

GT-VoA: Videos On Demand as Learning Objects

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Abstract

The use of multimedia resources inside classroom is increasingly common, making the learning process more participatory and interactive. Learning objects (LOs) are entities that can be used, reused or referenced during teaching. The Videos on Demand as Learning Objects Working Group (GT-VoA) is an ongoing development pilot that uses a multimedia authoring tool to build LOs with interactive multimedia content for use in distance learning (DL). The objective of this paper is to present Cacuriá, a service consisting of an authoring tool integrated with an online repository of LOs, that allows teachers and tutors to create and share videos enriched with interactive multimedia content. The LOs generated by the service can be saved in HTML5 format to be published in the Web or translated to NCL (Nested Context Language), the Brazilian Standard for Digital TV and ITU-T IPTV Standard. The tool empowers the creation of LOs with autonomy and flexibility without requiring multimedia technical skills. The pilot phase under development, includes experiments to store these LOs in the video on-demand service from RNP (Video@RNP) and in the distance learning object storage from RNP (VideoAula@RNP). Usability tests results show that Cacuriá can be used by teachers with efficiency and consistency. Partnerships with Brazilian institutions Federal Universities of Juiz de Fora (UFJF) and Federal University from Maranhão (UFMA) is key to project development, collaborating and definition of systems requirements and software enhancements, as well as new features for Cacuriá. Escola Superior de Redes (ESR) a technical and management training division from RNP is also engaged in the pilot phase to evaluate Cacuriá adoption to its authoring process.

Keywords: Multimedia Authoring, Learning Objects, Distance Learning. Videos on demand

1. Introduction

We live in times of great technological transformations, which have an impact on many of our daily activities in different knowledge areas, for example as happens in the field of education where the process of teaching and learning becomes more dynamic and

collaborative. Currently, it is common that both teachers and students make use of technological resources (eg, slides, videos and games) to improve this educational process to produce and share knowledge about certain subjects.

The Videos on Demand as Learning Objects Working Group (GT-VoA) has been developed in the context of RNP – Brazilian NREN – Working Groups programme and aims to enable the creation and exhibition of learning objects (LOs) and interactive multimedia content, while using them for distance learning (DL). LOs are stored and distributed using the video repository services.

LOs are defined as any other entity, digital or not, that can be used, reused or referenced during a learning or training process supported by computer(s) (IEEE LTSC, 2012) (Wiley, 2000). The main function of these objects is to act as a teaching resource, covering specific media contents of a subject such as image, text, video and audio. Some studies show that LOs facilitate and improve the quality of teaching (Nugent et al., 2005), and also provides several tools to facilitate the work of tutors.

The purpose of this work is to enable education professionals to create learning objects through an intuitive process, which is designed and crafted by the teacher him or herself. This process is based on educational videos, which will be enriched by the professionals directly (without the need of a programmer or designer) and also by adding multimedia content (image, audio, text etc).

The paper is organized as follows. Section 2 describes the Working Groups Programme. Section 3 provides the proposed solution to Authoring of Learning Objects. Section 4 describes a case study of the use of the tool. Section 5 presents the usability evaluation of the use of the tool. Section 6 provides the concluding remarks.

2. The Working Groups Programme (WG-RNP)

As the Brazilian NREN, RNP is responsible for promoting the development of networks in Brazil, including the development of innovative applications and services, especially for the benefit of its user organisations, comprised almost entirely of research institutes and universities. In the departments of computer science, information technology and telecommunications of many of these user organisations there are research groups in areas related to networks, engineering and distributed systems (middleware).

As a way of promoting greater interaction between RNP activities and such research groups, and also continuous innovation of RNP's products and services, the Working Groups Programme (WG-RNP) was created in 2002 within the Research and Development Directorate (DPD). WG-RNP aims to develop collaborative projects that can demonstrate the feasibility of using new protocols, services and network applications to meet the needs of users from educational and research institutions connected to the RNP network. Since then, this initiative has attracted, through an annual call for proposals, the interest of research groups from all over Brazil, challenged to build innovative applications and tools. The proposals are examined by an evaluation and selection committee with external representatives and the selected proposals become Working Groups (WGs) projects.

The WGs project receives funding to carry out their R&D activities, always closely managed by R&D project coordinators from DPD. This model has been proved to be an efficient way to promote interaction between RNP and the development teams, providing guidance and facilitating the delivery of results.

Each project is coordinated by a researcher in public or private institution, has its own development project team and is usually build up with contributions from partner institutions

(other universities or companies) as well as RNP specialists from different areas that may also participate in some project activities. ..

