

# Open Educational Resources: Developing and Evaluating in Master of Educational Technology Learning's Students

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**Abstract** The purpose of this research was to develop and evaluate one Open Educational Resources (OER), identifying: (a) instructional design strategy to facilitating the meaningful learning, (b) build an OER about making concept map with quality and (c) evaluate it and contribute to OER debates. This investigation was conducted in a Mexican University (Master of Technology Learning). The epistemological orientation was a constructivist philosophical stance, research paradigm used was mixed. The method used was Educational Technology Research and Development (R&D). The research was a diagnosis and the development was an OER. This method is a design-based research to develop new products to improve education. For Kozma (2000) this method, “demonstrate that this research is now at the center of some of the most creative, original, and powerful work in education”. We applied a three level process of formative evaluation proposed by Dick, Carey & Carey (2005) and used their recommend instruments: (1) trying out OER one on one; (2) a small group tryout with eight students; and (3) a field trial with a whole class of learners (twenty students). After, we did a summative evaluation by seven experts. The participants were eighteen students. The research findings were: a new OER was created to facilitate the meaningful learning about making concept map, summative evaluation was conducted an evaluation about the OER's design strategy by seven experts to provide a professional and qualified judgment and to determine the overall value of the instruction, an analysis and interpretation of the evaluations. The instruments were questionnaires.

**Keywords:** *educational resources, learning resources, learning strategies, instructional design, instructional material evaluation*

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## 1. Introduction

The field of Instructional Technology has tended to give little or no formal treatment of the importance of OER in instructional design. According to Yuan, MacNeill & Kraan (2008) OER have increased attention for their potential and provided new opportunities for teaching and learning. At the same time, they challenge established views about teaching and learning practices in higher education.

This paper provides information on the back ground and current development of OER's instructional design strategy to facilitate the meaningful learning in making concept map for MTA's students and evaluate the quality of this resource.

In this sense, Kozma (2000) noted that the projects that use technology to take design beyond the exclusive domain of the instructional designer, these projects are

opening up the design process, making it explicit, and making it accessible to others. This author declared that the users learn how to use technology to design solutions to problems they encounter in their everyday world because the traditional experimental designs often are not able to accommodate the complexity of these real-world situations.

On the other hand, Ausubel, Novak & Hanesian (2006) indicated that the concept maps are a representation of meaning or ideational frameworks specific to a domain of knowledge, for a given context of meaning.

## 2. Literature Review

You need to have a general statement or two before starting the review of literature. Butcher (2011) declared that one of the sustainable efforts is to invest in developing and maintaining quality teaching and learning materials. Ausubel, Novak & Hanesian (2006) argue that

education institutions needs to properly integrate instruction technology and those institutions are responsible for selection and organization of materials for learning experiences.

Smaldino, Lowther & Russell (2008) designated that Instructional Technology is part of educational practices (pedagogical functions of the teacher), that guide the teaching and learning process. For Ausubel, Novak & Hanesian (2006) educational practices address the selection of learning activities which have a close relationship with the existing cognitive structure and incorporate the student's concepts and skills. Therefore, the teacher requires sensitivity and understanding to come up with teaching strategies such as setting objectives and learning activities to be performed by students, evaluation strategies, general conditions (feedback, articulation and socialization), developing instructional materials and resources to be used by the students. In this sense, the teacher is manager student's learning.

Preceding, Ausubel, Novak & Hanesian (2006) noted that one of the measures to facilitate meaningful learning is the improvement of instructional materials. Then, how should Instructional Resources will be structured in order to facilitate meaningful learning?

Gañán, Caballé & Conesa (2013) contend that materials are a set of content, methodological and instructional resources (such as self-learning activities, assessment, etc.) based on objectives that aimed to facilitate learning process. Instructional Technology provides tools, resources and helps teachers to reach intended goals. Gañán, Caballé & Conesa (2013) noted that one function of these materials is motivating the student and communicating the content to facilitate understanding.

## 2.1. Educational Technology

Association for Educational Communications and Technology (AECT) declared that educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological process and resources (Januszewski & Molenda, 2008).

Concerning this definition, Januszewski & Molenda (2008) designated that resources for facilitating learning are central to educational technology field that requires ongoing knowledge construction and refinement through research and reflective practice. These authors noted that this field has been expanded with technological innovations, new knowledge development and the way that these technological tools help to guide learners, that is, mediated educational practices by different technologies. For Winn (2004) educational technology is applied field, its purpose is to improve practice (instructional design being part of this practice), it is selection of the courses or materials that will lead to the best results. This author noted that the instructional design relies on two things: (1) validity of the knowledge of effective instruction and (2) the reliability of the procedures for applying that knowledge.

