# Heuristics and Usability of a Video Assessment Evaluation Tool for Teachers

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Abstract: The article presents the design and development of an organized multimedia Web tool to help teachers evaluate videos produced by students according to the JuxtaLearn learning process. We use a development research methodology, fulfilling the following phases of the protocol: (1) preliminary investigation, (2) theoretical embedding, (3) empirical testing and (4) documentation, analysis and reflection on process and outcomes. We started with the exploratory analysis phase where it was intended identify scientificity and pedagogical potential of the video. Based on the data obtained in this phase, the tool was designed and further developed. Usability evaluation tests were carried out with experts and the target audience in order to adapt the product. Based on the results of usability testing, we can say that the prototype responded to the teachers' needs, arousing their interest in promoting video production with their students.

## 1 INTRODUCTION

Video editing by student can lead to reflection on their own learning (Otero et al., 2013; Adams et al., 2013). The editing process can improve the quality of reflection around concepts (Fadde, Aud, & Gilbert, 2009; Forman, 2000).These reflection are considered important factors for learning (Novak, 2010). By stimulating creativity through the video creation process, students have the opportunity to reflect on the information they collect and clarify possible mistakes (Adams et al., 2013; Otero et al., 2013) and identify doubts about the concepts focused (Hechter & Guy, 2010). Video construction allows a creative process for success in understanding concepts, leading to a shared understanding of a potentially difficult theme or concept (Fuller & Magerko, 2011).

The use of video in an educational context has aroused interest on some researchers, but the difficulty of evaluating the videos constructed by the students led us to think of an evaluation instrument by points, that allows to estimate / evaluate the student's level of understanding only viewing the video. This reflection coupled with the guidelines obtained from the literature in the area of video in education and in the area of knowledge assessment triggered this construction work of an instrument that allows the teacher who accompanied a video editing process by the student, viewing the video, estimate his level of understanding about the content.

In this article, we present the design and development of a video assessment tool to be used by teachers who applied the Juxtalearn learning process. The development process of this assessment instrument took place over the following phases: (1) preliminary investigation, (2) theoretical embedding, (3) empirical testing and (4) Documentation, analysis and reflection on process and outcomes.

We started with an exploratory analysis phase and based on the data obtained and the existing theoretical references on Bloom Digital Taxonomy, we proceeded to the design and subsequent construction of an instrument for observing the videos produced with the JuxtaLearn methodology that we present here. Throughout this process, evaluation tests were carried out with experts and with the target audience in order to adapt it to that audience.

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## 2 RELATED WORK

### 2.1 The JuxtaLearn

The lack of motivation, coupled with a certain social predisposition translated into some conformity to accept the poor results in the STEM areas, normally does not help to overcome obstacles. A possible approach can be positively influenced by the video creative editing (Adams et al., 2013; Otero et al., 2013), which can be an important contribution to giving the student a clearer view of the concepts. The Juxtalearn project focuses on the use of video to stimulate students' curiosity about difficult concepts, called Threshold Concepts in the literature, leading to deep learning by the student (Adams et al., 2013).

The JuxtaLearn learning process is a cyclical process consisting of eight stages, centered on the student (Martín et al., 2015).

In step 1, based in his / her previous experience with students, the teacher identifies difficult concepts to understand by the student. Each of these concepts can be divided into simpler concepts, called stumbling blocks.

In step 2, the teacher creates one or more Activities around the identified stumbling blocks. In this phase, the teacher also creates a diagnostic quiz where each question is constructed in order to focus on one or more of the identified stumbling blocks.

In step 3, the teacher applies the diagnostic questionnaire to students to determine their level of understanding about the concept identified. Then, the result and responses to the diagnostic questionnaire are analysed by the teacher and each student.

In step 4, the teacher proposes that students, organized in groups, create a storyboard to explain a concept. The storyboard is a framework for the development of ideas and the overall visual design of a video (Hartnett, Malzahn & Goldsmith, 2014). Its construction assumes planning of sequentially related actions, promoting a different view of the concept.

