

## Paths taken in the construction of learning objects: A case study

### Caminhos percorridos na construção de objetos de aprendizagem: Um estudo de caso

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#### Abstract

New ways of learning through learning objects is a prerequisite for this new generation in which digital media are part of the life of the student. In order to understand the importance of constructing these digital learning objects we developed the Digital Agents Project. By conducting a case study of the Project, in the State of Ceará, Brazil, we intended to realize the gear of people who work in the construction process in order to characterize their performance. Thus, we used a mixed research methodology, conducting a qualitative analysis with observation grids, as well as quantitatively, through a questionnaire. The research highlights the importance of this sector and the need for teacher training on development of educational resources. The results highlight the need for expansion of links and easy access to technological resources to mobilize teachers use learning objects in their classes, paying attention to the quality criteria.

*Keywords:* learning objects; digital resources; instructional design; online education.

#### Resumo

Novas formas de aprender por meio de objetos de aprendizagem é condição fundamental nessa nova geração em que os meios digitais fazem parte do universo do aluno. Com o objetivo de compreender a importância da construção desses objetos digitais de aprendizagem desenvolvemos o Projeto Agentes Digitais. Por meio da realização de um estudo de caso do Projeto, no Estado do Ceará -Brasil, procuramos perceber a engrenagem de pessoas que atuam no processo de construção no intuito de caracterizar a atuação dos responsáveis. Assim, utilizamos uma metodologia mista de pesquisa, efetuando uma análise qualitativa, com grelhas de observação, bem como quantitativa por meio de questionário. A pesquisa destaca a importância deste setor e a necessidade de formação de professores para o desenvolvimento de recursos educacionais. Os resultados destacam a necessidade de ampliação de links e recursos tecnológicos de fácil acesso que mobilizem os professores a utilizar os objetos de aprendizagem em suas aulas, atentando para os critérios de qualidade.

*Palavras-chave:* objetos de aprendizagem; recursos digitais; design instrucional; educação online

Technological advances and emerging paradigms of information and communication lead the enterprise of new approaches to foster students learning, one of them is the integration of digital technologies in education. The school has been challenged to bring all these technologies in

educational activities and empower teachers to understand the use of learning objects.

With the emergence of new modes of learning, whether in classroom or distance education, the use of technology is one of the key pieces, given the context of the Network

Society characterized by a pluralistic ecology of communication punctuated by connectivity, mobility and ubiquity (Santaella, 2011) which favours the presence of virtual learning communities in education (Silva, 2005).

With the development of digital technologies, virtual learning environments are no longer a simple document repository, they begin to follow the trends of Web 2.0 focusing on the interaction and collaboration. Virtual learning materials increasingly offer greater proximity between man and machine, once they simulate sensations, real spaces and promote interoperability that allows the development of new literacy (Oliveira, & Campos 2008).

A new area of work emerged for teachers who specialize in working with resources and technological simulations for the production of virtual learning materials, which should mobilize emotions, perception, comparison, analysis and critical thinking of students living in a context of digital convergence. Similarly, these interactive materials to be used in education should be anchored in pedagogical conceptions that mobilize development processes of student learning.

This is the context in which this research lies, intending to understand the paths taken in the construction of learning objects by teachers from Ceará. To achieve this objective the adaptation process of didactic transposition of the material for the virtual environment and the agents involved in this task will be observed. Having Digital Agents Projects (Souza, & Carvalho, 2011) as the object of our research, we seek to achieve two specific objectives: 1) to explore the construction of virtual learning materials, bringing the quality benchmark for distance education; 2) analyze the work of a multidisciplinary team to develop these resources, their management processes, specifically the role of instructional design.

To delimit this research, we first present a brief theoretical framework on education, learning objects and construction of educational resources process in order to characterize the benchmark. We proceed with the methodology and the presentation and discussion of research findings.

### **Technological changes and new ways of educating with learning objects**

Since the establishment of the WEB in 1990, and an increasingly continuous process, new cooperation processes burst, and in which the Digital Information and Communication Technologies (DICT) favour the emergence of new ways to communicate and learn. Castells (2004) endorses this change when states that the Internet is located at the base of the Network Society, giving rise to new social and cultural models. Thus, people work, read, study and learn in cooperation, they are "thousands of brains working together," a process that Lévy (2000) called "collective intelligence".

This progress requires a new educational modality that

links an efficient method to acquire learning with the use of DICT. According to Neves (2003) students who learn by Distance Learning (DL) can hold over 20% of applied knowledge than students who attend an institution of classroom teaching. These results are due mainly to the digital educational resources used to call attention and mobilize the youth to study.

