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Albarracin Villamizar, Carmen Zulay; Hernandez Suarez, Cesar Augusto; Rojas Suarez, Jhan Piero
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USING VIRTUAL LEARNING OBJECTS TO DEVELOP NUMERACY SKILLS: AN EXPERIENCE WITH BASIC EDUCATION STUDENTS

objeto virtual de aprendizaje para desarrollar las habilidades numéricas: una experiencia con estudiantes de educación básica

Carmen Zulay Albarracin Villamizar
carmenzulayav@ufps.edu.co
Universidad Francisco de Paula Santander, Colombia
Cesar Augusto Hernandez Suarez cesaraugusto@ufps.edu.co
Universidad Francisco de Paula Santander, Colombia
Jhan Piero Rojas Suarez jhanpierorojas@ufps.edu.co
Universidad Francisco de Paula Santander, Colombia

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INTRODUCTION

Recent observations and analyses conducted in educational institutions in Colombia evince students' lack of comprehension and interpretation of content pertaining the four mathematical operations, referring to basic concepts as being unclear. Based on this fact, it would be valid to ask if these difficulties could be the cause of students' underperformance in the Saber tests for the 3rd, 5th and 9th grades. A descriptive analysis of the Saber tests for 3rd, 5th and 9th grades (of 2009, 2012 and 2013), and Saber 11 (2014) in Bogota, Colombia, recommends that mathematics for 3rd graders requires strengthening aspects related to addition and multiplication; likewise, it argues that mathematics for 5th grade requires working on combination of numbers, construction of Cartesian planes, representation of data and formulation of problems (District Secretary of Education, 2014).

Also, some of the limitations of students' understanding of mathematics are associated with their type of learning and with the fear that has been traditionally associated with the subject, Nuñez et al. (2006) affirm that many pupils perceive mathematics as intrinsically complex knowledge that generates feelings of anxiety and unrest, constituting one of the most frequent causes for frustration and negative attitudes;

therefore, it can be said that students have an overall fear throughout basic education, and it may influence their future results and thus, drive demotivation.

On the other hand, traditional methodologies that are mechanistic, repetitive and require memorization in operation solving are given lots of importance, which can consequently lead to a lack of connection between concepts, use of basic operations, application and operationalization in their daily lives. Moreover, there are reports of lack of strategies in terms of new ways, spaces and times aimed at construction of knowledge through active learning applying Information and Communications Technology (hereinafter, ICT).

In that regard, technologies have a drastic impact on processes and services of any organization, including educational institutions, and the lack of these can generate disinterest among students, because according to Prensky (2010) they are digital natives who think and process information differently than their predecessors, a scenario that would affect fulfillment of defined goals, acquisition of numeracy skills and a waste of ICT to reach students with more assertiveness.

Thus, large number of policies adopted in recent years by the Colombian government, through the Ministry of National Education (hereinafter, MEN), promote the design of didactic strategies implementing, using and integrating ICT to schools for students to dynamically and autonomously acquire knowledge, particularly in mathematics (Arevalo and Gamboa, 2015). According to Gil (2002), ICT provides new ways of perceiving the world and the subject.

Yet, there is a need to build and produce Virtual Learning Objects to be integrated in different digital learning environments with the purpose of developing students' numeracy skills and to become socio-educational tools that facilitate communication of information and construction of knowledge, satisfying educational needs and providing the type of specific support required to reach the competence standards proposed by MEN.

Processes of teaching and learning are conducted in new learning spaces, these imply the use of technologies to create educational situations focused on encouraging students' self-learning, critical thinking, and others, using Leaning Objects (LO) or Virtual Learning Objects (VLO) that act as graphic work interfaces used by students to interact and construct knowledge; although for Gomez and Ramirez (2016) learning environments, including those mediated by technology, require readjustments in terms of pedagogical *praxis* for students to acquire optimum previous knowledge.

Then, there is no doubt that student interaction with didactic material (VLO) is an essential factor in the teaching-learning process, most especially in numeracy skills concerning the four basic mathematical operations. In that sense, Beltran (1993) states that learning is produced as the result of practice. In education, practice can be understood as *praxis* than entails knowledge to achieve certain goals. Practice is knowing how to do (Clemente, 2007). Therefore, when a person analyzes an activity in which he/she has been part of, knowledge is acquired.