### 2.1.1. Open Educational Resources

In 2001, Massachusetts Institute of Technology (MIT) announced the MIT Open Course Ware (OCW), is a global model for open sharing. This initiative has a

website (web-based electronic publishing), accessible on the Internet, making its core teaching materials (lecture notes, problem sets, syllabi, reading list, simulations, etc.) openly available for non-commercial educational purposes. These materials are OER; the MIT declared that the website visitors are highly satisfied with the quality of OCW content because this site is providing significant impact on their learning.

In this sense, for the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2012), Open Educational Resources provide a strategic opportunity for access to education, exchange knowledge, capacity building and improvement of quality education. The main feature of OER is generally free access for everybody for the self-learning, the self-cultivation and developing cyber cultural competences. That is: available information, multimedia teaching, instructional materials, learning for educational evaluation and research. We need to build OER for contributing to the user self-cultivation and to create meaningful learning materials proposed by Ausubel, Novak & Hanesian in 2006 or instructional resources suggested by Gañán, Caballé & Conesa in 2013.

In Mexico, Academic (In Spanish: Académica, 2014) a Knowledge Digital Community is an initiative arising from the imminent need to open virtual spaces of teaching and learning contributing to the development and training of individuals; created to promote the generation and exchange of knowledge in different areas. Also, this website has one space for open contents (OER).

Therefore, for the UNESCO (2002), some of the OER are open courseware and open teaching/learning resources; in defining these resources, the elements to consider are : (a) the vision for the service: open access to the resource, with provision for adaptation; (b) the method of provision: facilities using of information and communication technologies; (c) the target group: users diverse community; (d) the purpose: providing an educational, non-commercial resource; and (e) the open provision of educational resources, enabled by information and communication technologies. The OER goals are consultation, using and adaptation by a community of users for educational purposes and non-commercial. Table 1 shows an analysis about OER definitions proposed by different authors.

Based by reviewing the history of the OER concept, allowed us: classify these definitions, identify a central thesis of the authors and analyze their epistemological orientation about these resources. Hence, evaluate the OER designed. Hylén (2006), OECD (2007), Downes (2007), Baker (2007), Lane & McAndrew (2010), Goodwin (2011) and Wiley, Green, & Soares (2012) focused on free and digital educational materials. Their central theses are that knowledge must be open, free and shared with all the people who want to learn. The knowledge is acquired with the use and re-use of the OER.

Only Dos Santos (2008) and Lane & McAndrew (2010) have a constructivist position because their declared as a social construction of knowledge and understanding a multiple participant meanings. Their said: OER are widening participation and empowering individuals through access to knowledge and virtual collaboration with people who desire opportunities for learning. Our position about OER is a constructivist position, because meaningful learning occurs when students actively

construct their own knowledge, make sense out of the OER and understanding a multiple participant meanings.

**Table 1. Open Educational Resources Definitions Found in the Literature Review**

Year	Author(s) and epistemological orientation	Definition / Theoretical Contribution
2006	Hylén (Pragmatic)	OER are digitized materials offered freely and openly for educators, students and self-learners to use and re-use for teaching, learning and research; these materials include open content, but is not limited to it, because it can include: <ul style="list-style-type: none"> <li>• Learning content: full courses, courseware, content modules, learning objects, collections, and journals.</li> <li>• Tools: software to support the development, use, re-use and delivery of learning content including searching and organization of content, content and learning management systems, content development tools, and on-line learning communities.</li> <li>• Implementation resources: intellectual property licenses to promote open publishing of materials, design principles of best practice, and localization of content.</li> </ul>
2007	Downes (Interpretivists)	OER a wide variety of resources available, saying some material published by non-commercial entities like professional societies is not freely available or open while other resources created by profit-seeking enterprises like Google are “widely and freely available without constraint”
2007	Organisation for Economic Co-Operation and Development. Centre for Educational Research and Innovation (OECD) (Interpretivists)	OER are digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research.
2007	Baker (Objectivists)	OER a wide variety of educational material can be ‘open’ including: (a) learning objects like flashcards and puzzles, (b) audio and video lectures, (c) images such as photos, (d) sounds and music, (e) entire courses or ‘opencourseware,’ (f) collections of articles, (g) textbooks, and (h) software
2007	Atkins, Brown, & Hammond (Objectivists)	OER are teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license