The GT-VoA was established as a WG in 2012-13 cycle and will complete the second phase by the end of 2014. An experimental phase with several Brazilians' institutions is being planned to happen during 2015.

3. Learning Objects Authoring

The Cacuriá is an authoring tool designed to create LOs for the Web and Interactive Digital TV environments. The first stage of development of the tool was the capturing of requirements. These requirements were collected with the participation of 18 stakeholders in sessions of Participatory Design techniques: Focus Group (Santa Rosa & Moraes, 2010) and Card Sorting (Santa Rosa & Moraes, 2010). The next step was the development of the interface using the technique of Paper Prototyping (Santa Rosa & Moraes, 2010), which included the participation of the same stakeholders from the previous step. This step aimed at evaluating the concepts and clarifying the requirements. The Figure 1 illustrates how the technique was performed, keeping the participants anonymous.

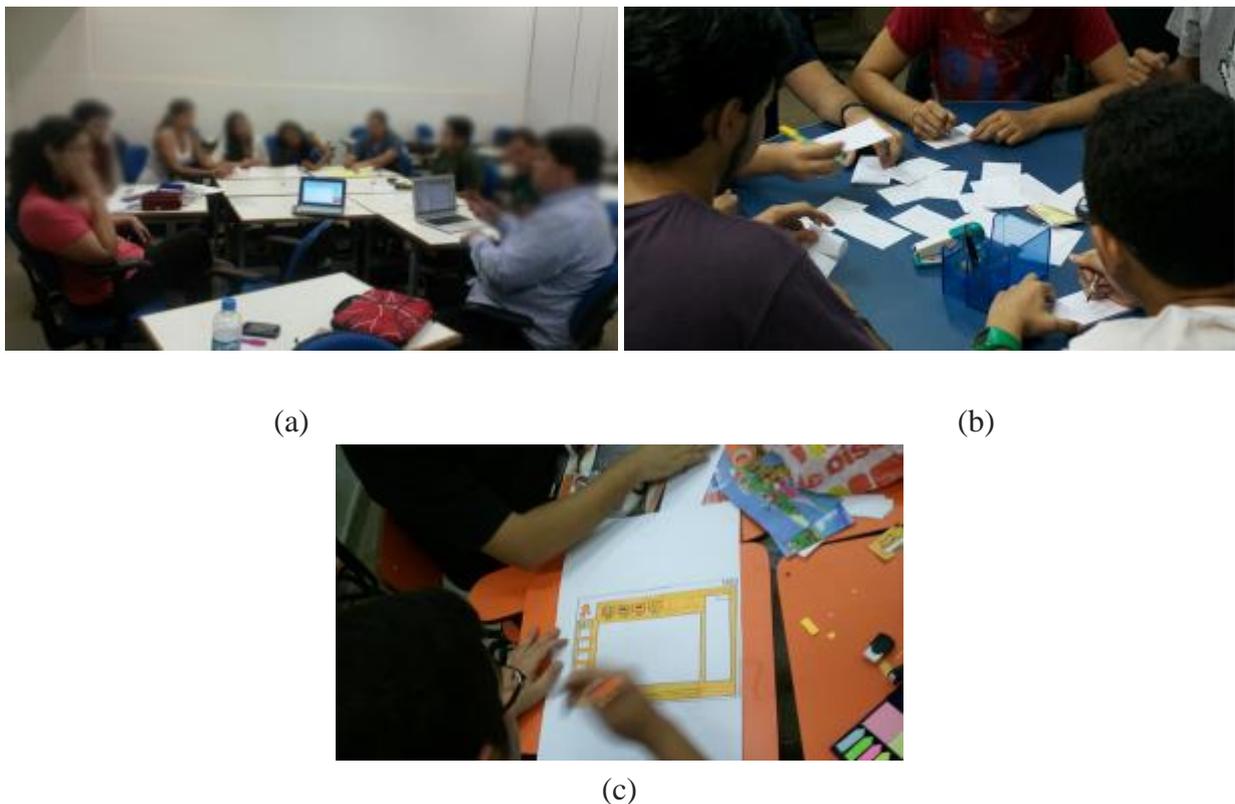
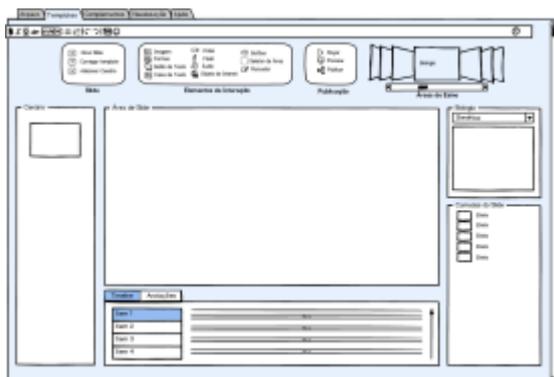


Figure 1 Focus Group (a) Card Sorting (b) Paper Prototyping of Cacuriá (c).

