INTEGRATION OF TECHNOLOGIES IN THE DEVELOPMENT OF INTERACTIVE EDUCATIONAL CONTENT

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Abstract: Nowadays, different possibilities like desktop, mobile computers and mobile devices allows learners to access digital learning content. These technologies and the Internet have enabled ubiquitous and virtual learning environments, but some issues arise when the user is not connected. This paper propose the use of sheets of paper as an alternative medium to provide ubiquitous learning even when the user has not an active connection. Although of printed media to be used a lot as an education resource, the printed media has limitations on interactivity. Thus, this paper presents some possibilities of use the printed media to access the content available in the Learning Management System (LMS), allowing more interactivity.

1 INTRODUCTION

Nowadays, different possibilities like desktop, computers and mobile devices allows learners to access digital learning content. Beyond these possibilities, this article highlights the integration of printed media.

About distance learning, according to data available in Censo EaD.br (2010), the media more used for distance learning courses are still printed material (87.2% of institutions use them), followed by e-learning (71.5%) and video (51.7%). Furthermore, Sellen and Harper (2001) highlight four key features of the use of paper (i.e., printed material), as the possibility of quick and flexible navigation through a document, the insertion of notes during the reading, mobility and hybrid integration of activities such as reading and writing. In Jaco (2008) are highlighted some positive aspects of the printed material, including the flexibility of space, time and pace of learning.

However, the printed media has limitations as little interactivity serving more to read than to study the material (Belisário, 2006). In relation to the material in Hypertext, Belisário (2006) points the printed media characterized by low-interaction. According to the author, that does not reduce the need and the importance of material printed, since, to the majority of populations, it still is and will be

the media used to activities in the distance learning.

Considering the limitations found in printed media, the paper presents a proposal to improve the educational material offered in distance learning in the search of providing interactivity and ubiquity. For this, one possibility is the use of resources in printed media, 2D barcodes and integration with mobile devices.

This paper is structured as follows: section 2 presents the proposal, section 3 presents some results with Learning Objects (LO) and section 4 presents some concluding remarks.

2 INTEGRATION OF PRINTED MEDIA, 2D CODES AND MOBILE DEVICE

Some possibilities of technologies appropriate to recognize the paper as an input device of data in a computer are presented in Klemmer (2003):

- Passive RFID tags (eg. RFID - Radio Frequency Identification and IR – Infra-Red);
- Active electronic tags (e.g., motes);
- Labels visual (includes 2D glyphs and QR Code);
- Content analysis based on image processing (eg, OCR - Optical Character Recognition).

Among these features highlights the 2D barcodes, which are two-dimensional figures that store information that can be read by compatible electronic devices. Practical examples of technologies that generate such codes are DataMatrix and QR Code [1].

The proposal this paper is to use the printed media integrated with 2D barcode, as an alternative means to provide learning mobile and interactivity by others devices. Furthermore, the proposal is to use the QR Code due to its characteristics, the processing speed and capacity data.

The proposal aims to improve the printed educational materials with use of methodology and pedagogical theories, designed for distance learning. The Figure 1 shows the access to dynamic content using the 2D Code and mobile devices.

Using QR Code technology in printed media, all the features present in the material, such as text, images, audio, video, etc., can be accessed in an integrated and/or individually, using a mobile device (Figure 1). When accessed, the QR Code allows to perform actions such as accessing a site, read a text, enter data for sending messages (SMS) and contacts.
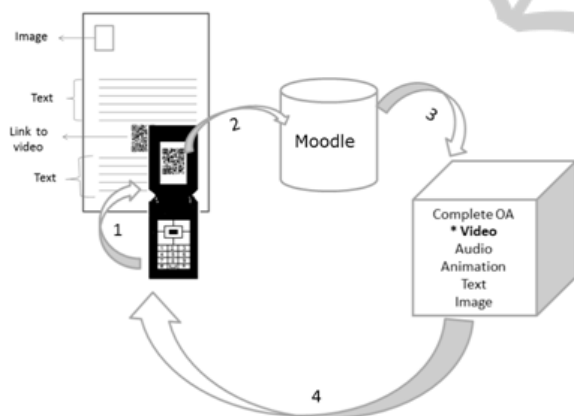

Figure 1: Access at LO in the Moodle between printed media, 2D Barcode and mobile device.

