

Development of audiovisual modules to improve digital skills of higher education students

Elaboración de módulos audiovisuales para mejorar las habilidades digitales de estudiantes universitarios

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ABSTRACT

Keywords

Learning packages;
educational video;
educational media;
digital skills; u-learning;
students; college

This study consisted of developing Digital Audiovisual Modules (DAMs) as a support resource with the mediation of portable devices, with the purpose of improving digital skills in the handling of information, communication and ethical aspects in higher education students. The methodology was based on the research and development approach with an intentional sampling of 69 first-year students at a public university in Mexico. The instructional design of analysis, design, development, implementation and evaluation was used to develop the educational audiovisuals, followed by an evaluation of the efficiency of this type of digital support. In general, the participants indicated that the modules met with the elements of precision in the handling of examples, simplicity in the development of the topics, clarity in explaining the contents, and relevance for the improvement of digital skills. The students who consulted the modules showed an improvement in their digital skills; however, the user's interest is required to consult the audiovisuals. This study contributes to the field of educational innovation in ubiquitous environments and it is concluded that these findings show the benefits and limitations of using pedagogical resources via DAMs to support university students in their digital skills.

RESUMEN

Palabras clave

Módulo de
autoaprendizaje; video
educativo; material
didáctico; habilidades
digitales; aprendizaje
ubicuo; estudiante;
universidad

Este estudio consistió en elaborar módulos audiovisuales digitales (MAD) como recurso de apoyo con mediación de dispositivos portátiles para mejorar las habilidades digitales en el manejo de información, comunicación y aspectos éticos en universitarios. Planteamos un enfoque metodológico de investigación y desarrollo con una muestra intencional de 69 estudiantes de reciente ingreso a una universidad pública en México. Para la elaboración de los audiovisuales, empleamos el diseño instruccional de análisis, diseño, desarrollo, implementación y evaluación, seguido de una valoración de la eficiencia de este tipo de apoyos digitales. Los participantes, en general, indicaron que los módulos cumplieron con elementos de precisión en el manejo de ejemplos, sencillez en el desarrollo de los temas, claridad en explicación de los contenidos, y relevancia para la mejora de habilidades digitales. Los estudiantes que consultaron los módulos mostraron una mejora en sus habilidades digitales; sin embargo, se requiere el interés del usuario para consultar los audiovisuales. Este estudio contribuye al campo de la innovación educativa en entornos ubicuos y sus hallazgos dan cuenta de las bondades y limitaciones de utilizar recursos pedagógicos vía MAD para apoyar a los estudiantes universitarios en sus habilidades digitales.

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INTRODUCTION

Incorporating new digital portable technologies in the educational context has brought aspects of flexibility, ubiquity, asynchrony, connectivism, and interactivity in the teaching-learning process, as well as in emerging new educational models mediated by information and communication technologies (ICTs), since its incorporating qualities offer a series of advantages in the development of innovative pedagogic practices which enable their scope and capabilities to be maximized.

Digital skills, however, depend on using tools offered by technological devices and the frequent use to make different activities (Croví, 2009; Mirini, 2016). It is convenient to state that “not every learner is completely literate nor that they lack any skill completely. In some cases, they are proficient in certain aspects and have difficulties in other aspects; that is, they have diverse skill levels”. (Marini, 2016 pp. 54-55); therefore, implementing teaching actions or strategies is recommended to foster a better proficiency on digital skills so that learners make progress in their academic trajectory in a satisfactory manner, and that they are better prepared for a global, informational and technological world.

In this scenario, using videos with a didactic purpose has become more frequent for higher education, as this allows the development of significant learning of learners. Some of the advantages are: versatile functionality and form of usage which facilitate the development of a critical attitude, this fosters better access to meanings by means of words, images and sound, and allows access to more detailed information (García, 2014). This makes us consider preparation of educational contents in an audiovisual format and to perform a planning, development, application and evaluation process of this type of educational resources with the purpose of measuring the efficiency thereof. Our task starts from the recognition of digital technology as a pedagogic tool, and as a means to establish better conditions that would encourage the generation of new knowledge.

Therefore, the purpose of our research is to resort to the features provided by digital technology, specifically of portable digital devices as supporting means for the implementation of a teaching-learning strategy with electronic means that give rise to better digital skills of learners as they advance through their academic studies.