**Table I. Open Educational Resources... continue**

Year	Author(s) and epistemological orientation	Definition / Theoretical Contribution
2007	Atkins, Brown, & Hammond (Objectivists)	that permits their free use or re- purposing by others. These OER include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge.
2008	dos Santos (constructivist)	OER widening participation and empowering individuals through access to knowledge
2009	Bissel (constructivist)	OER knowledge free in the sense of being open to sharing, customization, translation, and virtual collaboration with people who desire to improve opportunities for learning
2010	Håklev (Interpretivists)	The term is understood to mean that the material is also covered by an open license, usually a Creative Commons, which specifies which additional rights users have to modify, share and reuse the material. This is related to the history of the concept, which came out of the Open Source movement, where programmers freely share the source code of their programs with each other and encourage hacking and improvement
2010	Lane & McAndrew (constructivist)	Offering free access to some material online has shown the impact that openness can have on learners and identified a range of behaviors that cluster around content driven and social driven approaches to learning.
2011	Goodwin (Interpretivists)	OER are digital materials offered openly and freely for others to use and reuse for teaching, learning and research. Provide information to improve access, student success and reduce student costs to attend higher education
2011	The United Nations Educational, Scientific and Cultural Organization (UNESCO) (Interpretivists)	OER describes any educational resources (including curriculum maps, course materials, textbooks, streaming videos, multimedia applications, podcasts, and any other materials that have been designed for use in teaching and learning) that are openly available for use by educators and students, without an accompanying need to pay royalties or license fees.
2012	Gurell (Objectivists)	OER (e.g. lessons, plans, quizzes, syllabi, instructional modules, encyclopedia entries, and simulations) that was freely available for use, reuse, adaptation, and sharing. An OER may be open or closed to differing degrees depending on how it is licensed.
2012	Conole & De Cicco (Interpretivists)	The concept of sharing materials has gained some ground over the last decade, the principle of OERs is simply that teacher and lecturers make their learning materials freely available for others to use.
2012	Wiley, Green, and Soares (Interpretivists)	OER are educational materials produced by one party that are licensed to be used free of charge by others. These resources come in many forms—from curriculum to homework assignment to textbooks.

### 2.1.2. Debates about OER

Hylén (2006) designated some critical issues about OER, surrounding access, quality and costs of information, content and learning materials. This author said that Internet offers opportunities for improving access and transfer of knowledge and information; proposed what is meant by open and what are the arguments for striving for openness?

Wiley, Green, & Soares (2012) sought to provide a substantive understanding of OER and at the same time informed the emerging public debate over their use in public education, The OER must be part of the broader conversation concerning spiraling education cost and the

need to make education more accessible and affordable at all levels.

Wiley, Green, & Soares (2012) noted that OER hold some of the answers to maintaining the quality of learning material while significantly reducing the cost of education. Also, these authors marked that OER are being used by students for self-study, by teachers to enhance classroom learning, and by education providers to bring down the cost of instruction. But, what is the difference between educational materials and resources?

For Misra (2013) the critical phase for OER movement is: (1) the number of OER is increasing rapidly, and (2) debates about quality of OER-based course are heating up. For this author, the debates emanate from the fact the OER-based courseware are supposed to help users to

follow a logical learning path and get an engaging, interactive, and enjoyable learning experience. For this author present paper discusses and details about a number of guiding principles for enrichment of pedagogical quality in OER-based courseware.

Since 2006, literature review analyzed that the discussions about OER are: (1) The meaning of open (Hylén, 2006), (2) Quality Hylén (2006), Wiley, Green, & Soares (2012) and Misra (2013), (3) Costs Hylén (2006) and Wiley, Green, & Soares (2012), (4) Education more accessible and affordable at all levels (Wiley, Green, & Soares, 2012). Then, how can we build an OER with quality that facilitate meaningful learning?

### 3. The Study

#### 3.1. Context

**Area.** The Master's Degree in Educational Technologies (In Spanish: Maestría en Tecnologías para el Aprendizaje or MTA) in a public Mexican University. The curriculum of this master has a credit system, and the teaching-learning procedures are developed in a blended modality; some of the subjects are taught in person (face to face) while some others are delivered on line, inside a virtual environment (Modular object-oriented dynamic learning environment, Moodle) where the teacher and the students interact.

**Problem.** We made an initial diagnosis for statement the next problem description. In the first grade's students of the MTA require strategies to obtain meaningful learning, these students proved to have skills in the development of some kind of schemes. They have capabilities in studying MTA because most of them are self-managed, with clear objectives, having obtained qualifications between 80 and 100 percent, being able to elaborate academic writings, Power Point resources, and who have developed a research protocol.