This context of usage of ICT and VLO does not only allow children to learn in school, it also enables students or their representatives to plan the use of time allocated to studying and to set possibilities to develop proposed activities. Likewise, they may synchronous or asynchronously communicate with peers and teachers to solve problems, regardless of the schedule or distance, so long as the VLO exists in online platforms that allow said interaction.

Current educational tasks demand teachers to develop multiple competences related to the capacity to design meaningful learning experiences that place the student at the core of the teaching-learning process. In this, the usage of ICT and the implementation of a digital culture within the educational process are indispensable based on the needs of the students of the 21st century (Hernandez, Arevalo, & Gamboa, 2016).

According to the aforementioned, works by Garzon (2013) introduce the systematization of the experience of producing a VLO designed for the area of mathematics; Rojas (2015) designed and collaborated with a VLO to teach and learn algebra for 8th graders; Jaramillo and Quintero (2014) developed a virtual learning environment grounded on ludic to encourage stochastic processes in fourth and fifth graders; also, Rodriguez (2014) produced a VLO that integrates origami to improve comprehension of geometric concepts, aimed at mathematics teachers who need to strengthen classroom work; Zapata, Estrada and Chaparro (2015) presented the design and construction of a VLO as strategy to reinforce understanding the concept of fractions in basic education students.

In view of the importance of VLO, this research is justified based on the fact that it seeks pupils to actively acquire, develop and/or strengthen numeracy skills and experiment with meaningful, flexible and customized activities, selecting or choosing strategies according the their learning style and prior experiences. This contributes to the creation of e-learning study habits, which in a not-so-far-away future may become techniques that drive academic success in basic education students, offering the best education possible to contribute to the good of Colombian society as its ultimate goal.

In that regard, this article introduces a brief theoretical description of VLO, to then go deeper into the methodology to design it in its different stages: construction, procedures and methods to develop numeracy skills with basic mathematical operations in basic education students.

Virtual Learning Object (VLO). A VLO is defined as a set of digital resources that can be used in a diversity of contexts, it has an educational purpose and it is made up of at least three internal components: content, learning activities and contextualization elements (Tovar, 2014). Additionally, the learning object must have an external information structure (metadata) to facilitate storage, identification and recovery.

On the other hand, VLO are framed within the purposes of ICT tools, which are yielding changes in teaching and learning methodologies as to how teachers and students are relating to knowledge and in the way in which agents involved in the educational process interact (Cabrera, 2014). Likewise, instead of being a definable object, it is a complex and multifaceted technological construction, a larger technological puzzle in which pedagogical and curricular elements deriving from the practices of educational technology, information and communications technology, among others, converge.

As per the aforementioned, it is essential to specify that this inquiry into the production of a VLO to develop numeracy skills is based on the ADDIE model, as well as in varied learning theories: theory of information, which after the fragmentation process is divided in small pieces (Miller, 1956); and theory of connectionism (Schneider, 1987), which states that practice generates learning based on the amount of learned connections in previously encountered situations.

Similarly, it focuses on Bruner's constructivist theory, in which learning is an active process for students to build new ideas or concepts based on current/past knowledge. Also, students select and transform information, propose hypotheses and make decisions based on cognitive structures, which provide meaning and organization to the experiences and allow individuals to go beyond the information provided (Bruner, 2006).

The aforementioned coincides with the ideas of Piaget in terms that what is new is always built based on what has been acquired and transcends it (Gomez-Granell & Coll, 1984); introducing information in a VLO with games and steering from what is traditional would be meaningful, and according to Ausubel (2002), the individual builds meanings, mental representations related to content, and learning is knowing, understanding the meaning, thus, this is possible to the extent that new material gets anchored as product of motivation, needs and desires, as "learning is active" (Bruner, Vygotsky, Piaget, Ausubel); equally, considering Vygotsky (1978), who says that culture has a main part in human development, in the case of this work, everything that pertains current digital culture. From there, VLO could be an interactive strategy to learn and teach.

VLO in Virtual Learning Environments. Teachers who implement ICT as pedagogical tool capture their students' attention offering meaningful learning while facing the challenges proposed by technology when using Digital Learning Environments (DLE) or its equivalent, such as Virtual Learning Environments (VLE) through a Learning Management System (LMS), e.g., Moodle virtual platforms (Cocunubo-Suarez, Parra-Valencia, & Otalora-Luna, 2018; Prada, Hernandez, & Gamboa, 2019). These platforms offer the opportunity to manage VLO that comply with SCORM standards, as well as proposing a computing structure focused on meaningful learning, exceptional to automatically evaluate students' knowledge, seeing as it is responsible for each interaction with the VLO.

