metacognição na pós-graduação

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Resumen

Esta investigación tiene como objetivo sintetizar y analizar la importancia del desarrollo de estrategias metacognitivas, los recursos educativos abiertos (REA), la eficiencia terminal, el diseño instruccional y los sistemas de información a la luz de las necesidades educativas que genera la educación híbrida. Se utilizó el método cualitativo-documental y se evaluó la calidad de las fuentes consultadas; se aplicaron las estrategias de revisión documental y discriminación de información. Se tuvo como resultado la caracterización de las propiedades de los REA y cómo a través de su uso se desarrollan y promueven habilidades como la comprensión lectora y el lenguaje escrito, competencias esenciales para generar investigaciones, protocolos de investigación y proyectos de grado, entre otros productos que

inciden directamente en la eficiencia terminal de los estudiantes de posgrado. Asimismo, se definen los modelos para el diseño y construcción de los REA: Dick y Carey, Morrison, Ross y Kemp y "Análisis, diseño, desarrollo, implementación y evaluación" (Addie). Finalmente, se concluye que existe un campo fértil en el área de sistemas para el desarrollo de metodologías de gestión educativa para enfrentar la combinación que existe entre lo presencial y lo virtual.

Palabras clave: estrategias metacognitivas, eficiencia terminal, diseño instruccional, recursos educativos abiertos.

Abstract

In this framework, this research aims to analyze the importance of the development of metacognitive strategies, open educational resources (OER), terminal efficiency and instructional design in light of the educational needs generated by hybrid education. The qualitative-documentary method was used, and the quality of the consulted sources was evaluated; the strategies of document review and discrimination of information were applied. The result was the characterization of the properties of OER and how, through their use, skills such as reading comprehension and written language are developed and promoted, essential skills to generate research, research protocols and degree projects, among other products that directly affect the terminal efficiency of postgraduate students. Likewise, the models for the design and construction of OER are defined: Dick and Carey, Morrison, Ross and Kemp, and Analysis, Design, Development, Implementation and Evaluation (ADDIE). Finally, it is concluded that there is a fertile field in the area of systems for the development of educational management methodologies to face the combination that exists between face-to-face and virtual.

Keywords: metacognitive strategies, terminal efficiency, instructional design, open educational resources.

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Resumo

Esta pesquisa visa sintetizar e analisar a importância do desenvolvimento de estratégias metacognitivas, recursos educacionais abertos (REA), eficiência terminal, design instrucional e sistemas de informação à luz das necessidades educacionais geradas pela educação híbrida. Utilizou-se o método qualitativo-documental e avaliou-se a qualidade das fontes consultadas; foram aplicadas as estratégias de revisão documental e discriminação de informações. O resultado foi a caracterização das propriedades dos REA e como, por meio de seu uso, são desenvolvidas e promovidas habilidades como compreensão de leitura e linguagem escrita, habilidades essenciais para gerar pesquisas, protocolos de pesquisa e projetos de graduação, entre outros produtos. eficiência terminal de alunos de pós-graduação. Da mesma forma, são definidos os modelos para o desenho e construção de REA: Dick e Carey, Morrison, Ross e Kemp e "Análise, desenho, desenvolvimento, implementação e avaliação" (Addie). Por fim, conclui-se que existe um campo fértil na área de sistemas para o desenvolvimento de metodologias de gestão educacional para enfrentar a combinação que existe entre o presencial e o virtual.

Palavras-chave: estratégias metacognitivas, eficiência terminal, design instrucional, recursos educacionais abertos.

Fecha Recepción: Enero 2022 **Fecha Aceptación:** Julio 2022

Introduction

The synthesis and analysis of data are essential for documentary research because, based on these procedures, the constructs that are to be addressed can be defined to explore a problem or situation in which it is sought to impact. In the XXI century, the ways and methods to transmit knowledge have been marked by the use of information and communication technologies (ICT); however, not all actors in the educational process are enabled to incorporate the new learning paradigms. Likewise, some studies indicate that the process of providing technology and telematic networks to institutions and households must be continuous so that they are trained on the new knowledge demands (Jiménez, Hernández and Rodríguez, 2021; Lowell and Ashby, 2018).

This requires the use of digital platforms that allow synchronous and asynchronous communication, which encourages the development of teaching strategies linked to technological innovation, for example, the use of open educational resources (OER),

understood as free educational resources and materials. and freely available on the Internet and with free licensing so that they can be reproduced, distributed and used for educational purposes with a global impact, as well as openly offering educational resources provided through ICTs for consultation, use and adaptation for non-commercial purposes. (Lnenicka, Kopackova, Machova y Komarkova, 2020; Roeder et al., 2017; Sandanayake, 2019).

As already mentioned, for both teachers and students the way to assimilate, adopt and adapt these new schemes of transmitting knowledge and carrying out feedback has been complex due to the transition from face-to-face education to mediated distance education. by new technologies due to the confinement experienced worldwide and the technological tools available to them (Lim, Wang and Graham, 2019).

On the other hand, it is unavoidable that educational institutions will have to restructure their educational policies to integrate digital transformation, because current demands imply the use of new teaching-learning models, among which educational digital resources should be included with the idea that its incorporation into pedagogical models is an opportunity to make education more flexible and accessible, improve learning results and that the skills of graduates are in tune with the demands of the labor market (Navaridas et al., 2020).

A reflection of this is what is shown in the report Young people and the COVID-19 pandemic: effects on jobs, education, rights and mental well-being of the International Labor Organization (ILO) (2020): 65% of the young people declared that, despite the efforts to continue their studies during the health contingency, they consider that their training process was delayed and 9% think about the possibility of abandoning them outright because they are not enabled and adapted to the new demands of blended education, which affects the training quality.