With the use of 2D barcodes, the printed media can be more interactive. The components of material can be stored in the Virtual Environment, allowing the registration of learner access. By registering to access each feature of the LO, it can provide personalized feedback to the learner.

Thus, with QR Code the learner accesses the resource, the Moodle records in your historic and is possible can give feedback to learners based on historic. Thus, can verify the types of interactivity obtained in the LO, available in Moodle. Moodle is

[1] QR Code is registered trademark of DENSO WAVE INCORPORATED.

an Open Source Course Management System (CMS), also known as LMS or a Virtual Learning Environment (VLE) (Moodle, 2011).

About interactivity Moreno and Mayer (2007) presents five types of multimodal interaction in educational Environment (Table 1), as seen in Tarouco et al. (2009):

Table 1: Types of interactivity in educational environments (Moreno and Mayer, 2007).

Dialogue	The learner receives feedback or questions and answers for their reactions.
Control	The learner determines the pace and / or the order of presentation.
Handle	The learner establishes parameters for a simulation, sets the focus and approach (zoom) or moves objects in
Search	The learner finds a new material by search, verifies options and selects the desired alternative.
Browse	The learner moves through different areas of content by selecting different sources of information available.

The next section presents analysis performed with LO in order to verify if the LO materialized in the printed media, with 2D barcodes and resources accessed by mobile devices, offers the same interactivity of LO on the computer with Web.

3 ANALYSIS OF THE PROPOSAL AT LEARNING OBJECTS

For analysis the proposal were materialized two LO. The "Understanding greatness" LO (Figure 2) is the area of mathematics and goal is to provide the resolution of problems related with proportions using pedagogical strategies.

Based on the Seesaw Interactive LO (Melo et al., 2008) was developed using Flash and ActionScript. As presented by Melo et al. (2008), the Seesaw is an interactive simulation as a seesaw used by children in amusement parks, and the goal is that the weights on each side of the seesaw are balanced.

The LO is divided at scenes (Santos et al. 2008). The first scene introduces the concepts and challenges related to the proportionals theme. In this scene are provided access to the exercises, videos on the Web. In the second is possible to solve problems (simulation), involving notions of magnitude, up to 4

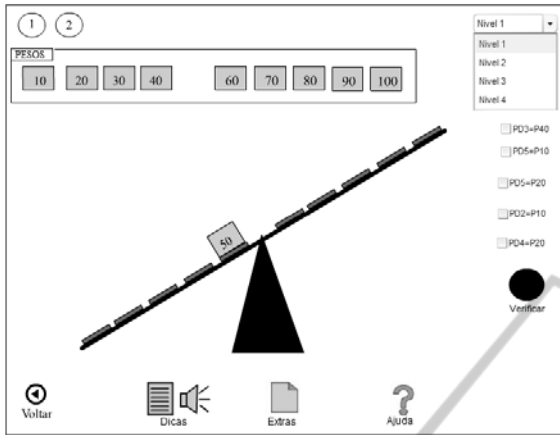levels of difficulty. The Figure 3 shows an example of materialization of OA.

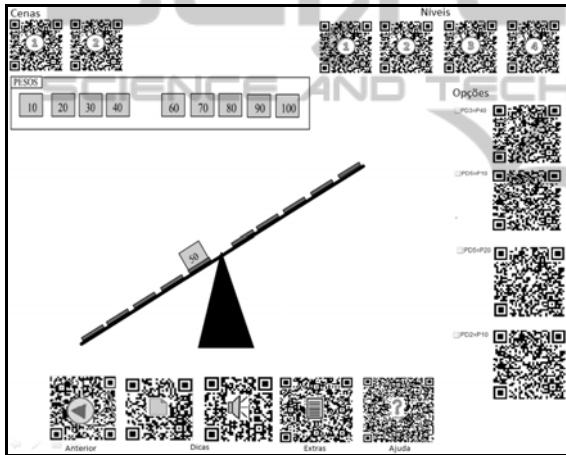Figure 2: The "Understanding greatness" LO.