SCORM (*Shareable Content Object Reference Model*) is a set of specifications that suggest a Content Aggregation Model (CAM), a Run-

Time Environment (RTE) and the Sequencing and Navigation (SN) of content (Hilera & Hoya, 2010). Furthermore, SCORM is arguably the industry's leading standard nowadays, since it has been implemented in most systems as reference model (Mayorga, Alfonso, & Escamilla, 2013). Therefore, different authoring systems such as Exelearning, allow building VLO with an SCORM package (1.2 or 2004), which is an XML file containing all of the information to run a format compatible with a Learning Management System (LMS) (Alvarez, 2017).

Numeracy Skills. Skill refers to the mastery of techniques, whether cognitive or practical; for instance, numeracy skills of basic operations in arithmetic correspond to addition, subtraction, multiplication and division, these are acquired by knowing, practicing and solving an exercise, and develop reflection of numeric systems. In this context, it is a person's overall understanding about numbers and operations along with the ability to make mathematical judgements and develop useful strategies with numbers and operations (Obando, Vanegas & Vasquez, 2006).

Additionally, it can be inferred that numeracy skills become visible as useful strategies are developed to handle different types (mental, written, estimate, approximate, exact and mechanical) of numbers and operations which are didactic strategies of numerical thinking that lead to correctly applied intelligence to adequately fulfill processes and work different mathematics topics (Galeano & Ortiz, 2008). It is thus assumed that they can be included in a VLO.

METHOD

The work herein is an applied research that set out to seek or perfect resources to apply previous knowledge which has been obtained through pure research; unlike pure research, this work intends to look for usefulness instead of truthfulness (Cazau, 2006).

Statistical tools were applied in data analysis. After the information was collected, it was charted in tables that were analyzed through descriptive statistics and Excel worksheets. An interpretation table or evaluation scale was built to analyze the VLO's dimensions, it contained range, interval and category for each descriptive statistical used (see Table 1).

Range	Interval	Category
5	5	Very good quality
4	4 – 4.99	Good quality
3	3 – 3.99	Medium quality level
2	2 - 2.99	Low quality
1	1 - 1.99	Very low quality

Table 1.
Evaluation scale.

ADDIE Model. The ADDIE model was used to build the VLO. Instructional design serves as a guide to systematize development processes of training actions (Belloch, 2017). ADDIE is an instructional design model consisting of five (5) stages: Analysis, Design, Development, Implementation and Evaluation. Likewise, it is necessary to mention that the model has global nature and acts as general framework in the development of different projects, both face-to-face and virtual (Muñoz, 2011).

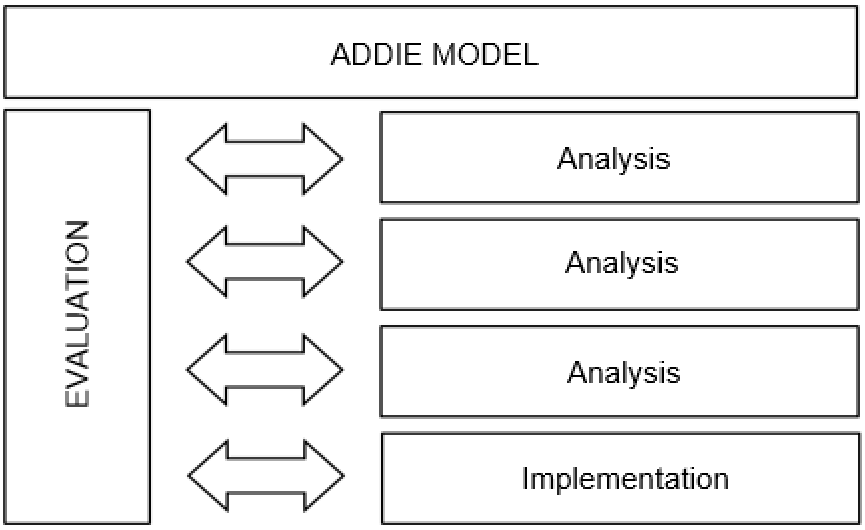

Fig. 1.
ADDIE Model.