OBJECT OF THE STUDY

To make educational audiovisual aids –called audiovisual digital modules (DAMs)– for consultation purposes by means of portable digital devices, aimed to support college freshmen to improve their digital skills on handling information, communication and ethical aspects that are paramount in preparing academic projects. For this reason, we have proposed the following specific objects:

- To specify the features of instructional design to develop DAMs that would enable the development of college freshmen's digital skills.
- To describe the general efficiency of DAMs on how to handle information, communication and ethical aspects.
- To identify the advantages and limitations aimed to implement the pedagogic resources of DAMs by means of portable digital devices for the improvement of digital skills.

METHODOLOGICAL DESIGN

We have considered a research and experimental development approach in the methodological design. This method is based on development as a starting point for research, which focuses on the analysis to prepare a product and the application thereof in the context of interest. According to the Organization for Economic Cooperation and Development (OECD, 2015), “research and experimental development (R+D) include a creative and systematic work to increase the knowledge base –including knowledge about human kind, culture and society– and to design new applications of knowledge available” (p. 44). [1]

During the first stage, we developed DAMs based on the ADDIE (analysis, design, development, implementation and evaluation) instructional design which is adapted to different educational contexts and includes relevant pedagogic elements for people using it; in addition, the application thereof is appropriate for preparing online content (Escala, 2015). During the research stage, we allocated the modules among participants for consultation purposes, next, we conducted an opinion questionnaire about DAMs and a two-stage test to identify the likely improvement of their digital skills by means of this pedagogic resource.

There were 69 learners from the Autonomous University of Baja California (UABC, by its acronym in Spanish) Ensenada Campus, Mexico, in our study; this was about a sample in the intentional

selection of two groups of the common core, in two knowledge areas: natural sciences (n=32) and social sciences (n=37), who were interested in partaking and evaluating an audiovisual support for the improvement of learners' skills with different academic profiles. The groups were formed in a natural way in the 2019-2 school term, and the age range was between 17 and 25 years.

Information gathering techniques corresponded to the application of the following instruments: a questionnaire to assess college freshmen's digital skills, a questionnaire of opinion about digital audiovisual modules and a digital skills test with nine questions. The kind of data analysis was based on descriptive statistical techniques.

Delimitation and features of digital audiovisual modules

DAMs refer to a set of educational contents regarding digital skills, organized by categories and presented as an audiovisual format to be consulted in diverse portable digital devices. These modules were organized in three thematic contents: communication, information and ethical aspects.

The thematic module of information handling is related to skills associated to search engines of digital information, efficient information searches via Internet, selecting quality or valid information, under the search criteria, and transferring this information to storage space of users (local, in portable devices or "on the cloud", such as Dropbox or OneDrive), organizing the information gathered and appropriation thereof.

In the thematic module of communication handling, skills identified were about how to use social rules and standards in digital environments, development of contents or messages in person regarding elements of form and substance in accordance with the addressee, collaborative development of contents, exchanging and transferring messages (in accordance to format, purpose, and addressee), and using digital media to communicate and disseminate information or main ideas of a document.

The thematic module of handling of ethical aspects considered skills regarding how to handle communication and proper use of information found in Internet, as well as the type of access to information (free or restricted), verification of authenticity and safety of browsing, confidentiality, and data integrity, publication and sharing contents responsibly, and respect to intellectual

property and to rights of ownership (Silva & Espina, 2006; Alarcon *et al.*, 2013; Ramirez-Martinell & Casillas, 2014).

Preparing digital audiovisual modules

We performed actions in an orderly fashion, in accordance with ADDIE's instructional design (see table 1). The first three stages of the module were used to prepare DAMs and the last two, to deliver contents and evaluation thereof.

Table 1. Actions to analyze, design, develop, implement and evaluate DAMs.