In step 5, students, based on the storyboard they created, capture an image, choose sound and edit the video. The greater the student's involvement in video editing, the greater the didactic effectiveness of this process (Cruz, 2019). The editing process can improve the quality of this reflection, since that structures it and encourages students to focus on the content itself (Fadde, Aud, & Gilbert, 2009; Adams et al., 2013).

In step 6, students share their work and reflect together. Reflection is considered an important factor for learning (Novak, 2010), leads to a deep understanding of scientific concepts allowing students to identify misinterpretations and doubts about the concepts (Hechter & Guy, 2010).

In the step 7, discussion is promoted between students and teachers allowing the social construction of knowledge, a better understanding of concepts, the presentation of videos, debate on the methodologies adopted and possible improvements for their implementation.

In step 8, students fill out the diagnostic questionnaire again to verify their knowledge of the concept and evaluation of the improvements.

The JuxtaLearn process is a way to support students in the deep understanding of a concept throughout a creative process in a stimulating and flexible approach, characteristic of the teaching of threshold concepts. The use and editing of the video is a natural process and can play a relevant educational role (Adams et al., 2013). In the following image we present a representation of this process.

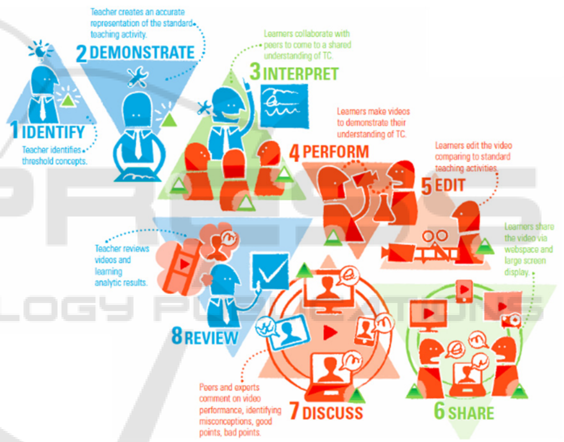


Figure 1: The JuxtaLearn Process.

### 2.2 Bloom's Taxonomy

The Bloom's taxonomy emerged as a result of work developed by several universities in the United States, led by Benjamin S. Bloom. Bloom organized a hierarchical structure made up of educational objectives. This structure allows to classify the learning in three great domains with different levels of depth: cognitive domain, affective domain and psychomotor domain.

Bloom Digital Taxonomy is a tool that follows the thinking process and allows to structure the cognitive domain at levels of increasing complexity. So, to understand a concept, it is necessary to first remember it and, in order to apply the knowledge, it is necessary to understand it (Churches, 2009). The categorization used in Bloom's digital taxonomy not only presents learning outcomes but also a dependency relationship between learning levels, because the results are cumulative. Cognitive development benefits from hierarchical structuring that allows students to be able to transfer, in a multidisciplinary way, the knowledge acquired (Ferraz & Belhot, 2010). In Bloom's perspective (taxonomy), lower levels of learning provide a basis for higher levels of knowledge and higher-order thinking involves overcoming difficulties and the ability to relate and combine new information from a given context (King, Goodson & Rohani, 1998). This cognitive development allows to reach higher order thinking, Higher Order Thinking Skills (HOTS). The concept of Higher Order Thinking Skills arises from learning taxonomies, namely Bloom's Taxonomy, where achieving higher order thinking involves the acquisition of complex skills, such as critical thinking and problem solving. Bloom's Digital Taxonomy is a hierarchical structure that classifies, learning objectives in the cognitive domain at six levels (Doyle & Senske, 2017). To Ferraz and Belhot (2010), using Bloom's taxonomy in an educational context allows the development of assessment tools and organize differentiated strategies in order to stimulate performance in knowledge acquisition levels.

Rahbarnia, Hamedian and Radmehr (2014), in their study, where they intended to understand the relationship between each of the multiple intelligences and the resolution of mathematical problems, performed multiple intelligence scans based on the Digital Bloom Taxonomy. They concluded that Bloom Taxonomy is a useful tool, as it allows to go beyond individual cognitive processes and focus math assessment on complex aspects of learning and thinking. The results of these authors show that intelligences such as mathematical logic and spatial visualization are positively related with solving mathematical problems. The abstraction of the content is developed from the cognitive development of the transition from concrete / real situations to abstract situations (Ferraz & Belhot, 2010).