If the impact by educational level is addressed specifically, at the postgraduate level, low terminal efficiency is a factor that is considerably affecting educational quality, since, according to specialists, this deficit may be due to the fact that the titling processes be very stiff. On the other hand, there is the low production of publications and even research reports (Bonilla, 2015). Therefore, this study aims to synthesize and analyze the importance of developing metacognitive strategies, terminal efficiency, instructional design, OER and information systems.

Materials and methods

The qualitative-documentary methodology was used, which, according to the experts, allows the documents to be interpreted in a specific context and in a different way from the initial intention with which they were written (Gegenfurtner, 2019). In addition, it seeks to systematize and bring to light the knowledge produced before the one that is being built now (Snyder, 2019).

From the point of view of specialists, documentary research should not be understood as a simple search related to the subject, but as a series of methods and techniques for exploring, processing and storing the information contained in the documents, in the first instance, and the systematic, coherent and sufficiently argued presentation of new information in a scientific document, in the second instance (Johnson and Vindrola, 2017).

The investigation was done in three stages. The first consisted of examining journals related to the area of education and technology, indexed in databases or electronic repositories of scientific prestige: Scopus (https://www.scopus.com/), Springer (https://www.springer .com/la) and SciELO (https://scielo.org/es/). Scopus is a source-neutral citation and abstract database nurtured by independent subject matter experts; automatically generates accurate citation search results and up-to-date investigator profiles, and helps bolster institutional research performance, rank and reputation.

Springer contains an extensive collection of scientific and technical books and journals that provides researchers, scientific institutions, and corporate departments with distinguished quality content through information, products, and services. Finally, SciELO (Scientific Electronic Library Online) is a model for the publication of scientific journals on the Internet that disseminates and makes visible the science generated in Latin America, the Caribbean, Spain and Portugal, as well as groups national and thematic collections of scientific journals that meet criteria. quality.

Once the aforementioned databases were consulted, the second phase was carried out, which consisted of selecting those scientific publications that had the words in the name of the journal: educational technology, science, technology, computing, society, educational praxis, educational systems, digital education, scientific education, educational resources, knowledge, society and interaction and higher education, as well as in Spanish: educational technology, science, technology, informatics, society, educational praxis, educational

systems, digital education, scientific education, educational resources , knowledge, society and interaction and higher education.

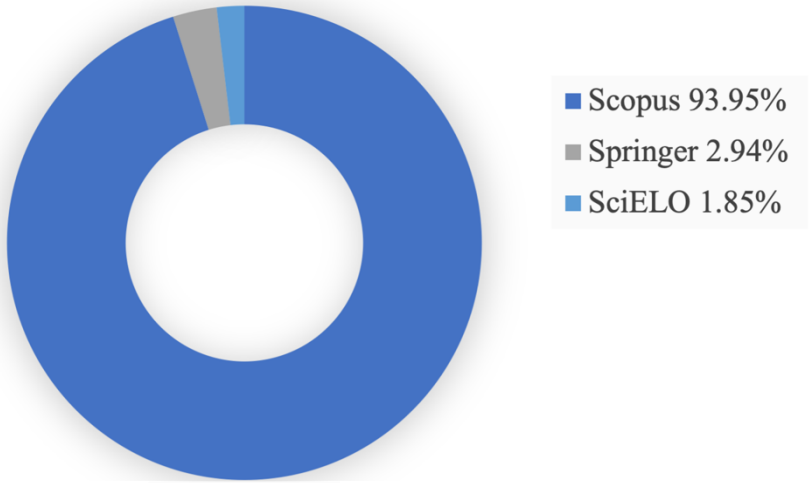
The third stage was to investigate in the journals found articles related to the following categories of analysis: Metacognitive strategies, Terminal efficiency, Instructional design and OER, that is, the constructs that gave guidelines to indicators, which were the minor aspects. These were translated into questions that were used in the data collection instruments. The questions were: what are the metacognitive strategies? What are the possible causes of low terminal efficiency at the university level? What is instructional design? And what are OERs and their usefulness?

The documentary qualitative approach was used based on the inquiry. Articles were analyzed that referred to the implications of terminal efficiency, the development of metacognitive strategies and the use of OER, based on its transdisciplinarity, with hybrid education as a context.

Results

In the Scopus, Springer and SciELO databases, in a period of 2017-2021, a total of 1588 indexed scientific journals were found that contain the word education in the name of the journal, as well as its equivalent in Spanish (education). distributed as follows: 1468, 91 and 29 in Scopus, Springer and SciELO, respectively. Next, another discrimination of information was made between the journals consulted in Scopus and those in Springer, since there was data redundancy because 45 names of the journals were repeated in both databases, that is, 48.96% of journals are indexed in Scopus and Springer; therefore, in Springer only 46 journals were located, which gave a total of 1,543 journals consulted (figure 1).