According to Figure 1, steps can be taken in sequence or may be used bottom-up and simultaneously (Muñoz, 2011). Each element of the instruction is managed by learning results, which have been determined after analyzing the student's needs, which is why some stages overlap and may be interconnected, providing a dynamic and flexible guide for an effective and efficient development of the instruction (Zapata, Bonfante, & Suarez, 2013; Bonfante, Lara, & Chico, 2013). In that same order and direction, an adaptation of the ADDIE model is presented with its main stages and evaluations. Figure 2 shows the systematic, planned and structured process that supports the pedagogical orientation of the design (Muñoz, 2011).

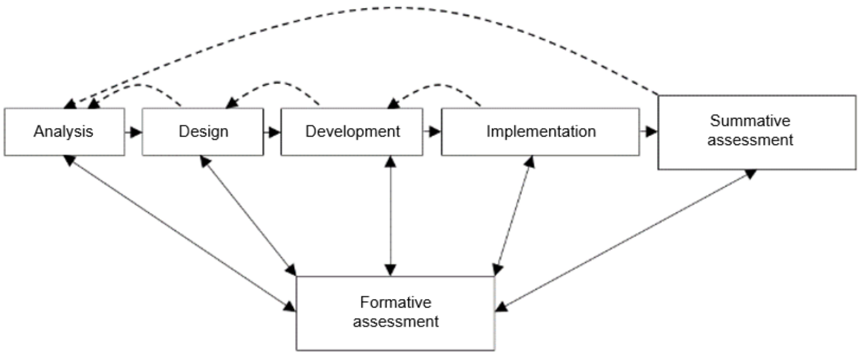

Fig. 2.
ADDIE instructional design model.

Analysis. As per Muñoz (2011), this is the foundation of the other design stages; in it, the designer must conduct an evaluation of the environment's needs (organization), define the problem, identify what causes the problem and look for possible solutions. In this part, the VLO intended to be built is defined. In this case, a practice VLO was developed, including information and an educational game to develop students' numeracy skills. This stage may also contain specific research techniques, such as: analysis of needs, context and tasks. In general, the output of this stage includes instructional goals and a list of tasks to be arranged (learner's profile, description of obstacles, needs, etc.), which will be the input for the next stage, meaning, the VLO's identification. In this case, the specific topic content of the VLO must be described in a few words.

In the same way, precise words have to be selected to facilitate its classification and search, aside from the keywords, program, subject, teacher or owner, multimedia designer. At the same time, profiles of the likely users of the VLO are recognized based on the depth and complexity of conceptual and practical development, and if necessary, on age, educational level, context, among others (Morales, Gutierrez, & Ariza, 2016).

With the information collected in this stage, a preliminary sketch of the course's content is prepared (Gonzalez, 2011). Then, the preliminary content of topics to be taught is presented, considering the target population which consists of students in elementary basic education (4^{th} and 5^{th} grade) and up to secondary basic education (6^{th} grade). This content will tackle the four basic mathematic operations and an introduction to algebra, which will help them in the Saber test.

Design. The design stage implies managing deductions of the analysis stage, with the aim of envisioning a strategy to develop the VLO. During this stage, the pedagogical, curricular and technological design of the VLO must be outlined to reach educational goals set in the analysis stage and broaden educational foundations (Muñoz, 2011).

Pedagogical Design. It entails how the object in itself, aside from being a didactic resource, becomes a learning strategy, defining the classes of activities that enable students to develop skills concerning the selected topic (Morales, Gutierrez & Ariza, 2016). The concepts in the VLO have to be of quality and of full reliability, reviewed and approved by an expert in the topic; concepts and information need to be presented in fragments but completely, its organization is to be clear and meaningful, as per the curriculum's objectives students' navigation has to be facilitated by understanding and building their knowledge (Morales, Gutierrez, & Ariza, 2016).

Which is to say that the unit or module's objectives are written, the evaluation is designed and the means and system to deliver the information to students are selected, the overall didactic approach is defined, training is planned by deciding the parts and order of the content. Students' activities are designed and the necessary resources are defined (Muñoz, 2011). In that regard, content has to be structured and organized in a system of labels, navigation and metadata based on its relation to context and users; also, it must comply with VLO international standards such as SCORM, guaranteeing interoperability, reusability and adaptability (Morales, Gutierrez & Ariza, 2016).

Technological Design. Refers to the selection of adequate technological tools to create the VLO, analyzing possibilities and limitations. Therefore, it supports the pedagogical integration of contents, learning activities and evaluation, because it is directly related to the construction of the VLO (Morales, Gutierrez & Ariza, 2016); with the purpose of producing different navigation routes for students and teachers to seamlessly use the VLO.