## 2.3 Construction of Videos by Students

The creation of video content and its integration in learning activities with students are extremely important for teachers in the century XXI (Kumar & Vigil, 2011). The use of cell phones or a tablet opens the possibility of new pedagogical approaches using video, because it allows to record video, edit it and share it (Múller, Otero, Alissandrakis & Milrad, 2014). The use of video in a pedagogical environment can facilitate the understanding of content, involving students in the teaching process itself, as it favours their participation in the learning context (Cruz, Lencastre, Coutinho, José, Clough & Adams, 2017). The creation of videos through meaningful experiences for students, allows the creation of engaging and favourable learning moments for the acquisition of knowledge (Otero, Alissandrakis, Müller, Milrad, Lencastre, Casal & José, 2013). Dadzie, Muller, Alissandrakis and Milrad (2016) reported two student-centered studies for social and constructive learning of concepts through creative, collaborative and reflective video composition. In their study, they explored the influence of software designed to increase students' reaction and collaboration in video editing . The results obtained by these authors led us to suggest the use of mobile devices to access shared information, to increase students' ability to follow the constructive learning process.

Aspects such as the elements of the video design, the pedagogical component involved in the process and ethics are fundamental, for the integration of this technology in the school environment. There are several ways to integrate video into the learning process, favouring students to build strong cognitive structures in understanding (Dadzie, Muller, Alissandrakis & Milrad, 2016). The video thus assumes itself as an enriching resource for the school environment, capable of offering a clear focus, experiences from the natural world, historical retrospectives, the understanding of current issues, facilitating the clarity of concepts, provide unique visual experiences, capable of favouring the teaching process and the acquisition of skills in students. Creative performance through the creation of participatory videos is a way to involve students in science, technology, engineering and mathematics (STEM), arousing the curiosity of students and the public (Hartnett, Malzahn, & Goldsmith, 2014). The video presents a narrative structure that manages to captivate the viewer's attention and encourages him in a constructive learning (Adams, Hartnett, Clough, Grand & Goldsmith, 2014). In addition to the motivational feature that characterizes it, video editing can be a good form of assessment, as students tend to think more carefully about what is presented. Video editing should focus on the process, not the product (Adams, Rogers, Coughlan, Vander-Linden, Clough, Martin, Haya & Collins, 2013). This process involves students so that they are an active part of the learning process. The greater the student's involvement in video editing, towards creative manipulation and the discovery of solutions, the greater the didactic effectiveness of this process.

Sengül and Dereli (2013) conducted a study, on which they intended to investigate the effect of using cartoons on students' attitudes towards mathematics, when cartoons are used to teach integers. The authors involved sixty-one students and concluded that teaching through cartoons positively influenced the students' affective characteristics and their attitude towards the discipline of mathematics. Creative performance, through the creation of participatory videos, encourages deeper reflection and understanding (Hartnett, Malzahn, & Goldsmith, 2014). The data obtained by Sengül and Dereli (2013) is also consistent with the discovery that it would be important to use conceptual cartoons to teach abstract disciplines, as mathematics, and in the development of students' affective characteristics in relation to this discipline. Also Loch, Jordan, Lowe and Mestel (2014) developed an image capture work with mathematical concepts, through which they investigated whether short video recordings explaining mathematical concepts, which are prerequisites for certain content, are a useful tool for improving student learning. They concluded that viewing short explanatory videos can be useful in reviewing concepts that are prerequisites for mathematics. Lencastre, Coutinho, Cruz, Magalhães, Casal, José, Clough and Adams (2015) developed a study that involved the organization of a video contest, in which students were guided in the creation of videos around specific curricular topics. The results obtained suggest that students are receptive to video creation.