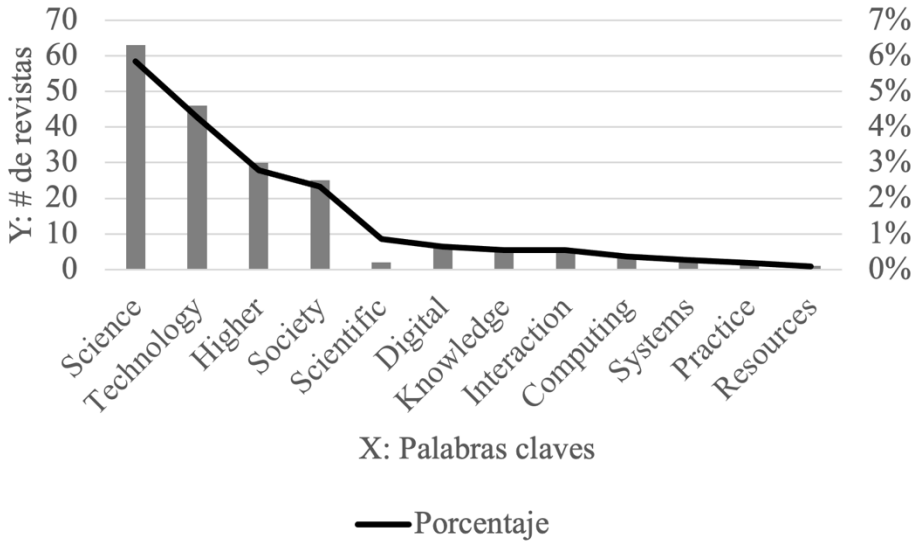
Figura 1. Distribución de revistas científicas que contienen en su nombre la palabra *education* o *educación* indexadas en Scopus, Springer y SciELO



Fuente: Elaboración propia

In the second stage, those scientific publications that contain words such as science, technology, computing, society, practice, systems, digital, scientific, resources, knowledge, society, interaction and higher were selected. In Scopus, 1073 journals were defined that are from the first to the third quartile because that is where the publications are grouped. Likewise, a total of 195 journals were located that include the words already mentioned in their names, that is, only 18.75% of the total (figure 2). However, Scopus was the database that brought together the largest amount of information on the different elements searched for compared to Springer and SciELO.

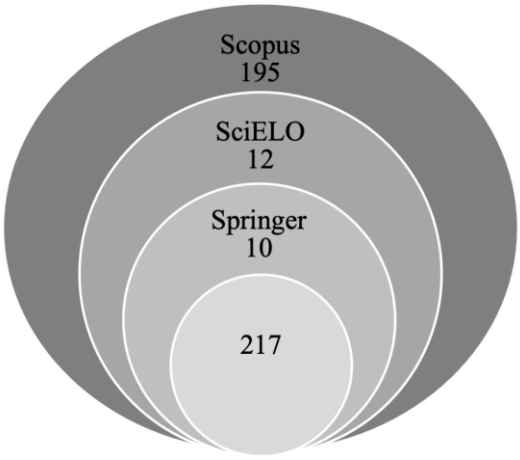
Figura 2. Revistas que incluyen en su nombre alguno o algunos de los temas en Scopus



Fuente: Elaboración propia

Regarding Springer and SciELO, out of 46 and 29 journals, only 10 and 12 have a word related to the term education in their name, that is, only 21.73% and 40.28%, respectively. If a comparison of the three databases is made, Scopus is the one that concentrates more information related to the investigation (figure 3). In sum, 217 journals related to the keywords mentioned in the second stage of the methodology were consulted.

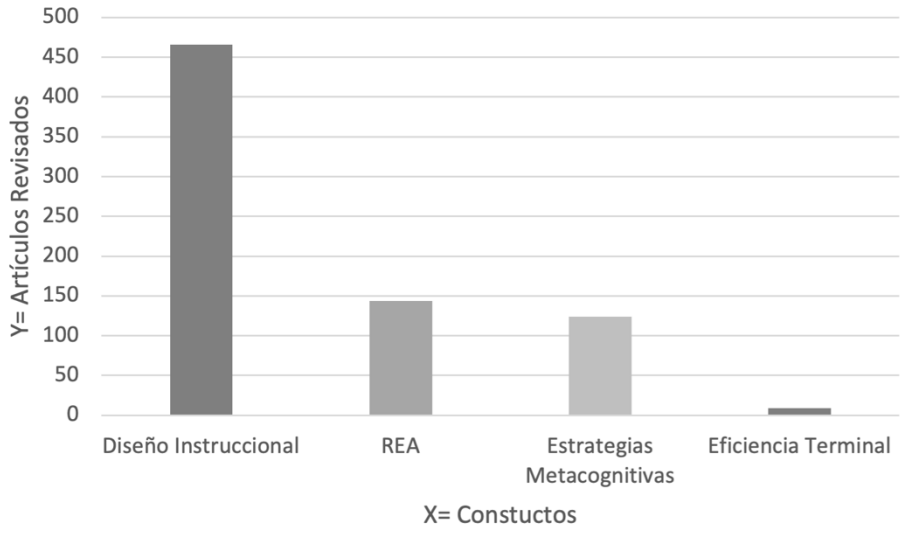
Figura 3. Revistas en las bases de datos en cuyo nombre tienen las palabras *education*, *science*, *technology*, *computing*, *society*, *practice*, *systems*, *digital*, *scientific*, *resources*, *knowledge*, *society*, *interaction* y *higher*



Fuente: Elaboración propia

In the third stage, articles related to the categories of analysis mentioned above were scrutinized in the journals found: metacognitive strategies, terminal efficiency, instructional design and OER, that is, the constructs that gave guidelines to indicators; As established in the methodology, these were the minor aspects that were translated into questions that were used in the data collection instruments. 217 journals were found and 743 articles were analyzed (figure 4). Of the articles found, those that answered the following questions were used: what are the metacognitive strategies? What are the possible causes of low terminal efficiency at the university level? What is instructional design? And what are OERs and their usefulness? Based on these parameters, 38 articles that directly address the characterization of each of the aforementioned constructs were analyzed and reviewed.