The project herein used the authoring system Exelearning to build the VLO (Garbarini, 2012) with the Educaplay tool other interactive activities were created and then integrated to the VLO thanks to the possibilities offered by the web 3.0 to insert programs in others, copying and pasting the HTML code (Fernandez, 2017; Tupiza, 2018). Moreover, tools such as Animoto were used to create introductory videos; Voki to create avatars, editing them in Camtasia to create video and upload it to a YouTube channel and then to the VLO. In terms of design, the VLO's navigation routes are highlighted in the initial graphic interface (see Table 2 and Figure 2).

Section	Description
1	Header
2	Button session
3	University banner
4	Title or topic
5	Access to information
6	Navigation bar

Table 2.
Initial Graphic Interface.

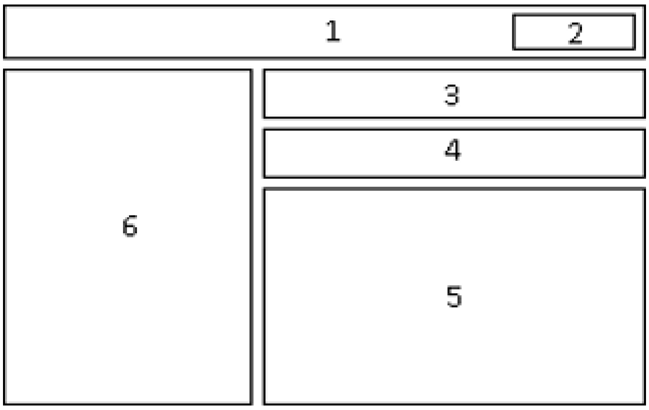

Fig. 3
Initial Graphic Interface.

On the one hand, the learning activities plan will consist of a sketch of defined content; in this case, the next task is to prepare the VLO plan that introduces the sequence of content topics of operations corresponding to the objectives of the instruction. For this reason, objectives and activities plan for the VLO are defined, "The Four Operations" (see Table 3).

Objectives: For students to accomplish	Through:	Type of activity in Exelearning
To know the rule of signs	Reading the rules and practical interactive exercises to apply the signs	Fill in the gaps
To know the multiplication tables	Interactive activity to fill in the gaps and complete the multiplication tables	Fill in the gaps
Write amounts	Interactive activity. Hangman, identifying and solving basic operations of mathematics in each statement, writing the result in letters	Hangman
To know addition	Interactive activity to solve simple addition	Fill in the gaps
To know addition and identify units and tens	Interactive activity. Addition in parts	Fill in the gaps
To know subtraction and identify units and tens	Interactive activity. Subtraction in parts	Fill in the gaps
To review addition and subtraction	Interactive activity of mentally solving an exercise, using the tricks of addition and subtraction in parts	Fill in the gaps
To solve simple exercises of addition, subtraction and multiplication	Interactive activity of solving exercises of addition, subtraction and multiplication	Fill in the gaps
To identify the terms of addition, subtraction and multiplication	Reading the material	Prior knowledge
To know the terms of operations	Interactive activity. Roulette of basic mathematics concepts	Free text. Insert interactive activity done in Educaplay
To know multiplication	Interactive activity. Multiplication using the dominoes game	Free text. Insert interactive activity done in Educaplay
To apply rules of signs in multiplication	Interactive activity. Multiplication of numbers and signs using the dominoes game	Fill in the gaps
To apply rules of signs in division	Interactive activity. Division of numbers and signs using the dominoes game	Free text. Insert interactive activity done in Educaplay
To identify mathematical expressions with operations	Interactive activity. Relate the expressions	Free text. Insert interactive activity done in Educaplay
To know mathematical expressions with operations	Interactive activity. Build the mathematical expression through the terms of the basic mathematical operations	Fill in the gaps
To know equations	Interactive activity. Build the equations identifying the variable and solving it through the basic mathematical operations	Fill in the gaps
To identify the elements of exponentiation	Interactive activity. Exponentiation	Fill in the gaps
To solve exponentiation exercises	Interactive activity. Solve exponentiation identifying the base and exponentiation and the development of the multiplication	Fill in the gaps
To solve verbal problems	Interactive activity. Verbal problems	Fill in the gaps
To identify the coordinates of a point	Reading the material	Prior knowledge
To solve exercises of coordinates of a point	Interactive activity. Finding coordinate points	Fill in the gaps
To identify and solve points in the Cartesian coordinate system and its quadrants	Interactive activity. Points in the coordinate system	Fill in the gaps

Table 3.

