Improving TelEduc Environment with GPL Software

The visualization content case for computers and mobile devices

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Abstract—**e-Learning environments are proposed to support teaching and learning activities using the Web infrastructure. One example is TelEduc, a GPL e-Learning environment which its developers are mostly students involved in academic projects, making it difficult to have a long-period team with expertise to maintain the code and evolve the software with new requirements and to new and desirable contexts, like mobile access. One solution is use third-party software to improve the software and minimize the code maintain efforts, solution applied in the TelEduc environment to visualize attached documents on computers and smart phones without installed appropriated software, an open problem in the environment before this work. The main result is a TelEduc version with visualization file for desktops and smart phones. Another result is identification of issues dealt when integrates with third party software like impact on usability, accessibility and performance, license compatibility and easily to integrate, update and change.**

Keywords-e-Learning environment; Mobile user interfaces; Mobile learning; software integration.

I. INTRODUCTION

Devices like smart phones are been increasingly popular; most of them have touch screen displays and access to the Internet. Therefore, Web sites and applications, initially developed to be used with keyboard, mouse and a medium size display, are been accessed by small touch screen devices. Tablets are been popularized too, and some models allow interaction with the Web applications using fingers and others models using special pens.

One kind of Web application is e-Learning environments, as Moodle [1], SAKAI [2] and TelEduc [3]. They are computational applications with tools to support teaching and learning activities though the Web. These tools allow users to create content, communicate with other users and manage the virtual space.

The actual version of these environments take advantages of the available Web resources and offers textual content with images, audios and videos in a hypertext document to transmit the content. Tools like chat, forums, portfolios, repositories are widely used. And tools that explore the audio and video resource to user communication, like instant messenger and video-conferences, are become common too.

Due to the quickly Internet growth (number and types of devices accessing it) and evolution (number of technologies that can be used to develop applications to use it), it is hard

to a small development team updates and evolves complex systems with their own solutions. A lot of new requirements are requested by users, bugs and errors are found every day, and a lot of technologies are available, requiring expert developers.

One strategy is found a development community with different knowledgeable and skill members that together maintain and evolve the system, like communities organized to evolve Moodle and SAKAI environments. TelEduc project is organizing its community [4], but some solutions need to be used to evolve the code until the community growth enough. Another strategy is get third-party software available that meets the requirements and integrate them.

We applied this strategy to attend a user-reported problem: visualization of attached items in the environment. This is an old problem in the TelEduc and other e-Learning environments (e.g., Moodle and SAKAI): the user needs to download the file, write permission to save the file and have the appropriated software to view it. To solve this, we integrated TelEduc with FlexPaper to easily the document view.

This integration generated some questions about the use of third-party software in the environment and a list of issues to be analyzed, like the distributed license. Other relevant issue is about data responsibility, like where the data will be persist, who will ensure the data availability, backup and restore mechanisms.

Section II presents the TelEduc Project with a brief historical view and the needs for use third-party software. Section III describes the TelEduc e-Learning environment its tools, features and problems. Section IV describes how to avoid the elicited problems in Section II and III through integration with existing free software, and Section V summarizes the dealt problems in this research. Section VI presents a conclusion and future works.

II. TELEDUC PROJECT

The TelEduc environment was conceited in the end of 90, born with the Cerceau´s Master dissertation (1998), with professor Heloísa Vieira da Rocha as advisor, using constructivism as base [5,6] for teacher´s continuance formation with situated learning bases [7] or contextualized learning [8] bases. In 2001 February, the first free version was released over GNU General Public License (GPL), an unprecedented fact in the Brazilian Educational Software

scenario. Many public and private institutions adopted the TelEduc as platform, maximizing the TelEduc user's community, and consequently, the development demand. This fact culminated in the release of TelEduc version 3.0 in March 2002. The version 3.0 was completely redesigned and optimized, reason for TelEduc project was awarded by ABED (Brazilian Association for Distance Education) in the "Research and Development about Distance Learning" category. In August 2011, TelEduc version 4.3 was released, with its user interface redesigned to improve user tasks and be more similar than the most visited Web sites.

The TelEduc development is mainly performed by a team situated at NIED/UNICAMP, composed of undergraduates, plus research graduate students of IC/UNICAMP. This is a small team, considering the complexity of the environment, responsible for developing new features, code maintenance and management of existing servers. The next Section shows some TelEduc features and problems.