Figura 4. Artículos revisados relacionados con diseño instruccional, REA, estrategias metacognitivas y eficiencia terminal



Fuente: Elaboración propia

From the data obtained in this study, it is perceived that most of the scientific journals that have words related to education and educational technology in their name are located in non-Latin countries and in English. Likewise, it is identified that only 1.85% of the journals found belong to Latin America, the Caribbean, Spain and Portugal. Also, it is noted that the Scopus database brings together more scientific journals compared to Springer, in addition to the fact that the vast majority are also indexed in Springer. Additionally, it is established that Scopus, despite the fact that it brought together more journals related to education, of these only 18.75% were related to the categories Instructional Design, OER, Metacognitive

Strategies and Terminal Efficiency; and in the case of Springer, 21.73%; the largest in this regard was SciELO, with 40%.

Once the above has been done, the characterization obtained through the analysis of information is presented below.

Discussion

Open Educational Resources

OER, taking up the definition of the United Nations Educational, Scientific and Cultural Organization [Unesco] (2015), are any educational resource (including curricular maps, course materials, study books, streaming videos, multimedia applications, podcasts and any material that has been designed for teaching and learning) that is fully available for use by educators and students, without the need to pay royalties or license fees.

These types of resources offer new possibilities to improve and change the teaching and learning processes through information technologies that allow access to university studies from anywhere, promoting free access and thereby promoting the expansion of educational coverage (Contreras and Gomez, 2017; Golitsyna, 2017). Their reason for being is that they have enormous potential to contribute to improving the quality and effectiveness of education (Morris, 2019).

These types of resources support the development and improvement of curricula, the design of current programs and subjects, the planning of contact sessions with students, the development of quality learning and teaching materials and the effective assessment design, all of which, in sum, contribute to improved teaching and learning environments, along with cost control through increased resource-based learning (Unesco, 2015).

In addition, reaffirming what Rodríguez (2013) establishes, its use in the classroom allows a step forward in the transversality of knowledge, since, according to the needs of each user, it fosters shared learning, while reducing the gap. digital. Similarly, it brings advantages to facilitators because they can distribute educational objects such as simulations, audiovisuals, interactive applications, among others (Roeder et al., 2017), and thus, in passing, they manage to decentralize and globalize knowledge.

Likewise, Unesco (2015) maintains that there are three essential advantages of OER:

1) The increased availability of high-quality, relevant learning materials can help prepare productive students and educators, because OERs remove restrictions on copying resources and help reduce the cost of accessing educational materials.
2) The principle that allows the adaptation of the materials provides one of the mechanisms for the construction of the student's role as an active participant in the educational process, given that they learn better by doing and creating, and not passively reading and absorbing. Content licenses that encourage student activity and creativity through the reuse and adaptation of that content can go a long way toward creating effective learning environments.
3) OERs have the potential to increase training by allowing institutions and educators to access, at little or no cost, the necessary means of production to develop their competence in the production of materials.

These advantages will be given as long as the OER are prepared with quality criteria (Nesbit y Li, 2014):

1) *Content: truthfulness, accuracy, balanced presentation of ideas, and appropriate level of detail.*
2) *Alignment of learning objectives: alignment between learning objectives, activities, evaluations and characteristics of the student.*
3) *Feedback and adaptation: adaptive content or feedback driven by differential learner engagement or learner modeling.*
4) *Motivation: ability to motivate and interest an identified population of students.*
5) *Presentation design: visual and auditory information design for better learning and efficient mental processing.*
6) *Interaction usability: ease of navigation, predictability of the user interface and the quality of the interface help functions.*
7) *Accessibility: Design controls and presentation formats to accommodate disabled and mobile learners.*
8) *Reuse: ability to use in different learning contexts and with students from different backgrounds.*

These elements of form and substance will allow the OER to achieve their mission, in addition to helping the university to fulfill its mission from the social and economic aspects (Al Abri, Bannan and Dabbagh, 2021; Sabirova and Shigabutdinova, 2019). However, OERs

do not automatically lead to quality, efficiency and profitability, since this depends on the procedures established in each institution (Unesco, 2015).

As can be seen, it is interesting to analyze the repercussions that can be generated when two binomials are used, OER and metacognitive strategies, to make the comprehension processes more efficient in university students.

Metacognitive strategies

Although this conception dates back to the times of Aristotle and Plato, who identify the epistemological forms of being and knowing, and is later taken up by Thomas Aquinas and Saint Augustine, through reflection and introspection of being, it is not until the middle of the 20th century when it connects with behavioral theories. Piaget was one of the pioneers in managing this concept associated with developmental psychology; later, Vygotsky relates it to social development.

Its main premises are that, in order to incorporate new ideas and knowledge, it is necessary to identify how knowledge is acquired and how one learns to think; thus, generating awareness and controlling the information that is processed in thought, manifested most of the time in the school stages (Garrison and Akyol, 2015).

However, the term metacognition as it is known today was coined by John Flavell, who in 1976 published the article called Metacognitive Aspects of Problem Solving, in which he alludes to thought processes and defines metamemory-metacognition as knowledge and the subject's awareness of memory (Tsai, Lin, Hong and Tai, 2018). Later, Dökme and Koyunlu (2021) agree with this denomination, understanding that metacognition articulates various mechanisms that are adjusted according to the needs of the individual in order to adequately perform the tasks entrusted to them. (Akben, 2020; Gurat y Medula, 2016).

Although there are various definitions of metacognition, experts agree that the subject plans the information he has and acquires before performing a task, which means that he observes his thinking, learns and understands while executing a task. task. Thus, he manages to control and regulate his thinking to achieve success in the entrusted activities and subsequently evaluate them (Atmatzidou, Demetriadis and Nika, 2018; Esquivel, 2021; Perez et al., 2020; Uwamahoro et al., 2021) .

Therefore, learners who develop cognitive skills throughout their academic history manifest and are aware of what they have learned and what they do not know; In addition,

they can monitor their knowledge, express their concerns, write about what they have reflected on, stay current on the frontier of knowledge and implement new learning strategies that help them acquire and generate knowledge (Burcu and Havva, 2017).