The Cacuriá tool was developed with the programming language C++, and the Qt framework (Blanchete & Summerfield, 2008). This framework allows the creation of multi-platform applications using the approach "write once, compile anywhere" (Blanchete & Summerfield, 2008), which enables the tool to be used on different operating systems. As we can see in Figure 2, the Cacuriá has evolved and is currently in version 1.1. The pilot participants ESR, UFJF and UFMA have been collaborating to systems requirements, software enhancements, as well as new features for Cacuriá with user feedback.



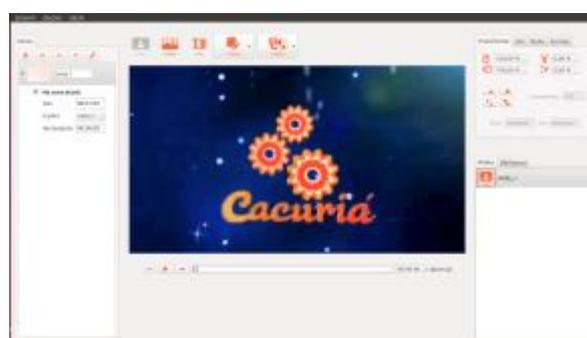
Conceptual Version



Version 0.9



Version 1.0



Version 1.1

Figure 2 Evolution of the Cacuria.

The current version of the tool consists of six different views used to manipulate the media as we can see in Figure 3. Menu View (1) is used to add media and to publish the LO. Scene View (2) is used to add, remove and sort the scenes, as well as to indicate what scene is in focus. It is also possible to create automatic links between scenes, allowing one scene to be started automatically at the end of a previously one. Layout View (3) is used to visualize the positioning and sizing of the media according to time. Time View (4) is used to run and manipulate the time of a scene. Properties View (5) is used to view and edit the properties of the media in focus. Vision Library (6) is used to list the media of the project and the current scene.



Figure 3 Layout of Cacuriá Views.

Cacuriá is integrated with the iVoD (Interactive Video on Demand) service from RNP. The iVoD was also specified to allow the storage and distribution of these learning objects integrated into the authoring tool. Figure 4, describes the architecture of the proposed service. First a teacher must create a LO using Cacuriá and then submit to the iVoD cloud storage. Then, students can watch and interact with the content created by the tutor with devices with Internet access, such as tablets, computers and smartphones.