III. TELEDUC E-LEARNING ENVIRONMENT

The TelEduc environment [3] is a teaching and learning environment developed by Nucleus of Applied Informatics in Education (NIED) of State University of Campinas (UNICAMP), adopted by many public and private institutions, like UNICAMP through Ensino Aberto project.

TelEduc is a system that aggregate administration, management and communication tools designed to support teaching and learning activities. Some tools allow content creation, other ones allow synchronous or asynchronous communication among users, participant and course management and administrative features. The TelEduc course page is structured in two parts: the left one (Figure 1a) has a list of all tools available and in the right one (Figure 1b) the content of the selected tool.

Figure 1a shows TelEduc instance for a course where the teacher dispose the Couse Dynamic, Agenda, Readings, Support Material, Activities, Chat, Mail, Discussion Forum, Frequently Asked Questions, Portfolio, Groups and other tools available. Figure 1b shows the user interface to visualize a Support Material item, where the teacher can change the title, content, attach or remove files or links and see and write comments, and the student can see the item, download the attached files and visit the posted links.

To provide content, TelEduc uses the Web infrastructure, more specifically, hypertext with images, links, audios and videos. All these media can be published as content in tools like Agenda, Support Material and Readings.

Agenda is the ongoing course home page and shows the course´s program for a given period (daily, weekly, etc.). Agenda is an important tool because organize the activities that must be done in a specific period, similar teachers do in the beginning of a presence class. The Support Material is a tool that provides an area for the file storage and sharing among course participants, named Support Material Area. To store an item in this area, the user needs to be a coordinator or an instructor. When the user stores an item in support material area, she can specify the type of access (for example, i) not shared, ii) shared only with users who have instructor role or iii) shared with all participants). Users with
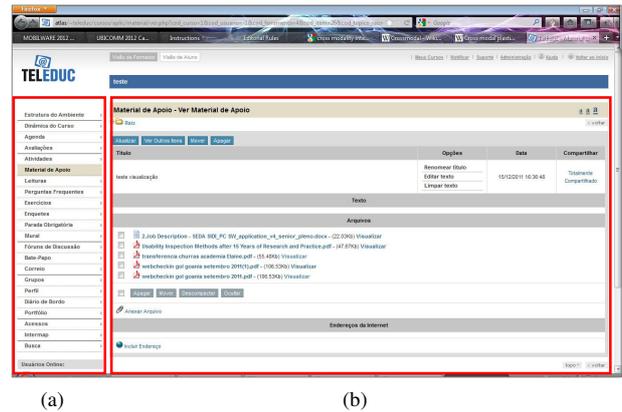

(a)   (b)

Figure 1 – Course page at TelEduc environment (a) tools available; (b) content of selected tool.

student role can access the stored items published with all participant sharing type, read their content, visit their links and download their attached files.

The Readings, Activities and Frequently Asked Questions tools have features and user interface similar with Support Material tool, but different purposes. Readings tool is used to publish relevant documents, like books, magazines, news and articles. The Activities tool is an area to publish activities to the accomplished during the course, like home work descriptions. And the Frequently Asked Questions tool contains a list of the most frequently questions done by the participants during the course and their respective answers.
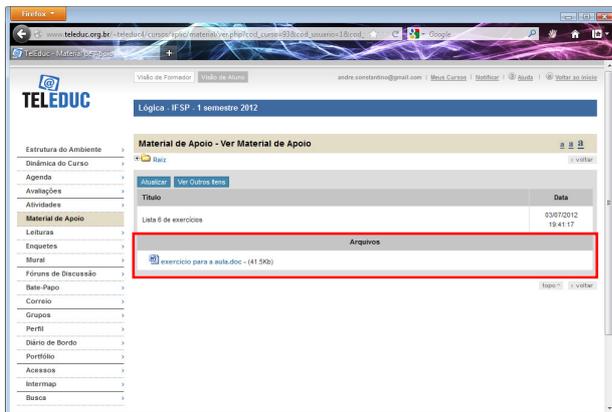
Tools like Discussion Forums and Mail are used to participant communication, supporting text message change in asynchronous mode. To synchronous communication, there is Chat tool, with some features similar with Web chat sites.