Learning objectives, strategies and type of activity.

The VLO's materials comprise text and multimedia resources, which in turn have images, audio and video. In this, the decision of which materials are available, which need to be converted and which need to be created (Gonzalez, 2011) is made. Lastly, technologically-wise, the type of activity provided by the Exelearning application in terms of didactic strategy and curriculum to be introduced is selected.

Yet, when the formative evaluation was applied to the analysis stage, it was decided that it was missing content, such as the rule of the signs, basic concepts to solve exercises entailing that knowledge; for that reason, these contents were added to the VLO.

Development. In turn, the development stage is structured based on the analysis and design stages. The intention of the development stage is to generate units, modules and/or their didactic materials. The instruction, means used in the instruction and further support documents are developed (Duvergel & Argota, 2017). Thus, this stage adds content to the designed framework.

Moreover, the text materials are written, multimedia resources recorded and edited as per the design resulting from the previous stage. It is essential for the VLO's sequences, explanations and interpretations to be easy to understand, since these give access and motivate participants to navigate the diverse resources created. This part requires production of instruments to complete different types of evaluations created (Gonzalez, 2011).

In conclusion, development is the actual creation (production) of content and learning materials based on the design stage (Belloch, 2017); it has to fulfill the following (Triana, 2015): (1) the VLO must introduce the objectives and a diagram of the topics to cover; (2) information introduced in the VLO has to be clear and legible; (3) the VLO's graphic interface requires the logo, shield and institutional colors of the university, as well as information to be understood and used, and (4) the VLO needs to be freely accessed by any student who wants to use it.

A formative evaluation on the design stage (pertaining the VLO's navigability) in which content was distributed in submodules, led to a noteworthy finding (with help of student testing), the VLO did not totally show the graphic interface in the menu, thus it made topic selection and practice of proposed exercises difficult.

Therefore, the VLO's topic arrangement was restructured, as featured ahead. Additionally, "evaluate your knowledge" was removed from the menu because this VLO is for practice and information, and knowledge is assessed in each strategy while navigating the VLO.

Also, some adjustments were made to the design of the VLO for the graphic interface to include the logo and institutional colors of the university. The information must be clear and legible, providing access to different topics established in the programmatic content. Therefore, different testing took place on multiple tools with the aim of generating interactivity with the VLO, both with SCORM and HTML, the two formats of export packages of the VLO used with Exelearning. Figure 4 shows the graphics with the content distribution.

Structure
- Landing
Diagnostic testing
The four operations
Rule of signs
Multiplication table
Hangman
Addition
Addition in parts
Subtraction in parts
Mentally solve additions and subtraction
Simple operations
Terms for the four operations
Interactive activity. Roulette of basic mathematics concepts
Multiply. Interactive activity
Adding, multiplying and dividing
Multiplication with signs. Interactive activity
Division with signs. Interactive activity
Connect the expressions
Build the mathematical expression
Build equations
Exponentiation
Solve the exponentiations
Verbal problems
Coordinate grid
Find points in the coordinates
Points in the coordinate system

table 4

Construction and Development of the VLO. To build and develop the VLO, and considering navigability, it is necessary to take into account the description of the VLO's use cases, as follows (Tables 3 and 4):

VLO's use cases	
Interaction with the VLO	
Actors	Student
Function	Usability of a VLO.
Description	Allowing students to access different modules of the VLO, which can be available in a LMS platform (such as Moodle) or hosted as a website on the Internet.
Incidents of the events:	• Visualize the VLO. • Access to the VLO. • Access to the navigation bar of the VLO. • Access to reading, videos, evaluated activities.
Development of diagnostic test	
Actors	Student
Function	Entering the test.
Description	Diagnostic test of student's prior knowledge.
Incidents of the events:	• Visualize the test in the VLO. • Access to the test. • Send the test. • Feedback of the test.
Development of didactic resources (access to reading)	
Actors	Student
Function	Entering the reading.
Description	The student has access to information such as reading, diagrams and images related to the operations.
Incidents of the events:	• Visualize the reading in the VLO. • Reading of the topics. • Visualization of diagrams.
Development of didactic resources (activities)	
Actors	Student
Function	Entering the activities.
Description	The student has access to information to manage his/her self-learning process through practicing and solving exercises with the operations, which evaluates each topic addressed.
Incidents of the events:	• Selection of the activity. • Development of the activity in the VLO.