From different revised theoretical positions on metacognitive strategies, metamemory is located, which serves to record, store and retrieve information. Also, to metalanguage, which starts from the use of language as a cognitive action to speak and write; in the latter, the compression of texts according to their properties and structure stands out to end in an appropriate interpretation and, as a culmination, the production of texts.

Metacomprehension goes hand in hand with metalanguage, since what is understood is spoken and written. In these three strategies it can be seen that essential processes are articulated: planning, supervision and evaluation, steps that are applied to any thought process (Bortone and Sandoval, 2014).

In this logic, reading comprehension is an elementary transversal competence. In this regard, in the study by Chirinos (2012) it was evidenced that although there is a degree of awareness about the mechanisms involved in the reflective act, there are still deficiencies to discriminate information, for which it is essential to apply strategies that help improve such. process to encourage the memory of what has been read and to be able to control the storage of the selected information. This coincides with what is established by Yuruk, Yilmaz and Bilici (2019), who explain that reading comprehension cannot be addressed without talking about metacognition.

For his part, Makuc (2015) characterizes university students with a poorly practiced reading degree, at least those who made up the sample of his study, because 58% of the responses of the participants pointed to a reading level inexperienced and 42% at an expert level.

In particular, reading comprehension in systems engineering students is a skill that has a significant impact on university learning and is clearly related to the comprehension of scientific texts and metacognitive planning and evaluation-control strategies, as demonstrated by the findings of the study by Villar (2020), which traces a significant relationship between both variables.

Other studies show that metacognitive awareness and the reading strategies used by postgraduate students help to achieve strategic or skillful readers, since metacognitive awareness is a cyclical process that, focused on text comprehension, is divided into three

subcategories : 1) global reading strategies, 2) problem-solving strategies and 3) supportive reading strategies (Hooshyar et al., 2020).

On the other hand, the use of resources mediated by technology in the production of scientific texts through metacognitive strategies can increase the motivation and confidence in the written production of learners (Cardona, et al., 2019; Ling, 2021; Lyons et al., 2017). In this sense, a focus of attention would be to know how terminal efficiency and reading comprehension are linked in the analysis and production of texts and how it can influence this scenario.

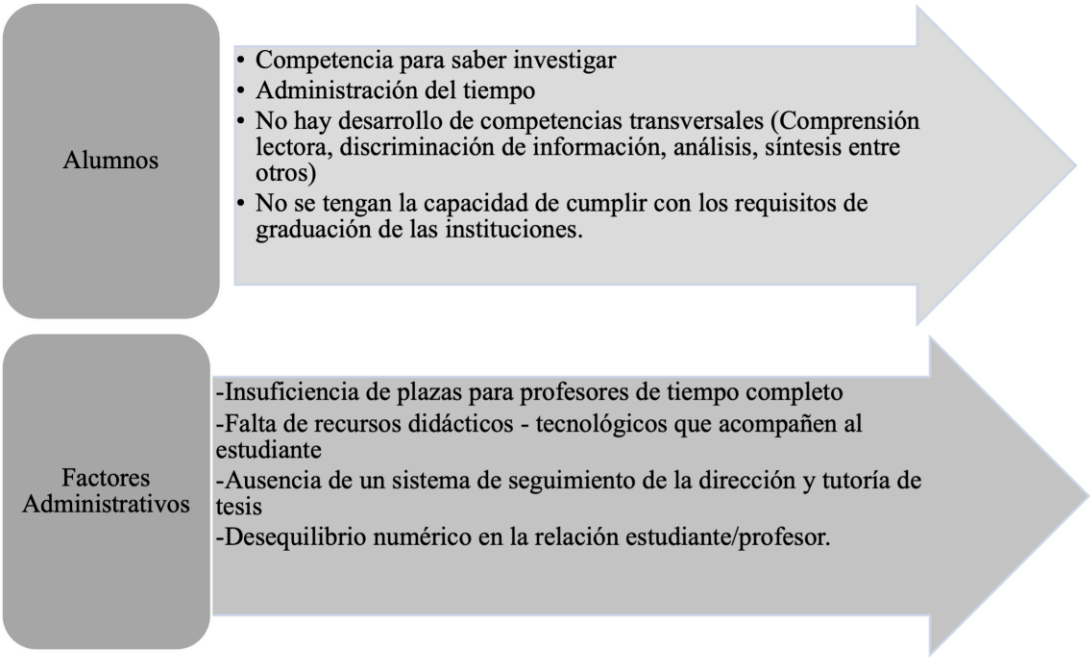
Terminal efficiency and reading competence

Terminal efficiency is understood as the number of students enrolled in the different programs of an institution, their generation and those who manage to graduate from the same generation, as long as they have accredited their entire curriculum, prepared their thesis or degree option and presented their degree exam in the times stipulated by the different study plans (Álvarez, Gómez and Morfín, 2012). In correspondence to the above, the National Association of Universities and Institutions of Higher Education [Anuies] (2021), in its 2019 annual report, announced that, of 361,267 students enrolled, 114,600 graduate and only 92,667 manage to graduate. . These figures indicate that at the postgraduate level only 25.65% of students manage to complete their studies and graduate. Even more, if the situation that continues to be experienced due to the pandemic is added to this percentage, these figures will undoubtedly have a downward trend in terminal efficiency.