## 3 METHOD

To understand how creating and producing a video on some concepts helps students to decode and understand it, we based our analysis on the learning objectives described in Bloom's Digital Taxonomy. We believed that creative editing and video production about a difficult concept for students could favour student development, knowledge at a higher level.

The development and evaluation process of the explanatory video analysis grid, followed a Development Research methodology. The Development Research allows to use both practical and theoretical approaches, allowing not only the analysis of a phenomenon but also the grounded construction of a model. The construction of the evaluation instrument allowed to analyse the impact of its use in an educational environment (Lencastre, 2012). So, our methodology is described in the following diagram:

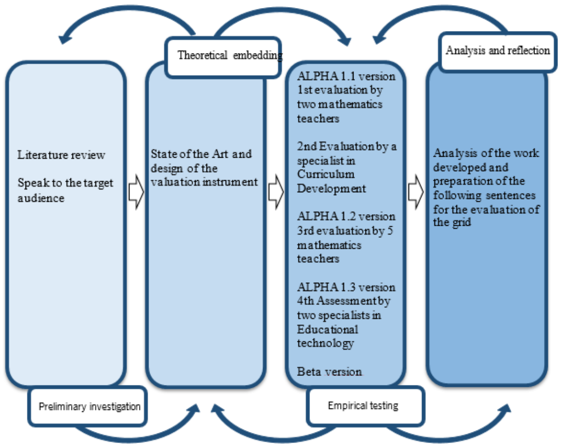


Figure 2: Methodology adopted for development the tool.

### 3.1 Participants

In the first phase, Preliminary investigation, we had the participation of nine teachers from various subject areas which scientifically and pedagogically validated the content presented in the videos by eight teachers, one teacher from each subject area of the videos produced. As our work is about students editing video on math concepts, in the phase Empirical testing, three mathematics teachers were involved, essentially in the construction of the various versions so that their profile would be similar to the target audience. Three experts were also used, one in Curriculum Development and two in Educational Technology.

### 3.2 Development of the Tool

In the first phase, bibliography on Bloom's Taxonomy was consulted and the informal opinion of some teachers regarding the use of this assessment tool, perspectives and particularly about its application in practice.

Google Forms technology was used to build the online version of the tool. Throughout the process of designing the multimedia prototype, evaluation tests with experts and users were carried out simultaneously with the bibliographic research, in order to achieve usability conditions.

#### 3.2.1 Preliminary Investigation

The exploratory test with the target audience was divided into two phases and aimed to survey and identify the knowledge of a group of teachers about the scientificity and pedagogical potential of the video, to understand their difficulties and suggestions.

The first stage of the test was carried out through a questionnaire survey, which allows estimating attitudes, gauging opinions or collecting other information from respondents. The questions were directed in order to allow to understand: (i) if the video is scientifically correct, (ii) if it has pedagogical potential and (iii) if the teacher would use the video in his classes. This questionnaire included closed response items and open response items, using a scale of Likert degree according to 5 points (from 1 = strongly disagree to 5 = strongly agree). We opted for the Likert scale to measure the teachers' evaluation of the videos evaluated. This survey was applied to a group of teachers who accompanied a group of students in the making of an explanatory video, all from the disciplinary area of the content covered in the video. We chose these teachers because they are aware of the process carried out during creative editing and because they have pedagogical and scientific mastery of the content covered in the video. With this test we intend to infer about the scientific and pedagogical value given by the teacher to the videos whose execution he followed. Following Tuckman's guidelines (2000), we applied the questionnaire to a group of teachers who are part of the population of teachers under study. A copy of the online's questionnaire was sent to each of the teachers. These teachers were chosen because they were teachers who participated in an initiative promoted by the portuguese team of the ANONYMOUS project and followed a group of students during the process of creating an explanatory video. After the first validation phase already described, there was a need to change some aspects. Thus, we have divided the domain of scientific evaluation into two subdomains: (i) scientific correction and (ii) information correction.