Table 4.
Description of the VLO's use cases.

DEVELOPMENT OF THE VLO
Title of the VLO: the four operations.
GENERAL DESCRIPTION SECTION
Title of the educational material: the four operations.
Description: educational material developed in Exelearning containing the basic concepts on mathematical operations, with an introduction to algebra, tackling the solution of simple exercises od addition, subtraction, multiplication and division, statements of mathematical expressions with the operations, construction of equations using operations' basic concepts, finding points in the coordinate system, basic mathematic operations, among others.
Objectives: • Mentally exercise mathematical operations of addition, subtractions, multiplication and division. • Become familiar with mathematical terms, expressions and equations. • Organizing operations. • Introduction to the Cartesian coordinate system. • Formulating and solving daily problems that require application of operations.
Language: Spanish
Keyword: VLO, the four operations.
LIFE CYCLE SECTION
Version 1.0
Date: June 2018
TECHNICAL SECTION
Format: HTML (SCORM package optional).
Localization: bank of VLO, to de defined.
Installation instructions: install as a SCORM activity package, needs a LMS, e.g., Moodle.
Requirements: LMS (e.g., Moodle) and navigator.
EDUCATIONAL SECTION
Learning context: basic elementary and secondary education
Possible users: teachers and students in the 4th and 5th grade of basic elementary, although it could span to 6th grade of basic secondary education.
LEGAL SECTION
License: intellectual property

Table 5.
Development of the VLO.

Implementation. In this stage, students are encouraged to understand the materials, supporting their mastery of objectives and following-up on knowledge being transferred to their daily actions (Sarmiento, 2007); this means execution and implementation of the training action through the VLO (Belloch, 2017). It is important to add that a test of the VLO was carried out as a Scorm 1.2 package in a virtual classroom in Moodle.

Evaluation. Although it is the fifth stage if the instructional model design, evaluations are a comprehensive component of each of the four prior stages. When executing each stage of instructional design, procedures and activities can be evaluated to guarantee they are done in the most effective way to ensure optimum results (Muñoz, 2011; Ceballos, Mejia & Botero, 2019).

RESULTS

According to Fernandez-Pampillon, Dominguez and Armas (2012), a VLO has quality when it is effective, didactic, renders good academic and technological results; they also suggest that in order to value a VLO's technological and didactic effectiveness, evaluation tools need to be used and tapped as guide, e.g., COdA, which is a form with ten quality criteria with scores ranging between a minimum of one (1) to a maximum of five (5). The first five criteria are of didactic nature, while the rest are technological, so both aspects are equally important. To wit (Table 5):

Didactic	Didactic objectives and coherence	Evaluates the definition and coherence of the objectives, as well as the user's use specifications.
	Quality of the content	Evaluates the content of the learning object, highlighting the content's exposition and the activities' use.
	Capacity to generate reflection	Evaluates the development of skills to solve activities or tasks to drive new ideas and look for new knowledge in the student.
	Interactivity and adaptability	Values the dynamic of the content presentation in connection with the student's use and the ease with which the VLO adapts to different types of users, be it students or teachers.
	Motivation	Evaluates if the learning object is capable of attracting the student to learn and acquire new knowledge with innovative proposals and didactic content.
Technological	Format and design	This criteria evaluates design, content and multimedia application in the learning object.
	Usability	Measures the ease with which the user interacts with the learning object in terms of content and interface.
	Accessibility	Grades if the VLO is built considering people with audiovisual or motor difficulties.
	Reusability	This criteria refers to the capacity and likelihood of using a VLO several times and evaluates if its parts can be used to build new learning objects.
	Interoperability	Evaluates the capacity to implement a VLO in several environments, such as virtual classrooms, via LMS, web environments and personal computers.

Table 6.
Didactic and technological criteria to evaluate a VLO.

Based on the aforementioned, an evaluation of the VLO took place with the help of three experts (a specialist in education, a VLO expert and an expert in methodology). Likewise an evaluation scale on the VLO's quality is presented based on the evaluators' responses. Consequently, the results obtained required statistical tables of frequency and percentage, as per the didactic and technological dimensions it refers, establishing the frequency of answers for each item, valuating it with through absolute percentages. The following are the results obtained (Tables 6, 7 and 8).