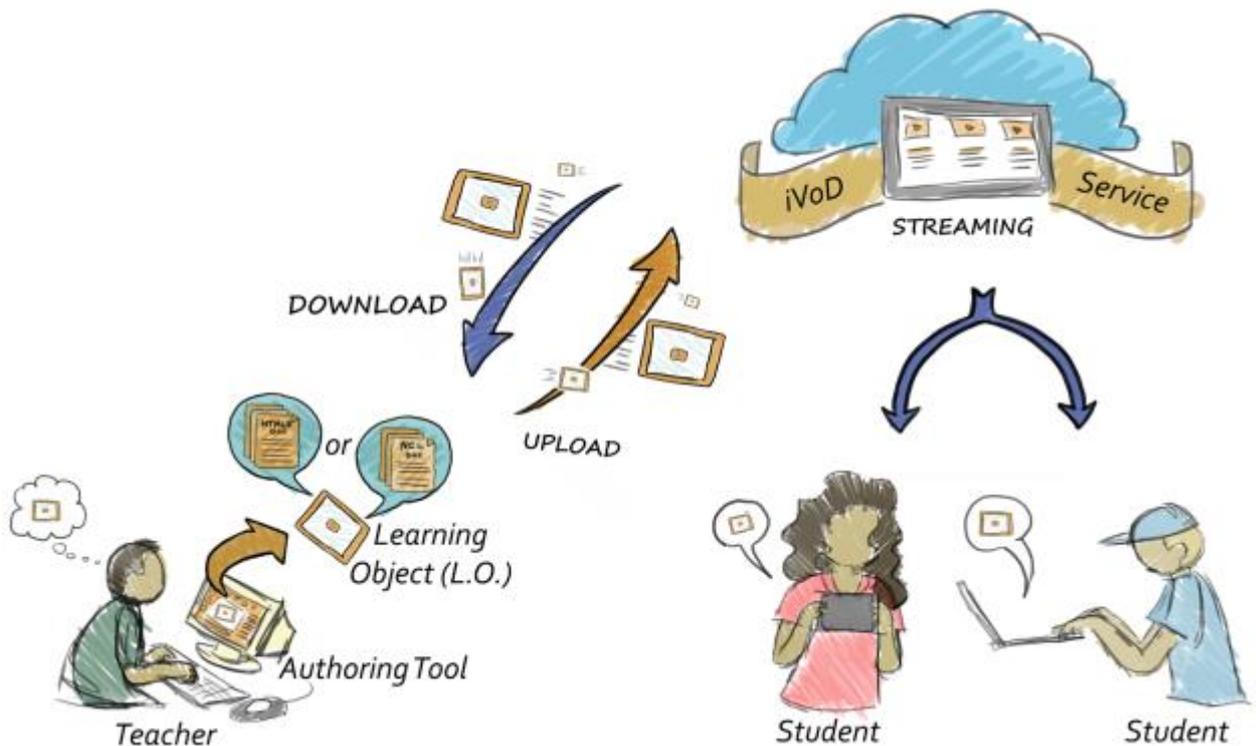


Figure 4 Architecture of the Proposed Service.

4. Case Study

This section presents the construction of a LO on the subject of algorithms using Cacuriá tool. The LO consists of a video where a teacher presents an introduction to sorting algorithms, as can be seen in Figure 5. At a certain time of this video, the student is offered the choice between two specific algorithms: *insertsort* or *quicksort*. From that point, the video stream is redirected to a new video about the algorithm chosen by the student.

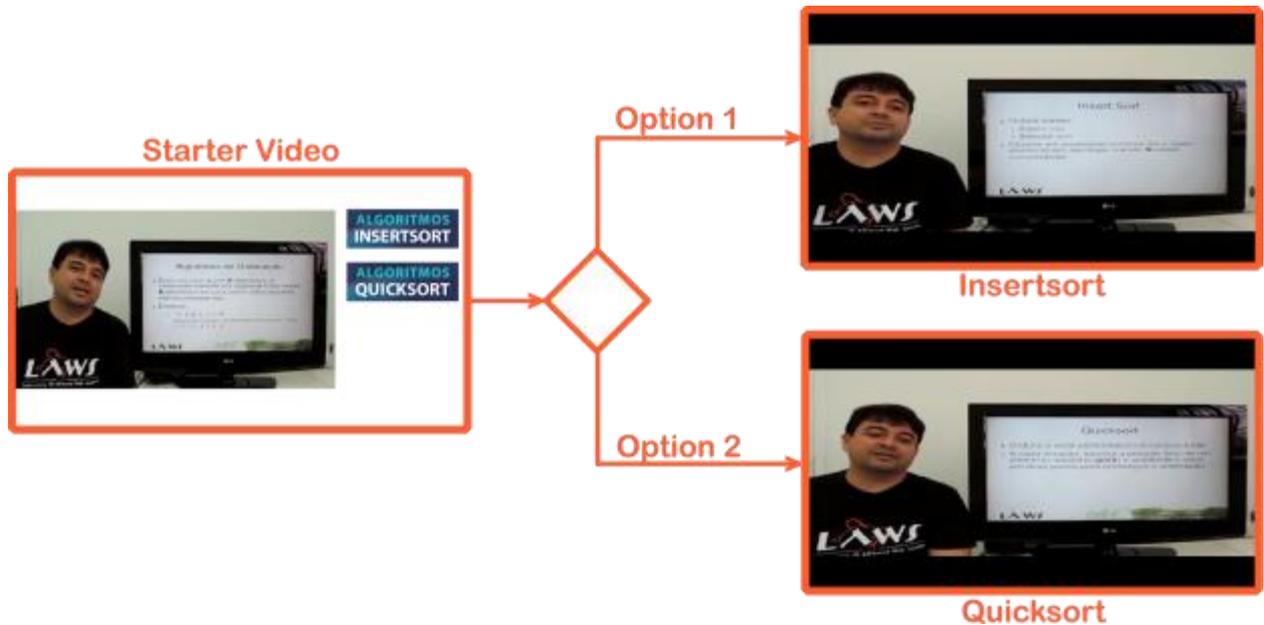


Figure 5 Sequence of the Sorting Algorithm LO.