The Portfolio is a communication tool that aims to promote the collaboration among participants through the sharing of "items" (documents, presentations, programs, links, etc.). So the Portfolio tool provides an area to item storage and sharing for each participant (user or group of users) within a course.
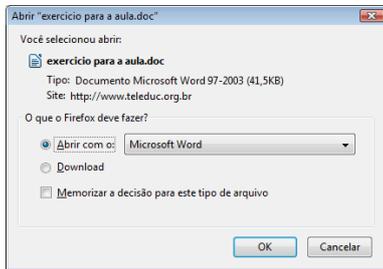
The Bulletin Board tool is a dedicated space where all the participants can post information considered relevant to the course content.

The Agenda, Activities, Support Material, Readings, Bulletin Board, Discussion Forums, Mail and Portfolio allow users to create text content using a text editor. Details about it are in Section IV.

The Agenda, Activities, Support Materials, Readings, Mail and Portfolio tools allow attaching files into them items in similar way, following these steps: the user goes to Files area, click in the link "Attach File", click in the "Select file..." button, browse into the computer directories, choose one file, click on "Open" button and waiting for the uploading process. The environment response for the correct uploading process is writing the feedback message "File attached successfully".

(a)

(b)

Figure 2. Step to view an attached file in TelEduc: (a) item
visualization; (b) open or save dialog..

To download the file, the users need to go to the Files area, click in the file name (Figure 2a), wait for the browser´s "Open" dialog, choose "Open" or "Save" (Figure 2b). If the user chooses "Open", the used computer needs to have the correct software to visualize and edit the file. If the user chooses "Save" option, the browser will download the file and save it into the download folder. The user will need open the download folder to open the file or change the file to another folder. In TelEduc version 4.3, there is no feature to preview the content file, as Moodle version 2.3 and Sakai 2.8. Moodle allows the instructor creates some spaces to visualize a content (e.g., a .PDF file), but it is necessary have the appropriate program installed to view. For attached files there is no preview feature.

In mobile devices, to view attached file it is necessary to have installed the appropriate software, an application to visualize the file. But, for some files formats there are no free applications or the device have a limited number of installed application.

Motivated by the lack of a solution for the described problem and focused to minimize the user efforts to view the content, we developed this work. Maybe the steps to visualize and edit a downloaded file are easy for Web experts, but it is not so simple to new users.

Since the e-Learning environments need to be easily to use for users with different levels of Web experience, the usability is an important nonfunctional requirement. TelEduc was designed to have good usability in an iterative design-

evaluation process, and the main focus is the user interface does not impair teaching and learning activities. The accessibility is another nonfunctional requirement desired for TelEduc, to allow impaired people to use the environment without meet barriers or obstacles.

Since the e-Learning environments are available on the Internet, this software can be accessed by mobile devices nowadays and the developers need to study how to allow all features into these devices. Access the environment in anywhere and anytime is one of the biggest attractions, but research is necessary to design good user interfaces that take into account the restrictions imposed by the devices.

The e-Learning environments are proposed to be generic so that they can be support any kind of educational content in any learning context. The solution adopted by the developers to reach out the generic state is dispose features that allow the users upload any kind of file; so, sometimes, the environment is used like a repository server and a lot of interactions problems appear. Users spend your time uploading and downloading files and need specific software installed into their machines to visualize the file. Sometimes, it is not possible to have this software installed, or the users just want to visualize quickly the content without save the file. So a solution is allow users preview the file in the browser, but it is not trivial to implement.

To guide what file extension to focus, we analyzed the files attached in the TelEduc at NIED servers. At NIED servers there are a total of 50 finished courses and 50 incoming courses running over TelEduc 4.x, and a total of 443 finished courses and 77 ingoing courses running over the TelEduc version 3.x. The users usually attach files with DOC or PDF extension for text content, PDF or PPT extension for presentations, MP3 or WAV for audio, and AVI or WMV for video. Figure 3 shows the quantity of each type file in the courses at NIED/UNICAMP servers since 2009 until 2012. Analyzing the extension of 9,019 attached files, 39.7% of all files are text documents at DOC, DOCX, ODT, RTF or TXT format. PDF documents are 23.5%, and
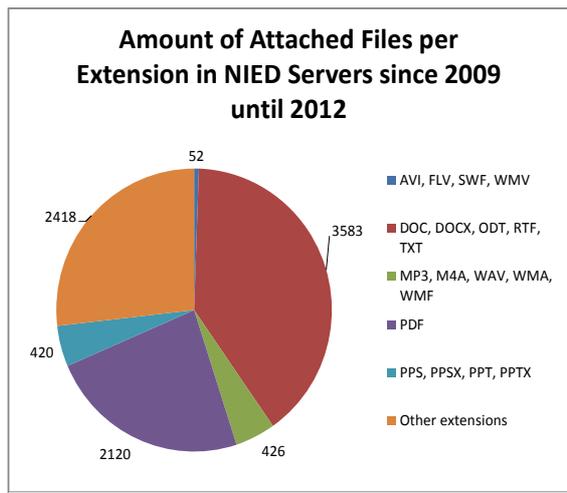