According to the Mexican Council for Postgraduate Studies (Comepo) (Bonilla 2015), at this level the indicators in 2014 on terminal efficiency were 41.5%, 33.8% and 27.5% in specialty, master's and doctorate degrees, respectively. These figures show that there is a considerable deficit, for which there is an urgency to address this situation, since postgraduate studies and their impact on the environment is of great importance. In other words, the growth of postgraduate courses affects the institutional strengthening of universities and research centers, in the scientific and technological development of the different disciplines (Cho et al., 2021). Likewise, they innovate in the various economic activities of the country and influence the environment where higher education institutions are located.

Some factors that incur in low terminal efficiency are those that concern the students and those that have to do with administrative issues (Bonilla, 2015) (figure 5).

Figura 5. Factores que influyen en la eficiencia terminal a nivel posgrado



Fuente: Elaboración propia con base en el Comepo (Bonilla, 2015)

A relevant fact is that the development of transversal skills can stimulate the growth of degree projects, research and the production of scientific texts and thus encourage terminal efficiency. Transversal competences are understood as that set of wide-ranging skills that affect different tasks and are generated in diverse contexts; therefore, they are widely generalizable and transferable, which results in effective professional execution (Sá and Serpa, 2018).

However, various studies such as the one by Caron, Mattos and Barboza (2020) have found that the main difficulties presented by students at the postgraduate level are: problems in finding a researchable aspect, little habit of reading scientific publications, lack of knowledge of writing standards, problems in writing the document, ignorance of the process of publishing research articles and lack of accessible spaces for the dissemination of scientific information.

Additionally, we must not lose sight of the fact that sometimes higher education institutions maintain content-based and teacher-centered learning approaches that, although they incorporate new technologies in their teaching materials, continue to evaluate in a traditional way. Therefore, it is necessary to align the evaluation with the skills and learning activities mediated by new technologies, that is, student-centered (Guerrero y Noguera, 2018; Çalik, Ebenezer, Özsevgec, Zeynel y Hüseyin, 2015).

Given this scenario, the use of OER in postgraduate students can affect terminal efficiency, since they have certain characteristics that help achieve this goal, since they are free educational resources and materials with free licensing so that they can be reproduced, distributed and be used for educational purposes with global impact (Henderson, Finger and Selwyn, 2016).

Through these it is possible to arrive at the theoretical conceptualization of the previously defined topics, derived from the didactic sequence they contain. Among the attributes they possess, the most significant are: relevance, accessibility, certification and availability (Wiley, Green and Soares, 2012). Their use brings with it great benefits because they are easily accessible, contain a didactic sequence and are permanently available. Ultimately, OERs are essential to equipping young learners with new occupational skill sets and life skills (Kaatrakoski, Littlejohn, & Hood, 2017).

The advantages that Lamb, Etopio, Hand and Yoon (2019) found is that there is some improvement in the performance of metacognitive strategies (both argumentative and summative writing products) when learners are exposed to educational resources mediated by virtual environments compared to participants who only have access to traditional textbook experiences. A clear example of this was its use in India, which began in the education sector, however, due to its results, it has been expanding through the adoption of non-formal and lifelong learning sectors as well to adapt to changing needs. inclusion and quality growth throughout the country.

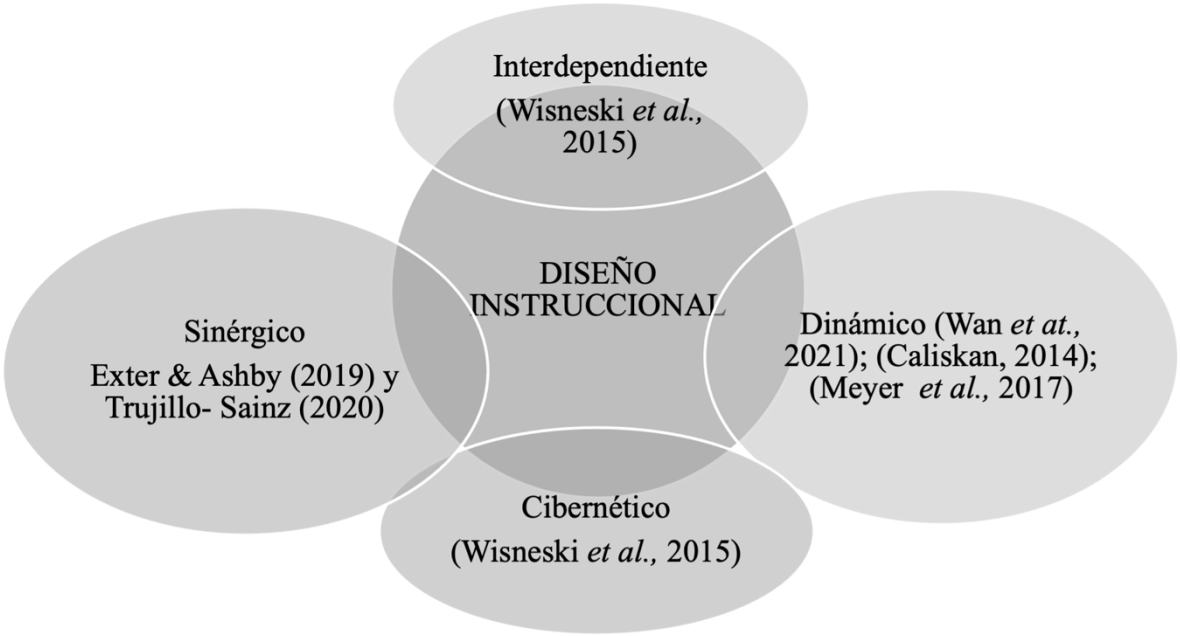
In short, the use of materials mediated by open access technology has a positive impact on university students, as pointed out by Arpaci, Al-Emran and Al-Sharafi (2020), who add that the way in which knowledge is accessed , storage and its application is accepted due to the advantages it offers compared to traditional resources such as textbooks, results similar to those reported by Burron and Pegg (2021), Romero, Vidal and Ramírez (2018) and Henríquez and Alvarez (2018).