Stage	Actions
Analysis	<ul style="list-style-type: none"> • Determination of digital skills levels • Estimation of digital skills levels of students • Definition of the digital skills that require improvement • Establishment of learning objectives for each module • Identification of possible limitations of production
Design	<ul style="list-style-type: none"> • Pre-production: <ul style="list-style-type: none"> ◦ Selection of technological tools ◦ Selection cognitive strategy ◦ Elaboration of sequence structure of thematic contents ◦ Selection teaching strategy in digital media ◦ Elaboration of <i>storyboard</i> and audio script ◦ Determination of visual style (colors, font, images, graphics and animations) ◦ Logo design
Development	<ul style="list-style-type: none"> • Production (video screenshots and audio recording) • Postproduction (editing, animations and codification of educational contents in H.264 format) • Revision of contents by a specialist in the area • Resolution of technical and design details • Creation of a YouTube channel
Implementation	<ul style="list-style-type: none"> • Delivery of modules • Resolution of technical issues
Evaluation	<ul style="list-style-type: none"> • Analysis of efficiency of DAM

Source: based in the outlining of the stages of the ADDIE Model as indicated by Yukavetsky (2003), Agudelo (2009) and York & Ertmer (2016).

Analysis

In the first stage, we determined proficiency levels of digital skills from a questionnaire to assess digital skills. This was developed on the basis of a modified version of the instrument reported by Organista-Sandoval *et al.* (2017), titled Survey on Digital Skills, whose purpose was to assess digital skills of college freshmen, to handle a portable device (laptop, tablet and cellular phone) with educational purposes. In our research, we included several personal variables to follow each participant's digital skills level, and dimensions of interest were organized in technological, ethical, informational and communicational aspects; the last three dimensions were considered to perform audiovisuals called DAMs.

Digital skill levels for the dimensions of handling of information and communication were based on operational definitions and observable behavior of skills included in the digital skills matrix to prepare the instrument mentioned above. Skill levels to handle ethical aspects were determined from items specified in the amended version of this same instrument. With the purpose of assessing and placing the skills levels of each learner, and, therefore, defining skills that need to be improved, in addition to setting learning goals in each thematic module, we considered the organization shown in table 2: "level 1" as an intermediate proficiency, which includes basic observable behaviors, and "level 2" as an advanced skill.

Table 2. Digital skills levels per dimension

Levels	Dimensions		
	Handling of information	Handling of communication	Handling of ethical aspects
Level 2 (advanced)	<ul style="list-style-type: none">• Appropriation• Organization• Transference	<ul style="list-style-type: none">• Communication and spreading of contents• Transference of messages• Organization	<ul style="list-style-type: none">• Publishing and spreading of messages and academic works• Development of contents• Transference of information
Level 1	<ul style="list-style-type: none">• Selection of information	<ul style="list-style-type: none">• Collaborative development of contents	<ul style="list-style-type: none">• Reviewing the quality of the information

(intermediate)	<ul style="list-style-type: none"> • Search of information • Selection of search engine 	<ul style="list-style-type: none"> • Personal development of contents (form and content) • Use of social protocols 	<ul style="list-style-type: none"> • Navigation on the Internet
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Design

In the second stage of the instructional design we acquired necessary technological resources to record audios and edit contents in an efficient manner. Regarding the means of publication for DAMs we chose the YouTube page as it is a free platform of greater audience [2] which is accepted by learners (Fernández, 2017); browsing is amicable with an intuitive design, a responsive page with ease of access from any portable digital device and basic statistics are provided in YouTube Studio Analytics, which allows evaluation of users' interaction behavior with the videos.

Once the basic elements have been designed to produce DAMs, we determined a cognitive strategy that was to be used in the videos with the purpose of developing contents in accordance with significant learning, which were obtained by means of guided discovery through an instructor, with the purpose of guiding learners' learning. In this sense, the strategy consisted on defining, first, the topics comprising the object of learning, followed by a short introduction to the content; then, we approached an explanatory sequence of the topics by means of the solution of a case or cases; finally, by way of a summary, we highlighted what we have seen in the module to remind learners what the presented skills were.

In order to promote a better learning ambience in digital media, presenting and explaining contents was based on the nine principles of the multimedia learning theory proposed by Mayer (2002), with the purpose of achieving better understanding of topics by using story-telling including animations, using practical examples by means of video screen capture and visual simplicity. Subsequently, we used the storyboard and drafted a narrative script of the contents per module.

For color selection, we resorted to color psychology so that learners would learn better. According to Cante, Fernández & Pulido (2017), "color may also help in developing efficient and feasible mental models, if the following guidelines are followed: color simplicity,

consistency, clarity and language” (p. 53). Therefore, we decided to use basic colors and to represent each module with a specific one to be able to make a distinction in accordance with thematic contents. On modules of handling of information, we used mustard yellow to represent understanding, wisdom and discernment; for handling of communication, blue as a symbol of confidence, harmony and intellectual qualities; and in ethical aspects, green, as this refers to acts of understanding, tolerance, confidence and safety [3]. Figure 1 shows the colors and shades under the RGB system [4].