Figure 3. Amount of attached file per extension at NIED/UNICAMP
TelEduc 4.x server since 2009 until 2012.

4.6% are presentations archive in PPT, PPTX, PPS and PPSX format. Audio files are 4.7% and the formats are MP3, M4A, WAV, WMA and WMF. Video files are 0.5% in AVI, FLV, SWF and WMV formats. It is important to consider that in this analysis, we did not consider audio and videos of other sites, like YouTube, that usually are posted like links instead of attached files.

Considering the small development team and the need to allow visualization of attached documents, as well as allow access from mobile devices, we used third-party platforms to integrate with TelEduc environment. These platforms are described in the next section.

IV. WEB PLATFORMS FOR SHARING CONTENT

Using third-party software integrated to TelEduc is not a new task. To allow users write rich text instead of simple plain text, the CKEditor was integrated with TelEduc (Figure 4) since version 3.0. So, the TelEduc team did not develop the text editor, minimizing coding efforts.

CKEditor [9] is a WYSIWYG text editor to be used inside web pages, bringing to the web application common editing features found on desktop editing text applications. Some of them are basic and advanced styling, block-quoting, colors, copy and paste features, build advanced links, insert images and Flash content. Its main purpose is, instead of having plain text fields to write content, having a richer content and a richer user experience. In the version 3.0 of CKEditor are possible insert videos from YouTube, so the user only needs get the video´s URL. In this case, there are some problems like data responsibility that will be discussed on Session V.

In version 3.0, the developers improved the accessibility, turned it compatible with screen readers, a better navigation with the keyboard and high contrast support. It is also compatible with Internet Explorer 6+, Firefox, Safari, Google Chrome and Opera.

The flexibility and performance are two important features of CKEditor. It is possible to customize the editor interface and behavior, choosing tool bar elements, interface colors or adding features. The editor loads fast and its features run.

CKEditor is distributed under the GPL, LGPL and MPL Open Source licenses, so the use of these tree licenses turn this software more flexible to be adopt in another Open Source software, as the developers intend:

> *"Because CKEditor is licensed under flexible Open Source and commercial licenses, you'll be able to integrate and use it inside any kind of application. This is the ideal editor for developers, created to provide easy and powerful solutions to their users."*

There are some solutions available into Web with different licenses and different mode of use, too. We analyzed free solutions, like Flexpaper [10]. Flexpaper is an open source web based document viewer allowing publishing documents to multiple platforms, making it possible to display and interact with PDF files in web pages.
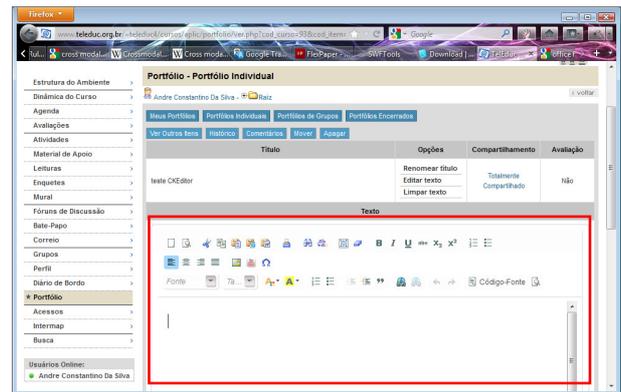

Figure 4. CKEditor in TelEduc environment.

So, it is possible to distribute the CKEditor with the application code in one package. These easier the software download and configuration.