In Mexico, Rivera, Lau, Esquivel and Martínez (2017) obtained as findings that the use of OER in postgraduate courses generates pedagogical flexibility and student-centered activities, encourages the development of skills and contributes to the personalization of teaching and even facilitates the student the production of contents.

Methodologies for the design of REA

In order to address the different OER development methodologies, one invariably has to talk about instructional design, because it is what gives the resources in question a reason to exist. This is defined as a system of procedures to develop educational content and training programs in a consistent and reliable manner (Caliskan, 2014; Meyer, Doromal, Wei and Zhu, 2017; Wang, Lee, Lin, Mi and Yang, 2021). Likewise, some specialists such as Exter and Ashby (2019) and Trujillo (2020) identified that instructional design is a set of integrated elements to achieve a defined objective. It is interdependent because it takes value from the content it wishes to transmit and it is cybernetic because it is supported by technology and computer systems (Wisneski, Ozogul and Bichelmeyer, 2015). Therefore, it must cover certain characteristics (figure 6).

Figura 6. Elementos del diseño instruccional



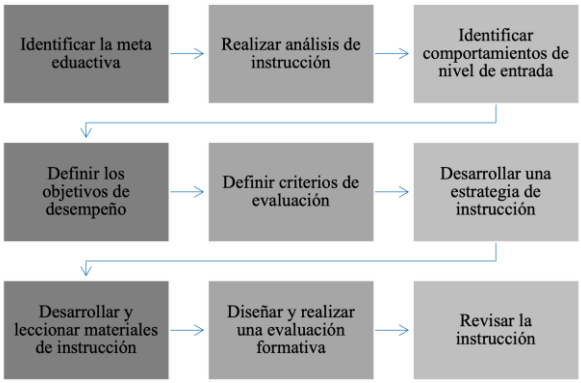
Fuente: Elaboración propia

Under this scenario, the question arises: what methodologies exist for the development of OER? One of them is the model proposed by Dick and Carey (Obizaba, 2015), which uses a detailed system of nine steps to give content to the course. In the same way, the model proposed by Morrison, Ross and Kemp (Obizaba, 2015) has four elementary

components: the student, the objectives, the method and the evaluation, and in turn they are deployed in other subdivisions. Finally, the prototype called Analysis, Design, Development, Implementation and Evaluation (Addie) is identified as being of a more constructivist nature; also, because each phase can be iterative and improved (Domínguez, Organista and López, 2018). It is worth mentioning that each stage is resumed to start with the next step.

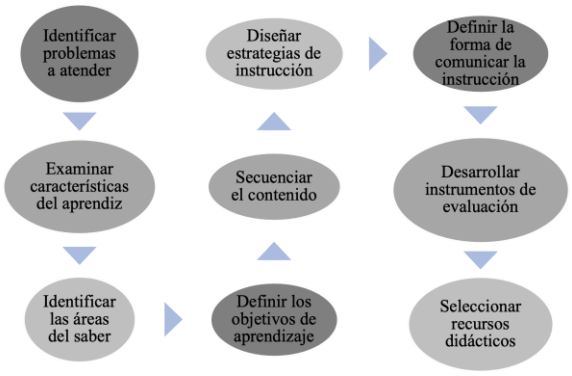
As can be seen, the models proposed by Dick and Carey (figure 7), Morrison, Ross and Kemp (figure 8) and Addie (figure 9) maintain some similarities, namely: the three proposals are focused on the needs of the student, they mention stages of evaluation and establishment of objectives.

Figura 7. Metodología de desarrollo de los REA propuesta por Dick y Carey



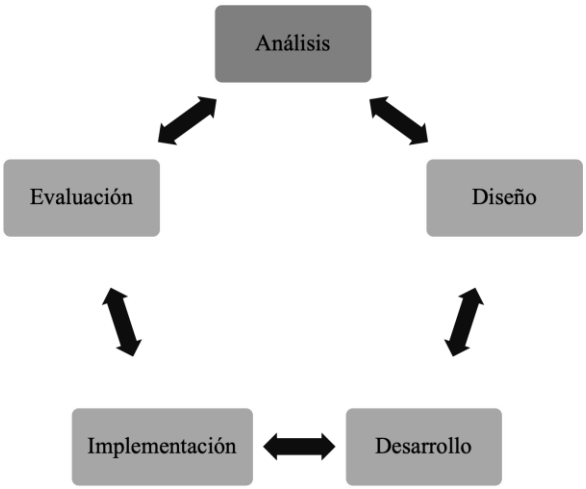
Fuente: Elaboración propia con base en Obizaba (2015)

Figura 8. Modelo Morrison, Ross y Kemp



Fuente: Elaboración propia con base en Obizaba (2015)

Figura 9. Etapas del modelo Addie



Fuente: Elaboración propia con base en Cheung (2016)

However, the first two models have more stages, with no possibility of regression, which is an advantage that the Addie model maintains. This is iterative and you can return to the stages in which there are adjustments as many times as necessary, that is, you can handle delivery products at each step and refine the products in question. Caliskan (2014) mentions in his research that this design is particularly useful for developing instructional programs that combine technology, pedagogy, and content to deliver effective and inclusive learning.

It should be noted that, regardless of the model to be used, it is necessary to consider collective research frameworks for its construction, such as the research process, the collective-didactic process and finally the technological one to facilitate the educational environments where they will be implemented, always considering the context. and good practices for its use (Michos and Hernández, 2020; Warner et al., 2020).