Figure 1. RGB color palette for DAMs

Regarding text typography, we used sans serif fonts [5] due to their simplicity and legibility. The text color palette was in accordance with the one mentioned for DAMs, as well as the white color (R:229, G:2529, B:229), and were applied to match the background shade for contrast and better legibility.

Generally, to compose images, signaling, typography, animations and colors on the modules, we chose a minimalistic design to focus learning in relevant aspects and to prevent any distraction. This type of design emerged in the 1960s in the United States as an artistic movement and it is characterized by using basic elements, such as chromatic simplicity, rectilinear basic geometry, plain language and reduction of decorations. Based on this criterion of visual composition of DAMs we designed an isologo [6] to be used at the beginning and at the end of videos and on the YouTube page. The design was created as a basic rhombic form with the DAM acronym broken down and the colors in blue-green to blue (see figure 2).



Figure 2. Design of an isologo

Development

In the third stage of the ADDIE's instructional model we proceeded with the production and post-production of content. Therefore, we resorted to use the free program and the open code of Open Broadcaster Software (OBS Studio), to capture screen video, and the Adobe Creative Cloud package to perform the following actions:

- Adobe Audition to record and edit voice regarding decibels (audio levels), narration mistakes, and some static noise.
- Adobe After Effects worked to animate the isologo.
- Adobe Illustrator was handled to create graphics and to edit images.
- Adobe Premiere Pro enabled the creation and edition of all audio elements, graphics and animations, and to codify final videos in the H.264 format, with a high quality of 1080 pixels, to be uploaded to the YouTube platform.

In this stage in the instructional design, each module was reviewed from time to time by a specialist in the ICT area in education at the Institute of Educational Research and Development of UABC, Ensenada Campus, Mexico, which included improvements of technical type, design, and content elements to achieve better clarity, consistency and objectivity of the topics addressed by DAMs. Finally, a YouTube, Digital Audiovisual Modules channel was created (see figure 3), where we uploaded all the modules and incorporated a short summary on the description box of each video to have the thematic content specified [7].



Figure 3. Screenshot of the Digital Audiovisual Modules channel of YouTube.

Implementation

Allocation of DAMs was made two ways: sending a daily email to each participant, through the official account of UABC (@uabc.edu.mx), and personal delivery of a brochure to ensure receipt of the information.

Furthermore, we specified the log-in channel to YouTube and the name or link of the videos learners were to consult during the week from their preferred portable device. In view of the scant visualization of the modules in the set period, consultation was extended to three weeks, and the teachers were asked for support to encourage participation. In this implementation stage, there were no technical failures by learners or of the website.

Evaluation

In this last stage, we applied an opinion questionnaire about DAMs in the classroom with the purpose of verifying efficiency thereof regarding contents, design, implementation and learning (see table 3). Of the 69 learners of the sample, 34 answer the questionnaire; the other learners said they had not consulted the modules due to lack of interest, time available and responsibilities, both academic and personal. On the other hand, the participation of learners who consulted the modules allowed us to gather valuable information on the aspects of opinion about the modules.

Table 3. Aspects and indicators in the questionnaire of opinion about DAMs

Aspects	Indicator
Context	<ul style="list-style-type: none"> • Place of access to the context • Use of headphones • Internal distractors (from the device) • External distractors (from the surroundings)
Technological elements	<ul style="list-style-type: none"> • Type of network connection (Wi-Fi/3G/4G) • Operating system • Physical conditions of the portable device • Access • Playback • Navigation • Visibility • Audio (volume)
Elements of learning	<ul style="list-style-type: none"> • Relevance • Clarity • Simplicity • Precision • Language • Attractive/striking/new • Understanding topic • Support in the resolution of problems • Motivation/disposition/attitude • Relevant elements for learning • Non-relevant elements for learning
General opinion	<ul style="list-style-type: none"> • Evaluation of DAM • Aspect of liking • Aspects of disliking • Proposals for improvement of DAM

We also applied a classroom test of nine questions (pretest-post-test type) with the purpose of supplementing results and identifying whether there was a significant learning reported of digital skills to handle information, communication and ethical aspects after consulting DAMs. The questions were based on items in the questionnaire to assess digital skills, and we selected those which represented necessary actions for the development of academic tasks, both at an intermediate level and at an advanced level.