When started, the Cacuriá tool already has a built-in scene, named Scene 1. For construction of the object, a video in mp4 format, for example, is inserted into this scene. This can be done by pressing the Video button in the Menu View, which triggers the opening of a browser window in which the user must specify the location where the video is located. As shown in Figure 6, the video is added to the Vision Library and the first frame is displayed in the Layout View. At this time it is possible insert others media like an image, shapes or texts. In addition, the video can have its size or position adjusted. This manipulation can also be performed through the mouse, using the resize handle that media has in Layout view.

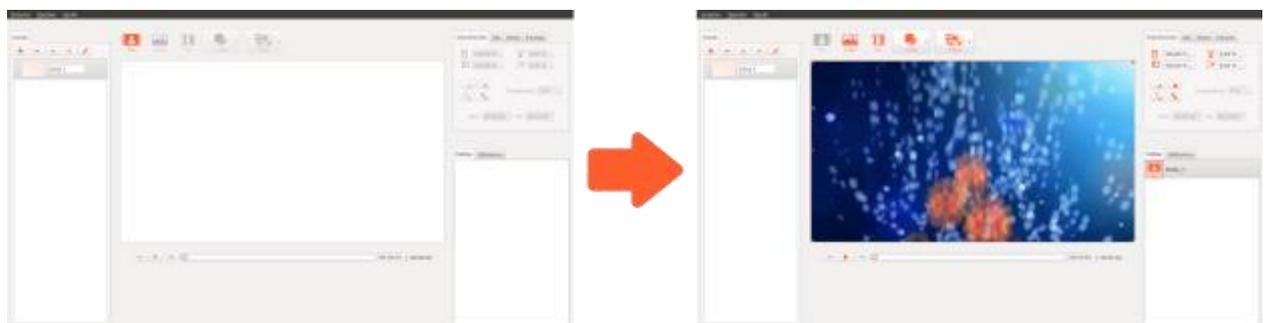


Figure 6 inserting a video in Scene 1.

In this example, after passed 57 seconds of the video based on Scene 1, the teacher requests the student to choose the option on how to continue the LO. At this point, the video is

resized and positioned to the left side of the screen. Then, two images are added to Scene 1, "Insertsort.png" and "Quicksort.png", which will be used later to make links with other scenes. A media image is embedded on the scene when the "Image" icon from the Menu View is clicked. Just like in the video, after clicking on the "Image" icon, a browser window pops up and the user can select the image location. The insertion of the image media, shapes and text can only be performed while the scene is paused. Then, the images are resized and positioned using the resize handle or by manipulating the properties of the "Transform" tab, resulting in the layout shown in Figure 7.



Figure 7 Scene 1 is paused at 57 seconds to add images.

During the development of this object, three videos are used. Since the tool only holds one video per scene, two more scenes are added to hold two more videos in this LO. The addition of a scene is done by clicking on the "Add" icon found on the Menu View. When a new scene is included, this new item is represented in the Scene Vision. To build Scene 2, it must be selected in Scene Vision. This way it becomes possible to embed the video about the Insertsort algorithm, "Insertsort.mp4", as shown in Figure 8. Then, Scene 3 is selected from the scene listing. An explanatory video about the Quicksort algorithm named "Quicksort.mp4" is inserted in this scene; this step can be seen in Figure 9.