However, at least 90% of the students do not know how to build concept maps. From the above, a problem about instructional design was identified; this raises questions such as, how to validate of the knowledge of effective instruction? And how reliable are the procedures for applying that knowledge?

**Research Questions.** The research questions designed for this study were: How to develop an OER's instructional design strategy to facilitate the meaningful learning in making concept map for MTA's students? How to build an OER about making concept map in the MTA's course with quality? How to assess this OER by experts?

**Purposes.** (1) Develop an OER's instructional design strategy to facilitate the meaningful learning in making concept map for MTA's students, (2) Build an OER about making concept map in the MTA's course with quality and (3) Evaluate the quality of the OER.

#### 3.2. Method

The method used in this investigation was Educational Technology Research and Development (R&D). According to Gall, Gall & Borg (2007) in the field of the Educational Technology, this method is a design-based research to develop new programs and materials to

improve education. For Kozma (2000) "Educational Technology Research and Development demonstrate that this research is now at the center of some of the most creative, original, and powerful work in education today". This author said: "no other area of research in education is now as productive and intellectually stimulating as that related to R&D". First, in the research, we made an initial diagnosis and the second, we was to develop a new material (OER). The goal of this material was: at the end of the instruction, MTA's students will be able to build and evaluate knowledge schemes represented as concept maps utilizing CMap Tools program. After, we evaluated the OER's quality.

For Gall, Gall & Borg (2007), in order to investigate new products is necessary to use the R&D method. These authors proposed that in the development must to use the systems approach model by Dick, Carey & Carey (2011), with the integration of a Summative Evaluation by Scriven in 1974. In this case, we used all the steps of this model for new OER, and for the evaluation we were used three survey instrument.

**Participants.** The applicants who enroll into the MTA have a bachelor's degree. The student's age range is between 22 and 55 years old; they have or quickly get the capabilities in studying this master's degree. The students were 20, 14 women and 6 men. For this context, is required developed a quality OER that conducive to meaningful learning, but how build it?

The criteria used to select the researchers were, being experts in: (a) learning theories, (b) apply these theories in educational practices and (c) instructional designer.

**Instruments.** In this case, to validate the effective instruction of the OER and reliability of the procedures was evaluated the instructional design. We applied a three level process of formative evaluation proposed by Dick, Carey & Carey (2005) and used their recommend instruments: (1) trying out prototype OER one on one; (2) a small group tryout with eight students; and (3) a field trial with a whole class of learners (twenty students). After, we did a summative evaluation by seven expert designers. For data collection we applied three instruments (one on one, small group and field trial). Based upon the results the OER was modified and further developed and improve the quality.

#### 3.3. Results

For answering the first research question, a new product(OER) was created to facilitate the meaningful learning about making concept map for MTA's students, we designed an instructional strategy. This instructional strategy was applied in an OER: assessing needs to identify goals, conducting instructional analysis, analyzing the learners and contexts, writing performance objectives, developing assessment instruments, developing instructional strategy, developing and selecting instructional materials, designing and conducting the formative evaluation of instruction, revising instruction, and conducting summative evaluation, all the process proposed by Dick, Carey & Carey (2011).

For answering the second research questions: How to build an OER about making concept map in the MTA's course with quality? Summative evaluation was conducted an evaluation about the OER instructional design strategy

by seven experts to provide a professional and qualified judgment and to determine the overall value of the instruction, these experts were interviewed in regard to evaluating this OER. All experts agreed that the OER design strategy facilitated the meaningful learning of the students. Based on their observations, we identified potential improvements to this instructional strategy, the design was reviewed and changes were made according to the suggestions made.

For answering the third research question: How to assess the OER by experts? Three evaluations were applied. The first was one-on-one evaluation (i.e., one evaluator working with one learner). In this evaluation a student (population investigated) participated, who gave suggestions, comments to the researcher to improve the OER and the changes were made; in the second small-group evaluation eight students participated, seven stated that the OER provide the meaningful learning and one disagreed; in the third assessment (field evaluation), eighteen students participated, they evaluated the OER instruction in the context of implementation and found weaknesses in order to improve the OER. Also, measure student attitudes about whether meaningful learning led instruction and obtained a positive opinion as agreed or strongly agreed on whether OER facilitated this type of learning.

In this sense, the researchers were revived as proposed by Ausubel, Novak & Hanesian (2006), that the student has the attitude or interest to learn significantly, to recover the students' prior knowledge or their previous schemes as a departing point, establish a strategy for the student relating substantially the knowledge models he/she already has with new knowledge and the student connects the new learning to his/her context, experiences, events or objects.