The second stage of the test was done by filling a grid. In this grid, the questions were directed in order to allow a scientific assessment under two subdomains (i) scientific correction and (ii) information correction. In this phase we involved eight teachers, each teacher would have to score from 1 to 4 each of the dimensions. In this step, the same videos from the previous stage were evaluated, we chose teachers from the same school and from the subject area of the content of the videos produced, who did not followed the process of creating the videos so that we could compare.

The results obtained by this test constituted the basis for the collection of information in the literature and for the creation of an instrument that allows a teacher to estimate the understanding achieved with the production of a video by JuxtaLearn methodology.

### 3.2.2 ALPHA 1.1 Version

Based on the literature and Bloom's Digital Taxonomy, a first version of the evaluation instrument was built with the aim of detecting errors in its construction and identifying situations to improve.

Bloom's Digital Taxonomy contemplates the following phases: remember, understand, apply, analyse, evaluate and create. The general idea of this taxonomy is that lower levels of cognition support higher levels (Doyle & Senske, 2017). We intend to carry out the analysis of explanatory videos on math concepts created by students under the supervision of a teacher. So, the assessment tool provides a method that can support teachers / educators in this analysis. Thus, this assessment instrument was organized according to the dimensions of Bloom's Digital Taxonomy. The version ALPHA 1.1 was designed to evaluate six dimensions: (i) create, (ii) evaluate, (iii) analyse, (iv) apply, (v) understand and (vi) remember. We consider the six levels of cognitive processes considered in Bloom's Digital Taxonomy to name the dimensions. Each of these dimensions was in turn subdivided into two sub-dimensions: thinking and communication. Each of these sub-dimensions was also divided into indicators.

### 3.2.3 Heuristic Assessment Tests

The heuristic evaluation allows to make a continuous evaluation of the whole process, involving mathematics teachers and specialists who evaluated based on a set of usability principles, called heuristics. It is an accessible method that seems to predict the problems of the end user (Mack & Nielsen, 1994).

The ALPHA 1.1 version, was evaluated only by mathematics teachers in two phases. With the usability tests we intend to find difficulties in the use of the evaluation instrument, problems of application with the teachers and make recommendations that allowed to improve it. Following the guidelines of Lencastre and Chaves (2007), we carried out this process throughout the design and development of the assessment instrument.

The first heuristic assessment test was with mathematics teachers, informally through the visualization and filling of the tool by the teachers, recording of the observations made and difficulties encountered by the teachers, complemented by the researcher's self-observation. The teachers performed a free exploration of the evaluation instrument without defined criteria, choosing an order, so that we could more easily detect mistakes susceptible to correction. The information collected during the heuristic evaluation was used to reformulate the tool according to the observations made by the teachers, the recommendations of the experts and the needs diagnosed by us.

The second heuristic assessment test was done by a specialist in Curriculum Development. The test was previously scheduled, during which the specialist made a free exploration of the video evaluation instrument.

The third heuristic assessment test was carried out with five math teachers and accompanied some of their students in the creative editing of videos under the JuxtaLearn methodology.

The fourth test was carried out by specialists in the field of educational technology. One of the specialists is male and the other female. The two experts have a PhD in Education, specializing in Educational Technology. The evaluation by experts is essential to allow the detection of mistakes that can be altered and corrected (Lencastre & Chaves, 2007). These tests were previously scheduled with each of the specialists and their responses recorded. In both heuristic evaluation tests, we used paper-writing material to make the records and the computer to search for anything that was needed.

The evaluation test with the educational technology expert resulted in the transition from a paper version of the evaluation instrument to a digital version.

### 3.2.4 ALPHA 1.2 Version

In this version we adjusted the order of the information presented, to clarify the text of the indicators and to better adapt the indicators to Bloom's Digital Taxonomy and the JuxtaLearn methodology. The tool was reformulated, and with the 3rd heuristic evaluation test, we intend to find difficulties in using the tool, to detect situations to correct and consider opinions in order to improve it and make it more suitable for use. With this test we intend bringing it closer to the target audience, so we involved six teachers and they were all familiar with the process.