One of the recommendations made by Chanayotha and Na-songkhla (2015) is that the design must have content organization and planning as an essential quality because the results they obtained in their research were satisfactory because the sample of students improved the skills of writing and reading when they applied the stages of development of the Addie methodology. Similar results were reported by Castellanos and Rocha (2020).

Additionally, there must be a balance between the technological and the pedagogical contribution (Quitián and González, 2020), since sometimes there is a risk that the designer focuses more on the incorporation of new technologies for technical design and loses In view of the pedagogical issue, as is also recommended by Podolskij (2020) when indicating that an open educational resource should be considered as an intellectual tool rather than as an

algorithm that provides instructions for the actions of teachers (Arslan-Ari, Crooks and Ari , 2020; Cheung et al., 2018; Golitsyna, 2017).

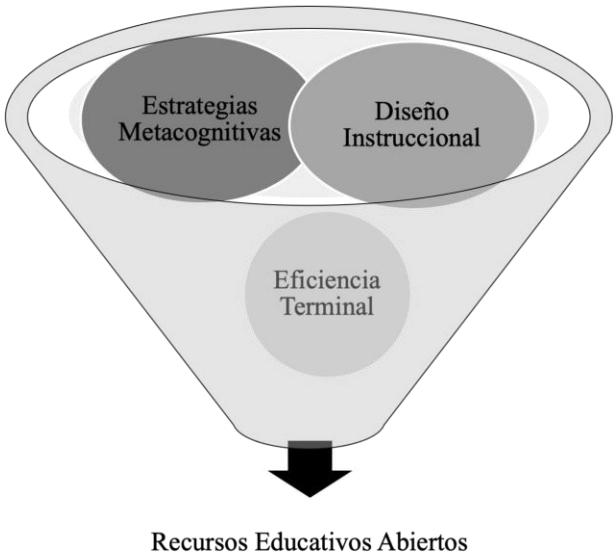
Consequently, the next question is what software can be used to build this type of resource? You can use a learning management system that is responsible for the administration of non-face-to-face teaching activities. Among its most outstanding functions are: user management (controlling their access and monitoring the learning process), content management (facilitating access to materials and the development of learning activities) (Javaid , Schellekens, H., Cryan and Toulouse, 2021). Also, carrying out evaluation processes and enabling communication and interaction services between users (chats, discussion forums, videoconferences); in addition to allowing reports and other additional services (González y Hernández, 2015).

Regarding the programming languages that can be used for the design and construction of OER, Action Script, Java Script, HTML and PHP are located; and for graphic design and animation, you can use SwiSHmax. Another software is eXeLearning, which is free, does not require an internet connection, is portable (does not require installation) and was specifically designed to contribute to the teaching-learning processes (Yánez and Nevárez, 2018). Likewise, GLO Maker is an open source desktop tool for the creation of educational content and that also allows you to create multimedia and interactive content in a guided way. The patterns used in Glo Maker are: 1) Explain and Show Amplified (EASA), which initially provides the student with a global approach to a certain concept to later work on and advance in the explanation through examples; 2) Evaluate Multiple Interpretation (EMI), which allows you to effectively teach multiple points of view on a given topic, and 3) Freestyle, which allows you to create resources from scratch (Dag, Durdu y Gerdan, 2014).

The transdisciplinarity of OER

According to the theoretical overview of the components of this study, as well as the analysis of various investigations on terminal efficiency at the postgraduate level and its relationship with the development of metacognitive strategies, such as reading comprehension and written language through Using the OER and using the instructional design, it is possible to distinguish a transdisciplinary systemic relationship (figure 10).

Figura 10. Modelo sistémico transdisciplinario entre los REA y su entorno



Fuente: Elaboración propia

Here transdisciplinarity is understood as a phenomenological perspective of reality and its manifestation in the world (Reséndiz, Zepeda and Peón, 2021). Therefore, this interrelation makes it possible to articulate triple helix knowledge (didactic-scientific-technological) and becomes a useful tool that helps the transition from traditional education to hybrid education, that is, the way forward is to generate learning environments. intelligent learning that pay more attention to the individual needs of students. This implies that the resources used for this task are adaptive and flexible to promote learning ecosystems that lead to personalizing and self-regulating academic training. (Cheung, Kwok, Phusavat y Harrison, 2021; Fawns, 2018).

Conclusions

After concatenating the results obtained through the synthesis and analysis of various investigations related to terminal efficiency at the postgraduate level, metacognitive strategies, OERs and their development models, it was possible to glimpse in the present investigation a systemic relationship transdisciplinary that addresses from different contexts the importance of producing tools that help generate skills that have a significant impact on the professional development of students.

By establishing the corresponding connections, we realize that terminal efficiency at the postgraduate level is affected by the lack of metacognitive strategies when analyzing and

developing scientific productions. Due to this, a viable way to strengthen these skills is through the construction and use of OER, due to their relevance and flexibility.

Future lines of research

There is a fertile field in the area of instructional design oriented to the generation of new resource construction models that are more aligned with educational policies that seek to support new models of education such as hybrid education, which means a challenge every time that It will be necessary to think of more flexible schemes to globalize the uses of these resources, considering the technological deficiencies that the apprentices present. Another route would be how to integrate teachers in the instructional design in an effective and balanced way, since sometimes not only the technological expert is required to have an effective and efficient resource, but also to have the pedagogical and specialized advice of the teacher to the success of the educational project.

On the other hand, it seems important to carry out information research and experiment with our own methodologies for searching for information that help simplify this process, without losing sight of the scientific rigor that it implies, in addition to clarifying the path that can be followed when carrying out a documentary review. and thus obtain a structured scrutiny that has a specific character, in order to systematize the information and, from its selection and analysis, make known theories and assumptions produced previously, incorporated into specific situations and thus produce new knowledge.

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