### 3.4. Discussion

In this investigation was applied a strategy to facilitate meaningful learning in an instructional design strategy of the OER about making concept map for students of the MTA. To facilitate this type of learning, the first task for designed this OER was the pre-instructional activity where the student's prior knowledge is retrieved.

About this prior knowledge, Gagné (1985) called organized prior knowledge; Merrill (2001) noted that is activation of prior experience and Driscoll (2005) declared that this meaning occurs when learners actively interpret their experiences using certain internal and cognitive operations. In this sense, Ausubel, Novak & Hanesian (2006) noted that the student will learn significantly if learning task may be related to what the student already knows, also, the student will adopts a meaningful learning.

Based on the above, it is inferred that it is necessary a pre-instructional activity in which recovers the students' prior knowledge or their previous schemes as proposed by Ausubel, Novak & Hanesian in 2006. Also, Smaldino, Lowther & Russell (2008) declared that is necessary assess students' prior knowledge with the purpose of gather information about their knowledge and skill level. In this way, Bruner (1986) claimed that constructivism focuses on the importance of prior knowledge (what the student knows) to what they perceive from out interactions with the environment.

The second task for designed the OER was develop learning activities that promotes meaningful learning, this activities were: the students reading an issue, concepts selected, organized according to their hierarchical relationships, linking words are used to describe the relationships among these concepts. After, they create a visual and spatial representation with CMap Tools program and then evaluate their schemas (concept map) these activities area cognitive for the students, it improves the construction of knowledge.

For Merrill (2002) the most effective learning activities are those that are problem-centered and involve the student in activation of prior experience, demonstration and application of concepts to real-world settings. Although, Misra (2013) declared that meaningful learning requires that the learner engage in substantial cognitive processing during learning and Mayer & Moreno (2003) considered that meaningful learning involves cognitive processing and building connections.

The previous exposed, it is inferred that it is necessary a meaningful learning activities that are problem-centered or their previous schemes as proposed. These offer opportunities for instructors to engage with students. Thus, concept mapping promotes the development of critical thinking skills.

On other side, the design and development of new products (OER), these products were a knowledge construction about something that did not exist. The development was based on systematic instructional design model of Dick, Carey & Carey in 2011. About it, Gall, Gall & Borg (2007) noted that for investigate new products (OER) is necessary to use the R&D method. These authors proposed that in the development must be used the systems approach model by Dick, Carey & Carey (2011), with the integration of a Summative Evaluation by Scriven in 1974.

Based on the above, it inferred that the instructional design is a knowledge construction because the developmental of this design was taken as a research (about combine of theory and practice). Authors as Bartolomei (2007) and Deabbagh (2014) reported that the instructional design is a process of supporting knowledge construction. The instructional design was based at model by Dick, Carey & Carey (2011) as proposed by Gall, Gall & Borg in 2007.

In this sense, Richey, Klein & Nelson (2004) noted that the developmental research is studies that involve the production of knowledge. This production is with the purpose of improving the processes of instructional design, development, and evaluation.

## 4. Conclusions

In 2005, MIT made an OCW program evaluation, the data was organized according access, use and impact. For this evaluation, data sources was web metrics (surveys of OCW users, MIT faculty, MIT students, and MIT alumni, e-mail feedback, OCW visitor interview and affiliate project data). The findings of this evaluation was: (a) online access to MIT Open Course Ware content continues to grow (1 million monthly, it represents a 56% annual increase), (b) this site is being used by educators, students and self-learners, the visitors are satisfied with

the breadth, depth and quality of OCW content and (c) individual educators and learners report high levels of current impact on their learning goals, visitors indicated that OCW had significant impact, institutions internationally and the United States are publishing openly, creating a growing body of available courseware.

In this way, based on the results of this study, the outcomes of a formative evaluation (one to one, small group and field test) and summative (experts evaluation) seem to support meaningful learning and the OER is being used by MTA students. These students report impact on their learning goals. Participants in the study were given the opportunity to control their meaningful learning. This could suggest that individuals involved in meaningful learning demonstrate an individual achievement through the activities that they made with the OER used.

This study illustrates changes in teaching and learning practices, these changes are good as teachers as students, because both of them are using OER. The open access is important because the students will be more academic powerful with OER when they need it in anytime in anywhere. The teachers will have more tools for management learning (teaching).

Also, according Mayer (2009) to the knowledge construction view, the learner is a sense-maker, whereas the teacher is a cognitive guide who provides guidance and modeling on authentic academic tasks. On the other way, that knowledge is constructed by the designer, in this construction process the learner.

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