Items	Very good quality		Good quality		Medium quality level		Low quality		Very low quality	
	Fs	%	Fs	%	Fs	%	Fs	%	Fs	%
6	0	0%	3	100%	0	0%	0	0%	0	0%
7	1	33.3%	2	66.7%	0	0%	0	0%	0	0%
8	1	33.3%	2	66.7%	0	0%	0	0%	0	0%
9	2	66.7%	1	33.3%	0	0%	0	0%	0	0%
10	1	33.3%	2	66.7%	0	0%	0	0%	0	0%

Table 7.
Technological nature of the VLO.

Table 6 shows items 1 to 5 concerning the VLO's didactic criteria. It is necessary to mention that the results of items 1 to 5 agree with the proposals by Zapata, Estrada and Chaparro (2015) to the extent that useful strategies of different types (mental, written, exact and mechanical) need to be developed when handling numbers and operations, which constitute strategies of didactic nature of the VLO and, to the evaluators, evince quality that is good to very good in the development of numeracy skills; similarly, agreeing with Tovar (2004), they say that a VLO is a set of digital resources that can be used in varied contexts with an educational purpose and comprising at least three internal components: content, learning activities and contextualization elements.

The aforementioned leads to infer that education (as part of new educational trends) is bound to seek new ways to teach and learn to innovate with technology. Because VLO are framed within ICT, they are bringing upon changes in teaching and learning methodologies, in how students and teachers relate to knowledge and in the way in which they interact (Cabrera, 2014) in a manner that is coherent with adequate content and for students to drive reflection and motivation based on its interactivity.

Table 7 shows items 6 to 10 concerning the VLO's technological criteria. Results obtained in these items reveal that the VLO's quality is good to very good. This matches what was highlighted by Callejas, Hernandez and Pinzon (2011) in terms of VLO being flexible and reusable in multiple educational contexts, adapted to students' different learning styles and interoperable to be integrated to other platforms, as is the case with this VLO, which was exported and tested as a SCORM package.

It can be inferred that the new educational trends plus a world with greater connectivity takes advantage of existing opportunities and creates new ones in technology-mediated studies; VLO's didactics and pedagogy lead to an analysis of the aforementioned natures of the VLO; Table 8 shows the results.

Item	X	Nature	Nature X	Criteria	VLO	VLO X	Criterion
1	4.00	Didactic	4.40	Good quality	Quality evaluation	4.37	Good quality
2	4.33						
3	4.67						
4	4.33						
5	4.67						
6	4.00	Technological	4.33	Good quality			
7	4.33						
8	4.33						
9	4.67						
10	4.67						

Table 8.
Quality evaluation of the VLO.

Results obtained allow visualizing that didactic nature had the highest average score of the mean with 4.4, indicating that the VLO has a criterion of good pedagogical quality, followed shortly by the technological aspect at an average of 4.33, similarly providing a criterion of good technological quality; these benefited the analysis, design, development, implementation and evaluation of the VLO.

The general score for the dimension was of 4.37, indicating that the VLO's production has a criterion of good to very good quality. Therefore, results prove that a methodological guide in the VLO's creation and evaluation could provide indications for a production substantiated in analysis and reflection of the VLO's design.

DISCUSSION

Theoretical bases deliver references for the analysis, design, development, construction and evaluation of virtual learning objects that can support teachers' pedagogical practices with innovative methods that enable to learn by seeking, doing and interacting through a VLO.

It was verified, based on results obtained, that an analysis of needs and identification of curricular, didactic and technological requirements, as well as of the target population, allowed programming top quality content, objectives and didactic coherence, benefitting the production and construction of the VLO, tools to develop students' skills, dexterities and competences in a specific area of learning, based on suitable instructions for the students' knowledge level, as well as to connect previously learned concepts with new knowledge.

Evidently and with the aim of tapping ICT-mediated learning in educational processes to access knowledge without time and space limitations, VLO may introduce essential information or practices in a specific area of the curriculum both by the person learning and by the person in charge of teaching.

On the other hand, it was verified that formative and summative assessments support VLO designers to create top quality VLO in terms of its didactics and technology. In other words, to design and build an accessible, interactive VLO with pedagogical strategies that are easy to use by the student interacting with the didactic content to be learned, practiced and strengthened in any area of knowledge for which the VLO is intended.

Pertaining this case's aim to develop numeracy skills based on basic mathematical operations, the evaluating team resolved that the VLO has good quality in terms of didactics and technology and very good quality in its design and production because they favor understanding and assimilation of knowledge of mathematical operations, with an attractive and innovative way of introducing content and/or pedagogical procedures.