According to Almeida (2003), the insertion of a technology does not guarantee success by itself, but rather a sum of factors. According to Silva (2001, pp. 842-843) "technologies are part of a comprehensive package of change", – i.e., it is the component of "strategy and the consequent strategic thinking in order to understand the reason for the integration and how it should be done" that defines its success.

Petri (1996, p.25) reiterates that in the case of distance education, as a modality of education, the use of technology is primordial because it occurs "primarily with content and forms of expression mediated by educational materials, technological resources, mentoring and evaluation systems". That justifies how the use of technological resources is essential for learning.

In this paper, we intend to clarify how the Learning Objects (LO) are essential in any educational modality (classroom or distance education), being used in diverse contexts and situations, according to the student profile.

The LO can promote cognitive and reflective processes necessary to support learning as they contain the necessary flexibility for the use of diverse technological interfaces, meeting the challenge of the mobility and ubiquity of current communicational ecology.

For Oliveira & Campos (2008), the use of LO provides the autonomy of the learner, anchoring on studies of Wiley (2002). Those authors emphasize that it's not just any Web link that is an LO, it must necessarily facilitate learning, activities and assessment. These structural components are minimal and defined by Instructional Technology Standards stated by the LTSC - Learning Technology Standards Committee, included in the Learning Content Management Systems (LCMS). Furthermore, Wiley (2002) also states that a learning object should present: Instructional Content, Keywords (to be searched); Interoperability (management options, database and network applications, e.g. with the use of Moodle, blog post and social networks).

Regarding the evolution of the concept of LO, the author considers two approaches: LO as a product (the most traditional) aiming successfully achieve predetermined outcomes, and LO as a process, reinforcing the need to read the world and the sociocultural contexts.

Accordingly, a LO provides the use in different contexts, whether spatial or time context, this flexibility and upgrade favour the adaptation of for different audiences and locations (Anderson, 2004). In order to understand the ease of development of the construction of this online content, we will present the preparation process,

understanding its evolutionary process, as its reutilizations that promote its insertion in different contexts.

### **The production of digital educational resources**

The development of learning objects, which we will call digital educational resources, a multidisciplinary team to develop a steady discussion about language and resources that will be appropriate for the pedagogical project and the audience that will use this resource on the Internet is necessary. In this process, a new profession has emerged in the education scenario, within the design area, in which a professional is responsible for coordinating the process of didactical transposition of content for use on the Web. It's usual to assign to this new professional the designation of instructional designer, function usually performed by an educator with expertise in Educational Technology (Santos 2012, p. 221).

This professional needs to know the multiple media that should foster interactivity, which may or may not be linked to virtual learning environments, and shall also, according to Santos (*ibid.*, p. 221), regarding the Distance and Online Education, "analyze needs, design the learning environment, select technologies according to the learning needs and structural conditions of the course participants, assess the processes of construction and use of the course and, moreover, mediate the work of the whole team of experts".

In order to regulate and assign a benchmark to the practices of Distance Education, the Ministry of Education in Brazil has published the Quality Benchmarks for Higher Distance Education, which contains indicators that should be observed in the production of teaching materials (Neves, 2003). For our study we adjusted these indicators to the understanding of digital educational resources in the aspects of quality, presentation and methodology, as well as guidelines and research activities, to "encourage the student to have the pleasure to return to that place, in other words, seduce him" as Neves (*ibid.*, p.1) states.

Flexibility is another differential that makes students feel part of the course since, depending on the approach, instructional materials break with the standardized model of education and fit to the students needs. In addition to the many different course models and methodologies for online learning, the educator who works in distance education and e-learning educational develops the educational, cognitive and social expertise. One theory that supports this study is from the Athabasca University, presented in the work *Theory and Practice of Online Learning*, winning award for innovation in distance education practice (Anderson, 2004):

Design and construction of the course content, learning activities and assessment framework constitute the first opportunity for teachers develops their teacher presence. The role the teacher plays in creating maintaining the course

contents varies from a tutor working with materials and instructional design created by others, to a lone ranger or teacher who creates all of the content" (Anderson, 2004, p. 346).

In the model presented by the author there are several tools that should fit the student needs, stating that the design of the course cannot be developed in isolation only for instructional designer, but all the peers of educational and technical areas should be together in order to validate and identify the appropriate uses of simulation, motivation and animation objects. The important thing is the development of cognitive, social and educational processes.