The test was previously scheduled with the group of teachers and was held at the school where they taught in a room equipped with computers. Each teacher had access to a computer and the printed assessment instrument. We ask them to choose one of the videos made by their students and evaluate it by filling in the tool. We also asked them to tell us their opinion about the assessment instrument, listing mistakes to correct, ambiguous or hard interpretation words in order to improve them. With this heuristic evaluation test, we also intend to understand the receptivity and acceptability of the evaluation instrument with teachers who accompanied their students in preparing the video, in order to improve it.

Heuristic evaluation is a method that allows, in a simple, fast and relatively inexpensive application, to obtain results that allow to improve a product. During the test, some questions were asked to highlight some of the potential of the grid in the analysis of the information transmitted by the video. Throughout the test, notes were taken in the logbook that made possible to complement the collection of information during the test. In this way, we tried to perceive possible difficulties in the interpretation of the information provided in the evaluation instrument and weaknesses in the instrument's ability to evaluate the student's creative video editing work. We also intend to evaluate the consistency of the indicators of each dimension with the JuxtaLearn learning process implemented by the student and the prevention of errors.

### 3.2.5 ALPHA 1.3 Version

In the construction of the ALPHA 1.3 version, we took into account the suggested changes and indicated the corrected errors. This version continued to be built on paper based on Bloom's Digital Taxonomy and in addition to some term simplifications, the main changes in this version were structural.

We started by reorganizing the information related to each dimension, which initially appeared all at the beginning of the assessment instrument and now appears when it is needed. The dimensions are also separated, and the dimension name is no longer on the side of the indicators and starts at the beginning, immediately before the description.

With the 4th heuristic evaluation test with an expert in Educational Technology, we intend to find difficulties in the use of the evaluation instrument, namely in the interpretation of information and problems on adapting the indicators to the video evaluation. We also intend to detect errors or situations where the usability criteria is not met, which can be improved. Thus, the video evaluation instrument was subjected to an evaluation by two specialists in the field of Educational Technology. The information collected with this heuristic assessment will serve to reformulate the video assessment tool based on the experts' recommendations.

This test was previously scheduled with the two specialists, on a date and place established for that purpose. Data collection was obtained using the method think aloud, where while the experts were analysing the video evaluation instrument, they were talking and we were recording what was going on to later review. The experts had a paper version of the evaluation instrument and performed a free exploration of the document, without previously defined criteria in order to detect anomalies that we can correct. We asked to analyse the video evaluation tool and verbalize the strengths, weaknesses and suggestions for improvement. The material used in this test was written material on paper for registration, the printed video evaluation instrument and the computer for viewing videos created by the students. Throughout this test, recommendations were made, suggestions to clarify the information present in the indicators and errors detected that were corrected in the following version (Beta).

### 3.2.6 Beta Version

With the results of the heuristic evaluation tests carried out and the experts' guidelines, we made the necessary adaptations and changes, going forward to the Beta version of the video evaluation instrument. In the heading in the new version we present the objective of the evaluation instrument and we also replace the title with the one suggested.

To make the video evaluation tool accessible, it became available online through a Google Forms form. This led to some changes in the initial structure. We chose to place the first dimension to be evaluated [Remember] next to the header of the evaluation instrument and the dimensions on separate pages to facilitate the analysis and completion by the evaluating teacher. Going online allowed the teacher after completing the filling, to submit the assessment and the data gets organized in the same document that allows further analysis. In this way, the same teacher can evaluate several videos and, in the end, analyse the results obtained.

## 4 RESULTS

In the first stage of the preliminary investigation, all teachers admitted, that the videos were scientifically correct and that they have pedagogical potential. Only 5 teachers indicated that they totally agree with the scientificity and pedagogical potential of the video. Only one of the teachers showed no desire to use the video in their classes.

In the second stage of the preliminary investigation, with regards to scientific correction, the teachers reported that most of the videos had an excellent mastery of concepts. Regarding the correction of information, the teachers reported that the videos present well-articulated information, without grammatical corrections or without scientific language inaccuracies. Teachers said that, the videos were scientifically correct and have educational potential. They only point out some inaccuracies in terms of the explanation of the information. But they recognize that the information presented by students in the videos is well articulated.