Figure 3: Materialization of the "Understanding greatness" LO.

Another LO developed was 'Prevention in the Web' (Figure 4), developed in HTML5 and Javascript; and stored in Moodle environment. Moreover, has resources that identify the location of acess when the user accesses the LO.

The LO is composed of several multimedia features (video, audio, animation) and was developed according to principles of multimedia learning (Mayer, 2009), such as:

▪ Multimedia Principle - people learn better from words and pictures than words.

▪ Spatial Proximity Principle - learners learn better when corresponding words and pictures are near, and not in places (page, screen) different. To Filatro (2008) when people need to integrate verbal and pictorial information (eg, on-screen

graphic and explanation of how to read the chart) - an overload can occur in working memory and learning process to be disturbed. The material must have text and images in an integrated manner, i.e., text positioned next to the images related. Thus, the cognitive resources are spared the task of integrating all the information.

▪ Temporal Contiguity Principle - learners learn better when corresponding words and pictures are presented simultaneously rather than successively.

▪ Signaling Principle - People learn better from a multimedia message when the text is signed rather than unsigned.

▪ Redundancy Principle - people learn more deeply from graphics and narration than from graphics, narration and printed text.

▪ Personalization Principle - people learn better from multimedia presentations when the words are in conversational style rather than formal style.
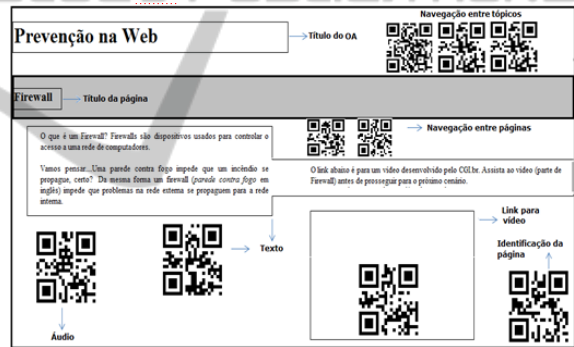

Figure 4: "Prevention in the Web" LO materialized in the printed media.

The structure of "Prevention in the Web" LO is presented in the Figure 5. The LO can have multiple topics, one topic can have multiple pages and each page can have multiple components.
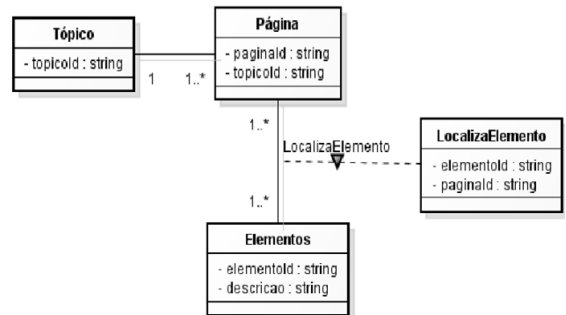

Figure 5: Structure of "Prevention in the Web" LO.

The "Prevention in the Web" LO has some activities (Figure 6) e when the QR Code related at a question is acessed, the link directs for the specific question in the Moodle, e no for general questionnaire.
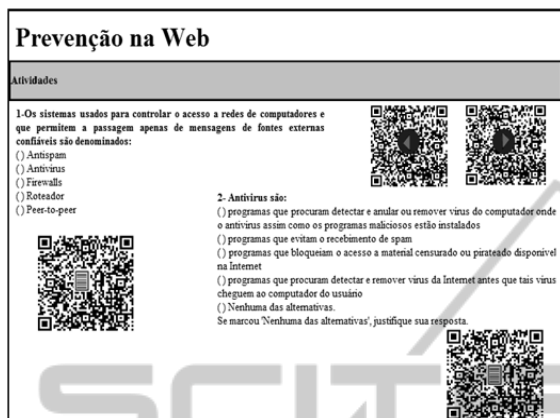

Figure 6: Exercises - "Prevention in the Web" LO.