To show visualize documents into browsers without the need of downloading. Some of these solutions is proprietary, but are solutions developed with free of use license and open

PDF files into Web browsers and without Adobe Reader installed on the device, Flexpaper needs to convert the PDF file to a SWF file. So, to see the document into Web browser is necessary to have Flash Player installed. To covert PDF to SWF, the Flexpaper uses SwfTools [11], an open source tool that can be automated if needed, and it is built in PHP language. The SWFTools have features to convert JPEG, PDF, PNG, GIF and WAV files to SWF files.

But some files upload is in another format, like DOC file format, as Figure 3 shows. In this case, it is necessary to use another software to convert DOC files to PDF files, like the CUPS-PDF [12] or WVPDF [13]. So, integrating CUPS-PDF and PDF2SWF it is possible to have a more powerful document viewer.

Flexpaper allows distributing the code with the Web application, but some sites expose the HTML code of a given resource to be copied and pasted in the Web application. For example, YouTube, a video sharing platform, the Issuu [14], a publishing platform for reading documents, the Soundcloud [15], a sharing sound platform, and the Slideshare [16], a platform to sharing presentations, videos, documents and webinars. All these platforms are Flash or HTML5 based technologies, so mobile phones with support for these technologies can access the content provided by these platforms.

The Issuu and Soundcloud platform have applications for mobile phone available at iPhone´s and Android´s market, allowing the user access the content in the device. Flexpaper does not provide an app for devices, instead of it uses Adobe Flash and needs to be installed on the server. A php script was created to, when user request file visualization (Figure 5a), the respective file is copied to a temporary folder and a convert command is executed to create the respective SWF file. After the conversion, the server response the user request sending a HTML code to visualize the created SWF file (Figure 5b). So the user can see the document in the Web

(a)   (b)
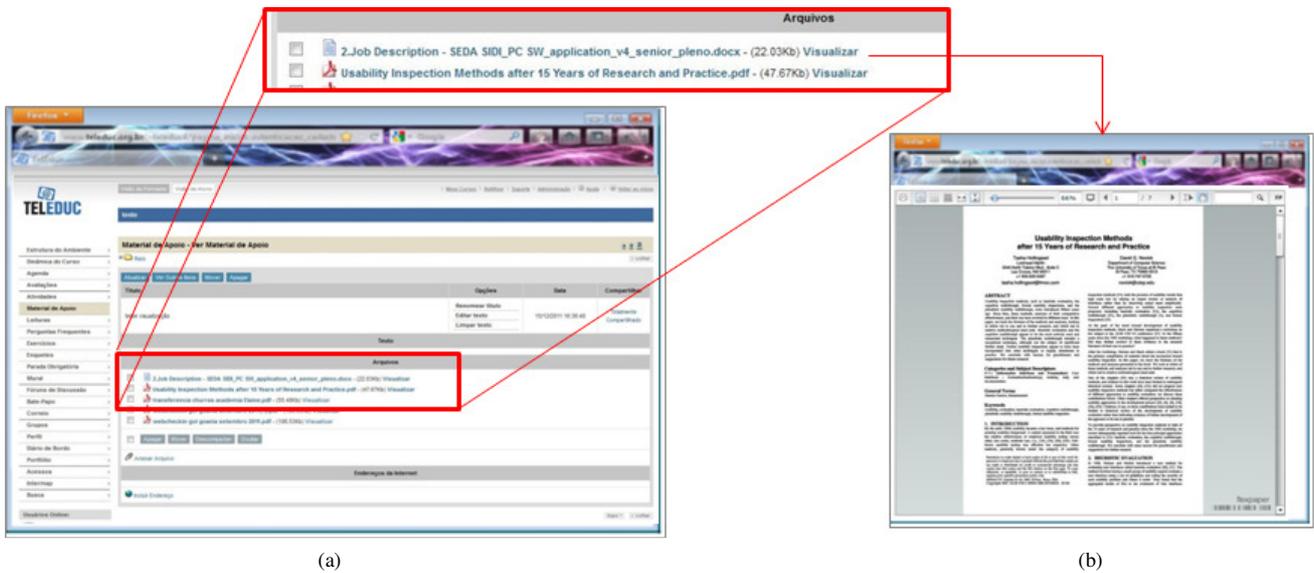
Figure 5. Integration between Flexpaper and TelEduc accessed on desktop: (a) an item with attached files; (b) file preview using Flexpaper.

browser. The access can be done into an Android-based phone (Figure 6a and 6b) with similar steps.