In the 1st heuristic evaluation test with two mathematics teachers, teachers were informed that the test consisted of assessing the clarity of the instructions, and in relation to the mathematical concept covered. The evaluators started by viewing a video on divisibility criteria and reading the text of the evaluation tool. We noticed that the way the sub-dimensions were presented and the fact that they were the same in each dimension created some confusion in the interpretation of the grid. Mistakes also arose regarding the significance of the grid's dimensions.

Teachers questioned us about what each dimension meant and what it implied for the video evaluation process. We realized that we needed to further adjust the information contained in the indicators to the stages of the Juxtalearn learning process, to facilitate its interpretation for the user. We also noticed that some of the indicators were not clear enough to allow a quick response. Teachers were unable, for example, to respond to the indicators “plan a coherent explanation structure”, “formulate hypotheses” and “list the essential aspects of the information presented”. The indicator “marking the key aspects of the concept” and the indicator “shows understanding about the concept” also raised doubts and different interpretations regarding what it referred to, how it was intended to be marked. The indicator “use mathematically correct and clear terminology” in the opinion of one of the teachers should have only the word “correct”, because according to this teacher, the word “clear” is understood to be correct already.

In the 2nd heuristic evaluation test with an expert in Curriculum Development, the collection of information from this test served to reformulate the tool according to its recommendations. In this test, previously scheduled, we presented the expert, the ALPHA 1.1 version on paper. We also presented an example of a video created by a student so that he could explore it. The expert, read, analysed and performed a free exploration without previously defined criteria, in order to detect mistakes and irregularities in the evaluation instrument to be corrected by us. The test was carried out using the think aloud data collection method. In this way, the expert commented aloud on his observations while analysing each of the dimensions of the evaluation instrument. During the test, the analysis verbalized by the expert, the expert's reaction to the information presented was recorded for later analysis.

The second expert is a doctor in Education, specialist in curriculum development, author of several presentations in the field of assessment. He currently works as a teacher in a group of schools in the north of the country and as coordinator of several projects at school level. The Specialist started by reading the video evaluation instrument, then viewed the example of one of the videos made by the students and then analysed each of the dimensions of the tool. He identified some mistakes: the lack of an explanation of what each of the dimensions presented throughout the assessment instrument means. A different organization of the indicators was suggested, organizing them in order of execution in the action. He also suggested the removal of the side numbering in each of the indicators and that we add at the top of each dimension the phrase [The student can…], to make it clearer what we want to evaluate. He suggested that we standardize the categories, putting in the same verb tense, for example [Describes], [Understands]. The expert also suggested that the last indicator of each dimension should use the word of the dimension itself corresponding to a more advanced level of understanding, for example, in dimension "A", [remember], in dimension "B", to [understand]. Throughout this test, the expert made suggestions that were met and corrected in the next version of the video assessment instrument. At the beginning of the tool we present a brief description of each of the dimensions. We reorganized the indicators according to the sequence of steps in the JuxtaLearn learning process. We removed the numbering in each of the indicators. We have standardized some terms used in the text of the indicators. We reviewed the verbal forms used in each of them and add in each dimension an indicator with the word used to characterize the dimension. We also simplified the presentation of each of the dimensions, presenting in the new version only its name.

With the 3rd heuristic evaluation test, we realized that we would have to better clarify some of the indicators. The indicator [clarifies the obstacles] of the [remember] dimension, the indicators [Focuses presentation on information about the concept], [informs about the concept] and [deconstructs the concept] of the [Analyze] dimension raised doubts regarding its interpretation, in relation to what was expected to be evaluated with these indicators. As the test progressed, we also noticed that some teachers had difficulty distinguishing the indicator [presenting information for the perception of the concept, without which it would not be noticeable]. Still in this dimension, three of the teachers asked us what was the difference between the indicator [makes generalizations in relation to mathematical ideas and procedures] and the indicator [makes inferences about the information presented]. Similarly, in the dimension [Create] the difference between the indicator [building a connection of ideas capable of exemplifying the concept] and the indicator [producing an explanation of the concept] also generated in the teachers the feeling that they were evaluating the same thing.