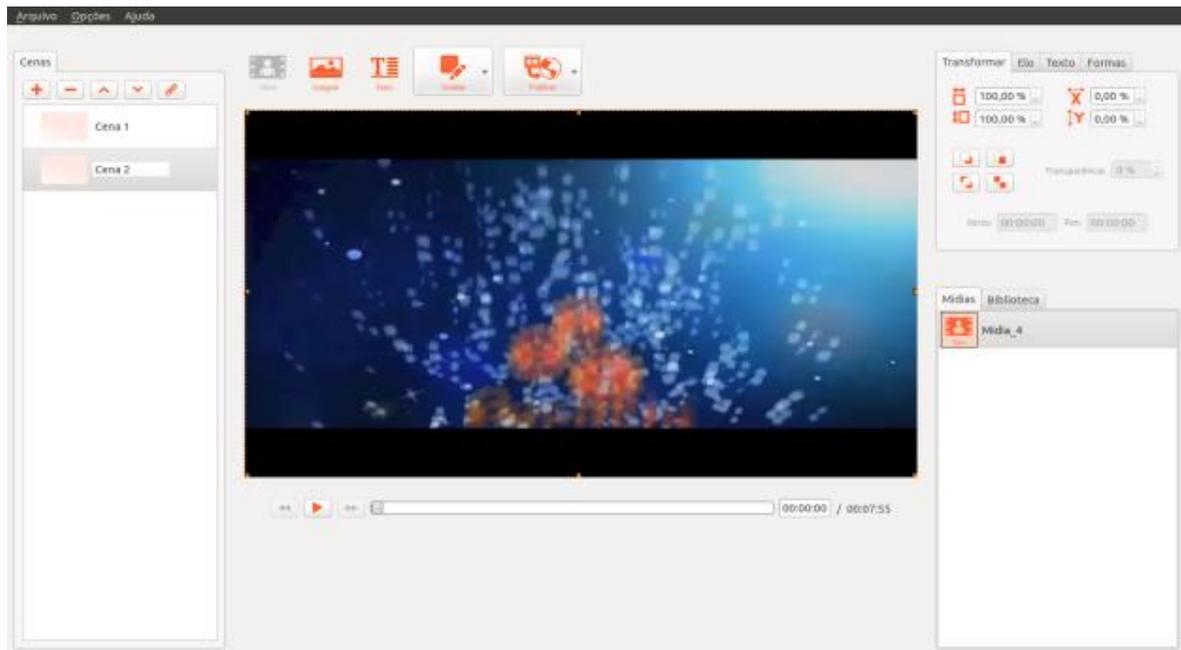


Figure 8 Cacuriá Interface after inserting a video in Scene 2.

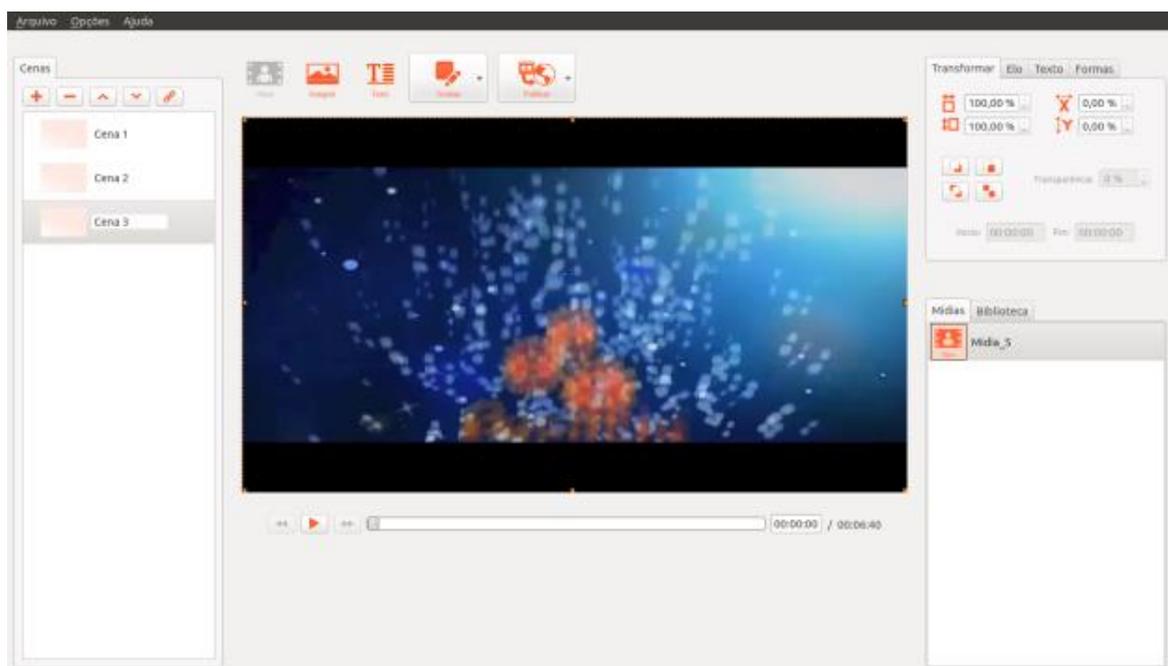


Figure 9 Cacuriá Interface after inserting a video in Scene 3.