RESULTS

We made a total of six videos, two for each dimension; one for the intermediate level and another for the advanced level on digital skills. Because of the diversity of topics developed in each module,

average time of the videos was nine minutes, with a size of 37 megabytes, and they were mostly watched in smart phone (85%), followed by laptop (65%) and very few in tablet (11.8%). Figure 4 shows two scenes of the ethical aspect modules on the opinions of reproduction quality (144 pixels of high resolution quality) and the style of graphic elements.

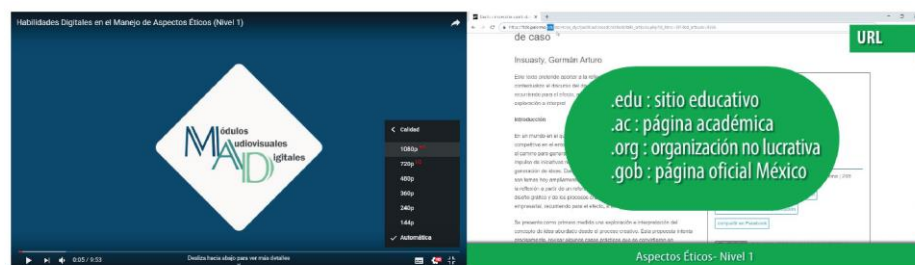


Figure 4. Screen capture of the beginning of ADMs and a scene explaining ethical aspects.

With the purpose of identifying the level of relevance, clarity, simplicity and accuracy of thematic contents of DAMs, we asked participants to value each element per thematic module, in an ordinal scale from nothing (0) to a lot (3), and the results for each dimension are shown in the chart.

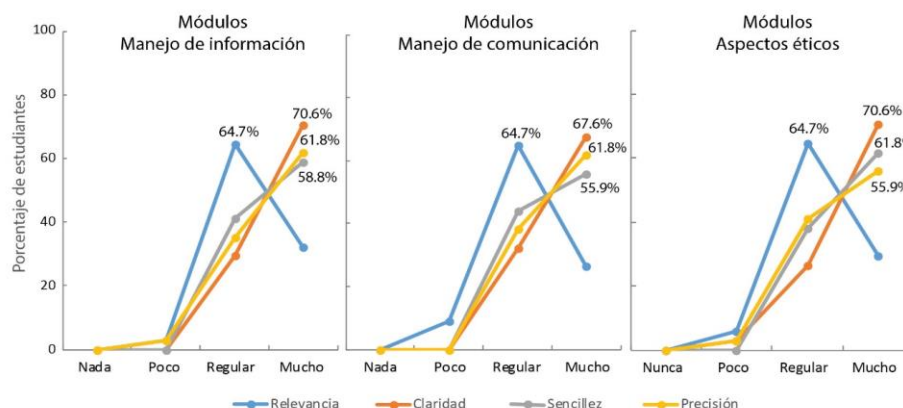


Chart. Evaluation of aspects of relevance, clarity, simplicity and accuracy of ADMs.

The most relevant elements for learning, in accordance with the modules consulted, were topics on how to make advanced searches, to use the format of the American Psychological Association (APA) and to recover any loss of information consulted previously. In

contrast, the least relevant elements to improve digital skills were those related to ethical aspects and the use of social networks.

In addition to the above, the learners said that DAMs were moderately attractive, with an appropriate use of language, which helped in understanding the topics at an intermediate level and this encouraged their learning process on the thematic content in a regular manner. Most of them (94.1%) considered them to be useful to make future academic works. It is generally held that learners graded the modules about using ethical and communication aspects with 8.9 –in a scale of 0 (terrible) to 10 (excellent)–, and those using information with a score of 9.1. Figure 5 contains comments of satisfaction, displeasure, and improvement of DAMs related to pedagogic and design elements; there were no opinions on technological aspects.



Figure 5. Aspects of satisfaction, displeasure and improvement of ADMs.