In the 4th heuristic evaluation test, the experts in Educational Technology detected some mistakes and suggested moving the video evaluation instrument from paper to digital format. It was also suggested that the title should become just [Video assessment based on Bloom Digital Taxonomy]. Regarding the supporting information that accompanied each of the dimensions, they suggested that it was just [For each statement, check the option that best applies to the video you are evaluating]. In the response options, they suggested replacing [Not applicable] with [I don't know] to simplify the task for the evaluator. In the [Recall] dimension, they proposed replacing the word [Recognizes] in the first indicator with the word [Identifies]. They suggested replacing the second indicator with [Recognizes the obstacles that make up the concept], removing the last two indicators and adding the following [Recalls information related to the content]. In the [Understand] dimension, the experts suggested reducing the number of indicators presented. In the [Apply] dimension, they proposed replacing the word [uses] by [makes] and removing the third indicator. In the [Analyse] dimension, they suggested replacing the first indicator with [deconstructs the concept into simpler components] and eliminating the second, third and eighth indicator. In the [Evaluate] dimension, experts suggested replacing the indicators with the following: [formulate hypotheses for explaining the concept], [try an explanatory hypothesis], [judge the solution found], [making value judgments about it and evaluate the solution found]. In the [Create] dimension, the experts suggested replacing the indicator [underlining the supporting information, without which the concept would not be perceived] by [idealizing a coherent answer to explain the concept], the indicator [building a link of ideas] able to exemplify the concept by the indicator [draws a logical sequence of ideas capable of explaining the concept], and the indicator [build a correct logical-mathematical explanation] by the indicator [build a correct explanation from the scientific point of view]. They also warned about the need to change the word [created] with the word [create] in the last indicator.

The results obtained in this test, led to the next version in digital format. In the new version, we corrected the title, supporting information and the text of the indicators according to the suggestions that were made by the experts. In the [Understanding] dimension, we replaced the indicators for: Interpret the concept, compare the concept with related information, exemplify the concept in similar situations and understand the essential aspects to apply the concept.

## 5 DISCUSSIONS AND CONCLUSION

Seeking to answer the problem of the lack of an instrument that allows evaluating videos produced by the students themselves according to the JuxtaLearn process (Cruz, et. All., 2017), this study aimed to design and develop a tool capable of assisting teachers in this task.

Throughout this article we describe the various stages of developing a tool to evaluate the videos produced according to the JuxtaLearn process. Throughout the tool's creation stages, we followed Nielsen's (1993) guidelines, according to which they must be appealing, intuitive and be products that can be used with (i) ease of learning, (ii) efficiency in performing tasks and (iii) satisfaction.

In the Analyse phase, in addition to a study of the state of the art, we applied an exploratory test with the target audience in order to understand their characteristics, needs and interests. Then, in the Design phase, we developed the content and drafted the ALPHA version that we thought would meet the needs of our target audience. We carried out the heuristic evaluation by experts in order to detect possible errors in order to solve them before the tool is tested as a target audience. After correcting the detected errors, in the develop phase we applied the tool to teachers similar to the target audience to see if they could easily learn to use the video evaluation tool and understand if it was a resource they needed.

The pedagogical system is in need of a new paradigm, to which the traditional school is unable to respond, and an active search for possibilities for change, which will put the development of the individual first, instead of memorizing an infinity of facts. Society is becoming dependent on technology and new ways of integrating it into the learning process, where being able to learn and adapt to the new training skills needed is a basic skill (Laal, 2013). It is necessary to learn based on research carried out in the area of learning and focus teaching on understanding and practice (Dadzie, Benton, Vasalou & Beale, 2014). In general, all teachers were able to evaluate videos produced by their students with the tool. The application of the Beta version allowed us to realize that the prototype was useful for teachers who used it and may be useful for teachers in general. Allows quick assessment of student knowledge.

It also seems appropriate to analyse in future research if the level of reflection achieved, with the use of the evaluation instrument of videos created by the Juxtalearn methodology, contributes to change the teachers' professional practice.

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