After inserting these three scenes, the LO should be completed by configuring the links between each scene. In the Cacuriá tool, links can be made using images, shapes and text. In the example of this LO, links are made using the images "Insertsort.png" and "Quicksort.png" in Scene 1. When the image is selected, the fields "Ir para Cena (Go to Scena)", "Inicio da Cena (Beginning of the Scene)" and "Tecla (Key)" from the "Elo (Link)" tab (on the Properties View) are enabled for edition. The "Go to Scene" field provides a list of existing scenes. The "Beginning of the Scene" field determines in which instant of time the scene (which was chosen using the option "Go to Scene") will start. The "key" field displays the hotkeys that can be used to link scenes. The options selected for the "Insertsort.png" picture

were: Go to Scene 2 starting at time zero seconds, using as a shortcut the key "2", as displayed in Figure 10 and 11. As for the "Quicksort.png" image, the options were: Go to Scene 3 starting at time zero seconds, using as a shortcut the key "3", as displayed in Figure 12 and 13.



Figure 10 Cacuriá Interface.

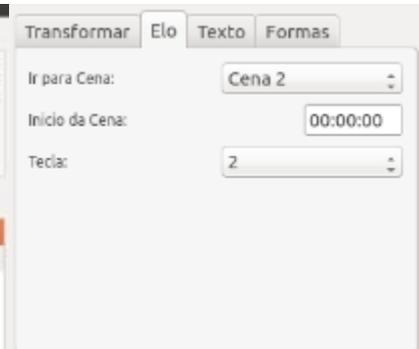


Figure 11 Properties of the "Link" tab.



Figure 12 Cacuriá Interface.

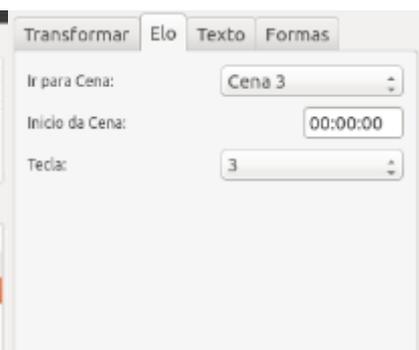


Figure 13 Properties of the "Link" tab.

With the construction of this LO about algorithms, it is possible to view some of the features available in the Cacuriá tool. The use of links between scenes to set the path that the LO should follow according to student choice, characterizes the nonlinear authorship. The example also allows us to understand the abstraction of scenes and the media synchronization with the time of the scene video, by studying how it was done with the images "Insertsort.png" and "Quicksort.png". Inserting media becomes easy using the "Menu View", and manipulating its properties using the resize handles and the "Property View".

5. Usability Evaluation

The evaluation consisted of using design technique of Usability Testing to measure the effectiveness, efficiency and satisfaction and to get feedback from users about the tool and

find new requirements. The sample selection for the Evaluation Design was a group of 24 different stakeholders who participated in the phase of the Participatory Design.

The sessions were started with a presentation about the evaluated tool. Then, participants agreed to participate in the test by answering an identification questionnaire. After that, a task guide was presented to participants about steps for the construction of a learning object on the Cacuriá 1.0. In addition, there was an agreement with stakeholders that the time limit for completing the tasks would be 40 minutes. After the step of using the completed tool, each user responded to a questionnaire assessing the usability of the tool. Finally, participants in the evaluation were gathered at the end of each session for a group interview. The purpose of the interview was to extract feedback and their opinion about the tool, such as positive features, what needed to be improved and what features of the tool should be provided to enhance the efficiency of Cacuriá. The Figure 14 illustrates the execution of usability tests, keeping the participants anonymous.



Figure 14 Execution of Usability Tests.

Some interesting results were obtained with the use of Usability Testing Technique. It was observed that among the 24 participants in the sessions, only two failed to perform the tasks. Most participants felt great difficulty in starting the construction of a learning object, however the average time to learn how to use the tool was 10 minutes. Another interesting point was that most participants completed the construction of the LO before the expected time of 40 minutes. This demonstrated that the effectiveness of the tool was reached. However, as we can see in Figure 15, the tool still needs to be improved to enhance its efficiency. During the group interview step, positive feedback about the purpose of the Cacuriá tool was reported. However, all sessions had reports stating that the main aspects that had to be improved in the tool were:

- Commands and shortcuts for performing tasks.
- Viewing changes in the media during their execution time in the timeline properties.
- Identification of icons
- Properties View.