Results of the digital skills test

Regarding the level of knowledge of digital skills, we asked participants to answer a test with nine multiple-choice answer questions (*a*, *b* and *c*); three questions were related to the use of information (like making an advanced search, recovering searches, and making a list of links); three on using communication (like working collaboratively online on a document in a digital format), and three, on the use of ethical aspects (such as activating browsing filters, citing and verifying reliability of information found in Internet). The answers were evaluated under a nominal dichotomous scale (correct/incorrect) and the general test results were set in a scale from 0 (null) to 100 (high).

With the purpose of exploring whether there was a general improvement on digital skills with DAMs, we made a *t*-learner contrast from the scores obtained in the test before and after audiovisuals were consulted. The results showed significant differences ($p < 0.01$) in favor of skill improvement evaluated in the post-test, with nine points of difference among general means (see table 4).

Table 4. Comparison between pretest and posttest

Test	N	□	Standard deviation	Sig. (bilateral) ^a
Pre-test	34	74.8	21.1	.033*
Post-test	34	83.9	12.3	

Note: the median corresponds to a 0-100 scale.

^a t-student Test for related samples

* Significant contrast $p < 0.01$

With regard to exploration, there was a specific improvement of digital skills on the use of information, communication or ethical aspects; the results were valued per dimension in a scale of 0 (null) to 3 (high), in accordance with the number of questions per item. In this sense, we applied the Wilcoxon contrast and obtained a significant difference among the means in favor of evaluated skills in the post-test, with an improvement in the dimension of ethical aspects and on the use of information, and not significant in the item of using communication (see table 5).

Table 5. Comparison between pretest and posttest, per dimension of digital skills

Dimension	Test	N	□	Standard deviation	Sig. (bilateral) ^a
Ethical aspects	Pre-test	34	2.1	0.74	.052*
	Post-test	34	2.4	0.71	
Handling of information	Pre-test	34	2.0	0.97	.004*
	Post-test	34	2.4	0.71	
Handling of communication	Pre-test	34	2.6	0.82	.557*
	Post-test	34	2.7	0.54	

Note: the median corresponds to a 0-3 scale.

^a Wilcoxon contrast.

* Significant contrast $p < 0.10$

DISCUSSION

Generally, DAMs were given a score of 2.5, in a scale from 0 to 3, on the accuracy elements on handling examples, simplicity on developing topics, clarity on explaining contents, and relevance on improving digital skills; however, there was a lower mean in the latter concept at a regular level (2.2), because six of 34 learners selected level 1 (little relevance).

Specifically, the three thematic modules were evaluated to be clear and simple on the explanation and development of topics. The difference of attributes between the modules was on the use of examples, which were considered to be less accurate in the modules of ethical aspects, and the relevance element of contents, which was given a regular value, in a lesser level, on the modules on the use of communication by three learners of 34. This is consistent with the

statement made by De Boer (2013): the challenge to see videos with educational purposes lies in activating the learning process of learners to encourage them to build relevant knowledge from what is shown on screen.

The thematic contents on ethical and communication aspects were regularly motivating regarding the learning process, in contrast to the use of information; therefore, most of them considered the latter was useful to support the preparation of academic papers, because it explains how to use APA rules, to recover previous searches, to block unwanted messages during network browsing, to make a list of links, to use Google's academic search engine, among others. This reflects on the specific need of college learners which were identified in a research performed at UABC by Avitia & Uriarte (2017), who found that the learners have an intermediate level of skills associated with the search, organization and analysis of information (low use of advance searches with Boolean operators):

Regarding aspects of satisfaction, displeasure and improvement of DAM, positive comments were predominant on the pedagogic and design elements, such as explanation and presentation of the topics, relevant contents to prepare academic papers, and a different and simple learning offered thereby. In contrast, a recurrent comment of displeasure and improvement was on the duration of some of the modules.

Fernández (2017) recommends that videos are made with an approximate duration of five minutes, because there are more reproductions. It should be said that in view of the number of topics developed in the different modules related to the level of communication, information and ethical aspect skills obtained from the sample, they were planned as modular teaching mini-videos. According to Letón *et al.* (2012), this classification was of short-duration educational videos (between five and ten minutes), where the topics are presented by means of modules in a specific and plain manner; they may include text, animations and graphics; they may be seen on the Internet or on a mobile device; and the explanation of content may be in charge of the instructor, whether in a narrative or visual manner, partially or in full, in accordance with the teaching aim.