Flexpaper integration is simpler, since the Flexpaper code can be distributed with Web application code, so both can run in the same server. Issuu, Youtube, Soundcloud and Slideshare have different approaches to integrate, but similar steps for the user, turn more easier to see the document content.

V.   ISSUES ABOUT WEB SOFTWARE INTEGRATION

The first one issue analyzed was meeting requirements. So, we selected some Web platforms focused on content visualization and studied them, how to integrate them and the licenses compatibility.

The TelEduc environment was designed to have good usability, performance, and have accessibility studies to improve its access by impaired people. So, when the code is modified, e.g., during the integration between TelEduc and

Flexpaper, it is necessary to verify the impact on usability, accessibility and performance from TelEduc. Is not desirable increase the usability, accessibility or performance problems, so it is necessary investigate these nonfunctional requirements on platform and after integration.

The TelEduc was implemented to be compatible with the most used browsers, so it is desired to, after the integration, does not minimize the compatible browsers number.

The flexibility to adapt the platform was considered another important issue, since this impact on usability and gives for users a unity sense.

More than be easily to integrate, it needs to analyze the platform updating and changing. Since Web applications are evolving quickly, it is important to update the version used in the integration. Since, sometimes, the platform can be discontinued, so it is necessary replace with another one.

TelEduc has three languages, Portuguese (Brazilian and Portugal), Spanish and English. So, one issue is considering if the platform offers user interfaces on these languages.

(a)   (b)

Figure 6. Integration between Flexpaper and TelEduc accessed on Android-based phone: (a) an item with attached files; (b) file preview using Flexpaper.

Changing the language it is important too, e.g., if the TelEduc interface is in English, the platform must be in English too.

Before integration, it is necessary to analyze the platform license to verify law violation and to choose the better integration form. If the platform cannot be delivery with the environment code, it is possible create a plugin and give instructions about how to configure the integration.

Platforms like YouTube, Issuu and Slideshare, need to have the file into their servers. So, these platforms are data servers, too. It is important to analyze data ownership issues and if this data violate some law. It is not a trivial task, since the content generated sometimes cannot be available to all Internet users due to intellectual property or special owner restrictions.

VI. CONCLUSION AND FUTURE WORK

Developing e-Learning environment is not a trivial task: the software has a variety of users and roles, many features and must be technologically updated and get advantages from Web to facilitate the teaching and learning activities. The Web evolves quickly, a lot of technologies are proposed, requiring for projects have high expertise members. One example is the Web applications, either e-Learning environments, are been accessed by mobile phones. But how teams without expertise in these technologies can improve them software? One approach is integrating the application with third-party platforms available in Web.

To explore this solution, we chose the content visualization problem in the e-Learning environment for desktop and mobile devices. Files in the environment need to be downloaded to be viewed, and the device needs to have installed appropriated software to show the content. TelEduc version 4.3, Moodle version 2.3 and Sakai version 2.8 have this problem.

There is a lot of third-party software to content visualization, like Flexpaper, YouTube, Issuu, Soundcloud and Slideshare. An environment integrated with these platforms can allow documents, audio, video and presentations visualization more easily to the users and better usability. This motivated this work.

Analyzing the number of documents uploaded in TelEduc at NIED servers from 2009 until 2012, the DOC, DOCX, ODT, RTF, TXT and PDF files correspond to 63.24% of all uploaded documents. So in this work we decided to integrate Flexpaper to allow visualizing these type of files. Integration with YouTube, Issuu, Soundcloud and Slideshare will allow users visualize almost all uploaded files using desktop and mobile phones.

In this work, we challenged some problems and questions, and we generated a list of issues to think about when integrate two Web applications: features; usability; accessibility; performance; license compatibility; browsers compatibilities; flexibility to adapt; easily to integrate, update and change; user interface languages; data location and data ownership.

Using platforms as Flexpaper, Issuu, Soundcloud and Slideshare is possible to increase the e-Learning environment with features hard to implement and maintain. Doing an appropriate relationship, it can be beneficial for both software, one use the platform and increase the number of users, turning the platform more popular and receive code contribution, and the another, who increase its features and turn easier the users tasks.

The integration among TelEduc and content platforms is not the only one necessity to turn this environment accessible on mobile phones. For example, it is necessary study the influence of changing the mouse by touch screens (and some coding solutions like use of JavaScript's onMouseOver events) and medium size display to a small one.

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