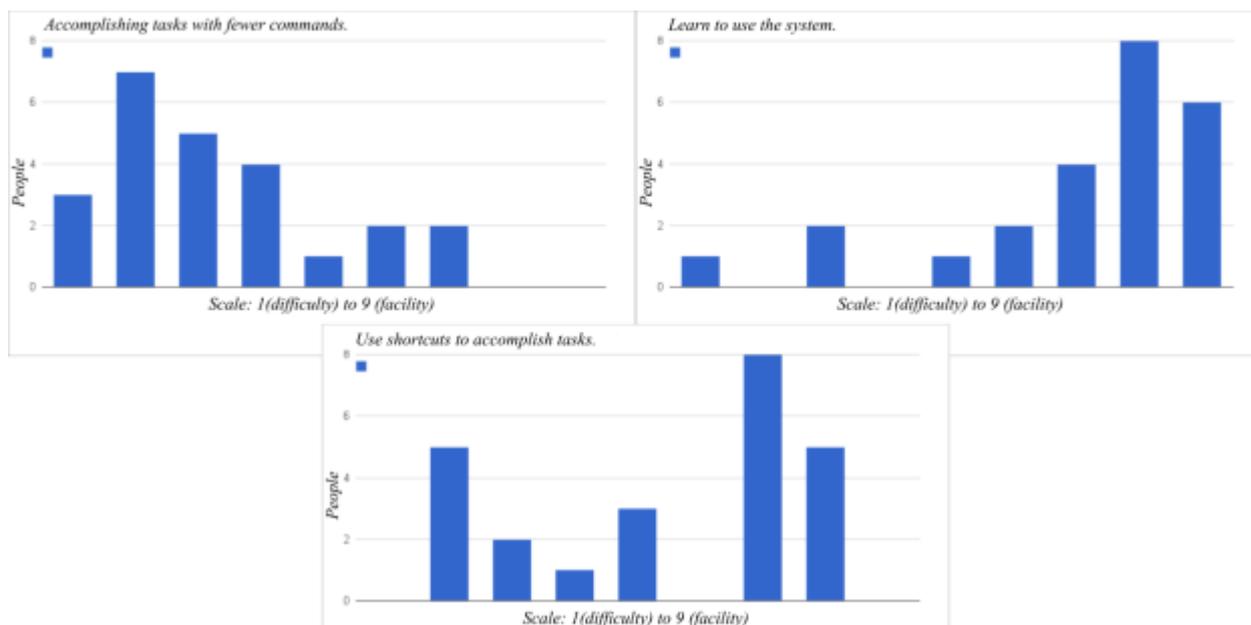


Figure 15 Results of the Efficiency of Cacuriá.

6. Conclusion

This paper presented the development process of the authoring tool Cacuriá. The tool aims to create learning objects by teachers without necessarily having previous programming knowledge. In order to do this, a methodology based on Participatory Design techniques (that allowed focusing on user needs) was used by collecting requirements of the target audience of the tool according to their expectations.

Cacuriá is not yet in its final version, and still needs more reviews about the abstractions and usability of the tool. Nevertheless, the case study is promising in the sense of pointing out that it is possible to create learning objects with the tool, as described in the usability evaluation of the tool.

The idea created for Cacuriá is that it is an integrated environment for authoring LOs and for sharing them with students. Furthermore, it is interesting that it is possible for a teacher to publish not only the resulting LO, but can also share and reuse the project file so that other teachers can learn how it was built and feel free to learn, modify and improve it.

Integrating Cacuriá tool with storage systems and video distribution (iVoD) appears as the ideal usage scenario of this work. In addition, it is possible to integrate Cacuriá with several others systems, for example, to offer LOs with accessibility features. Some planning initiatives has been already started to integrate Cacuriá with RNP's experimental project AAAS (Accessibility as a Service).

References

- Blanchete, J. & Summerfield, M. (2008). 'C++ GUI Programming with Qt 4'. *Prentice Hall Open Source Software Development Series*.
- IEEE Learning Technology Standards Committee (LTSC) (2012). "Draft standard for learning object metadata". *IEEE Standard 1484.12.1*.
- Nugent, G. et al. (2005). "Design, development, and validation of a learning object for CS1", *Special Interest Group on Computer Science Education*.p.370

Santa Rosa, J. G. and Moraes, A. D. (2010). “Avaliação e Projeto no Design de Interfaces”. *2ab* (in Portuguese).

Wiley, D. A. (2000). ‘*Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy, in the instructional use of learning objects.*’ <http://reusability.org/read/chapters/wiley.doc>.

Biographies

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Rafael Valle is Coordinator of Research and Development at RNP. Rafael has graduation and M.S. degrees in Telecommunications Engineering at Federal Fluminense University (UFF) in 2008 and 2011, respectively. He works at RNP since 2011 and currently has been coordinating R&D projects involving advanced internet, wireless networks, dynamic circuits, video applications and accessibility.