On the implementation of DAMs, the general pedagogic purpose was met to a greater extent to improve the digital skills of freshmen at the higher level, because, in a scale from 0 (Null) to 100 (high), the results of the pre-test (74.8) and the post-test (83.9) were

significant, with a difference of $p < 0.01$) in favor of learning. Specifically, in a scale from 0 (null) to 3 (high) on using information (pretest: 2.0/posttest: 2.4) and ethical aspects (pretest: 2.1/posttest: 2.4), learning was favorable, although with a lower score difference.

This makes it evident that the improvement of digital skills specially was on learning how to activate browsing filters; to prevent the use of ideas, words and text of others available on Internet, as if they were their own; to verify that the information found on Internet is trustworthy; to make an advanced search; to recover searches; and to make a list of links on the browser for later access. Regarding the use of the communication dimension, there was no skill improvement (pretest: 2.6/posttest: 2.7), as learners are more literate in this topic and, therefore, they need minimal support to know how to work on a document online in a collaborative manner, on the use of hashtags on social networks and on applying spelling and grammar rules on a document in a digital format.

Consequently, the advantages and opportunity of implementing this type of pedagogic tools depends on designing learning materials considered as instructional elements including pedagogic components, of design and technological, as well as to align them with educational purposes, in view that one of the limitations is apathy of a learner if they refer to learning topics. In this sense, ICTs have enabled new and innovating pedagogic scenarios; nonetheless, it is important to plan technological strategies focused on the user and not on technologies (Cebrian, 2011) to foster significant knowledge.

CONCLUSIONS

Generally, DAMs showed elements of efficacy for the improvement of digital skills, specifically, on using information and ethical aspects, of college freshmen; however, it is necessary that thematic modules on the use of communication and technical aspects be analyzed to focus them to more relevant contents for the college learner. Additionally, this requires the interest and participatory attitude of learners to acquire knowledge through technological mediation in the digital learning ambience, since participation of college learners was reduced.

Findings of this survey reveal the positive impact of implementing pedagogic resources via DAMs, because they provide the basis of pedagogic, technological and design guidelines to develop educational contents in a digital audiovisual format as a self-

learning material, in parallel to a learner's education, reproduced in several portable digital devices, aimed to enrich their academic wealth in ubiquitous environments.

Some of the recommendations for future research on preparing pedagogic resources in an audiovisual format consist in adapting information or dividing the topics in segments with a maximum of five minutes of play time, because this was a relevant aspect to have learners participate in viewing the contents; to employ a semi-formal language, together with visual reinforcing aids to explain the topics; without image saturation and text to foster better understanding and interest; to use an instructional design in accordance with the educational purpose established to employ more efficient processes; and to disclose them on networks of easy reproduction in different portable devices to create an ambience of mobility. Likewise, it is important to employ a process of formative (processes) and summative (results) evaluation of learning, both on the subjective opinion of participants by means of questionnaires, interviews, or focus groups, and on measuring knowledge by means of a test aimed to supplement the results.

Finally, the analysis on this topic adds to knowledge in the manner that ICTs have permeated the college educational activity so that we would be able to take advantage of the pedagogic potential of portable digital devices and digital platforms, and to generate better opportunities for professional development in this mediatized society by technological innovation.

- [1] Our own translation of the original Manual Frascati 2015 in English.
- [2] According to the compilation of Hootsuite and We are Social (2019) in Digital 2019 reports, 98% of internet users in México look up videos online and the most active platform is YouTube.
- [3] The interpretation of colors was based on Heller's book (2008), sociologist, psychologist and specialist in communication theory and color psychology. Its publication was made from a survey applied to two thousand participants between the ages of 14 and 97 and with various professions.
- [4] RGB is the chromatic model of light intensity for the treatment of video signal and images projected on screens. Each light signal is separated into red (R), green (G), and blue (B) and, when mixed, generate a variety of colors and shades.
- [5] Fonts are classified as: with serifs or without serifs (dry stick). The former are also known as "finisher", "grace" or "serif" to refer to those ornaments that have certain typography at the ends of each of the characters, for example, Times New Roman. Dry stick characters are plain, unadorned characters, such as the Arial font.
- [6] An isologo or isologotype is a logo designed by joining a graphic symbol and text represented by typographical signs.
- [7] This is the access link:
<https://www.youtube.com/channel/UCOTv342RrhZfAsionLOXRMA>

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