Both LO were materialized in printed media with QR Code. Analyzing interactivity in both LO available in a Moodle, developments using the proposal this paper, was possible verify:

▪ Dialogue. Through the links available in the material the learner can get feedback textual and offer more information about the content. An example: on page 4 of the Prevention LO, learners can access the Moodle forums on the subject presented on the page. In addition, through the QR Code on paper can be accessed exercises and receive feedback in the form of text or audio. The LO in printed media has links (QR Code) that allows to access synchronous and asynchronous tools (chat, forums, wiki, etc.) in the Moodle. Example: getting help, click on a hyperlink to additional information.

▪ Control. The material has links of navigation that allows to switch between contexts different of LO (navigation between topics and pages), control of animations, video and audio (forward, rewind, pause, etc.).

▪ Manipulate. This type defines parameters in a simulation game and executes the simulation to see what happens. The LO "Understanding greatness" allows moving objects (weights) to verify the result. To solve the problem, the learner can choose the QR Code that deemed correct and thus move the elements of LO and the result is displayed. Thus, the learner can analyze, take notes on paper and then check the answer with the simulation in LO. In LO prevention is possible to manipulate the animation.

▪ Search. In the LO the learner can search for information on the Internet, as well as responding to questionnaires. Each question has a QR Code allowing direct access to the corresponding question. The material has links to educational sites and can be used for search various sources such as repositories of LO, educational videos, etc. The LO allows search for other exercises on the same content on the Web. The learner can still access complementaries information the content, in the Web.

▪ Browse. The LO allows to navigate between different resources available in the LMS. Thus, the learner can navigate within the LO, as well as in Moodle. In addition, it can get complementary information on the Web.

To allow more interactivity, the LO must be stored in a LMS. Each feature of LO is represented by QR Code and when the user decodes the QR Code with your mobile device will have access to the resource. Thus, all that is accessed in the LO will be registered in the LMS (Figure 7).

Figure 7: Example - part of Moodle report: date, resource and content.

Özdemir (2010) points out that, besides providing a more significant learning, the integration of mobile technologies and printed books with help of 2D barcodes, has the potential to reduce the cognitive load.

After analysis the LO was seen that the resources represented by the QR Code in the printed media, when accessed by the mobile device, can allow interactivity as through the computer with Web.

4 CONCLUDING REMARKS

This paper presented examples of application of the proposal. The first example is based on an LO "Understanding greatness", similar to a game that goals to bring the learner to reflect about the problem.

Other LO refers content about the risks and prevention methods on the Web, presents a variety

of possibilities for interaction using the Moodle environment. With this, intends to search improvements to the development of content that may promote distance learning, utilizing the advantages of each technology (printed media, mobile, Web). The LO can be accessed on the Internet (desktop, notebook), the printed media (with QR Code) and / or mobile devices (cell phones, smartphones) and in the absence of a type of media may continue their studies using others resources availables.

Because of the limitations of printed media, the model proposes the use of QR Code as a means of access to multimedia content (integrated the device mobile) and the application of appropriate methodology and educational theories. Thus, the content available on the LMS could be accessed via device mobile, printed media with QR Code and Web.

Moreover, the material should be multimodal in order to offer different ways to be accessed in a learning environment. Moreno and Mayer (2007) defines multimodal learning environments as environments that use two different ways of representing content: verbal and nonverbal.

This paper was important to analyze the types of interactivity possible, using printed media (with 2D barcode) as a resource and mobile devices as input. In this case, if the course offers only printed material, the use of QR Code (and mobile device) can provide access to other multimedia resources, collaborating for Multimedia Learning.

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