For this, digital resources need to use multiple media, have the attributes of navigability and use of interfaces that foster interactive process. Who plans and articulates these resources is the instructional designer, as we have seen, that coordinates the choice of resources that will be used for the development of content. Furthermore, he establishes management and monitoring strategies to ensure the flow of educational and communicative actions. As a great conductor who coordinates the team of experts, he is responsible to plan, develop and implement specific didactical situations that incorporate mechanisms that provide the contextualization and flexibility during all the process stages, from design to implementation (Filatro, 2004).

For teaching transition the assignments and activities are designed based on the material requirements matrix, with the necessary mediation of Web designers and programmers responsible for turning the material into a dynamic resource, to be published on a web page or other open language.

Thus, it becomes necessary to develop strategies according to the studies of cognitive development, so that the material can actually be adequate for the different rates of the student study, reflecting on the development of autonomy. Filatro (2004) outlines some strategies for the development of educational content in distance education modality, such as: greater customization to individual styles and rates of learning, adaptation to institutional and regional characteristics; update from frequent feedback, access to information and external experiences the organization of education and the possibility of communication between the agents of the process (teachers, students, technical and pedagogical staff, community), and automatic monitoring of individual and collective construction of knowledge.

Empowering technology resources will only be viable if the orchestra, which is made up of teachers, content makers, tutors, teaching staff, students, is facing the construction of online learning. Moreira (2009) presents the members which constitute this large team that we represent on the Figure 1.

Everything is designed by different actors with different professional competencies. As Moreira (2009) emphasizes,

the analysis of any process of distance/online education demands an integrated view on everybody who is in the process of learning, from the learner, the teacher/trainer, instructional materials and technology, the processes of pedagogical and management mediation.



Figure 1. Responsible for construction of digital learning materials

In distance/online education modality, since the student is not face-to-face with the teacher, the care with the availability of resources becomes crucial, since it is this material that will provide much of the pedagogical mediation. The success of a course is closely associated with the quality of existing communication in the resources. In this context, Neves (2003) provides some criteria for the development of educational resources: content organization, dialogical language, introductory module (with presentation of the material), detailing cognitive competencies, skills and attitudes that students must reach by the end of each unit (module, discipline), self-assessment systems, and diverse ways of student assistance, bibliography and additional sites indicated.

Thus, the relevance of this research regarding the apprehension of the processes of construction of digital educational resources, as well as to understand the complexity of the project team to be aware of the impact that educational digital resource presents are demonstrated.

## Method

### Case study

The methodology used in the study was the exploratory, through the case study of the Digital Agents Project, aiming to understand the process of developing digital educational resources, including the role of the different actors involved in the production process. According to Yin (2008), this

method allows the scientific understanding through every day or centred observations during the course centred allowing a triangulation between theory and practice. The excerpts made during the development of educational resource in the years 2010/2011 served as a starting point for understanding the construction of educational resources process, comparing it with the theoretical benchmarks resulting from the Ministry of Education (Neves, 2003).

Data collection was done through observation grids, categorizing a qualitative analysis of the competencies developed by the Project team, as well as quantitative data, using an evaluation questionnaire was applied to all project participants at the moment of its conclusion.

### Procedures

The project action was developed with 200 young people from public schools in Brazil, in the state of Ceará (Souza & Carvalho, 2011). Currently there's a replication process with young students in Portugal, based on the doctoral research at the University of Minho. The learning object analyzed through reports from of the multidisciplinary team, observation grids during the execution design and analysis of data from the questionnaire with the target population in 2010/2011.

During the monitoring, in the didactical transposition of content process, forums in the virtual environment were also used in order to support the outline of the variables: the operation of the production team and the construction of teaching material.

We will present, then, the exploitation of documents and observation grids with excerpts from the virtual learning environment (E-proinfo) used as a tool for monitoring the Project implementation, with all the material available at <http://blogtasabendo.com.br/ead-novo>. (The courseware after validation is the link: <http://agentesdigitais.virtual.ufc.br/>).

## Results and Discussion

### The progress of work – Production network

The developed work was only possible due to a network of people who pooled their efforts to construct a material that allowed the customization of content involving Entrepreneurship and DICT. Thus, coordinators, instructional design team, illustrators and animators, programmers, content makers, media supervision and coordination of tutoring took part at fortnightly meetings for one year, so that the material could be disseminated by tutors to high school students.

The communication process was supported by a mailing list (group in Gmail), moreover monitoring reports of activities were delivered according to deadlines in order to validate the system of scholarships granted by MEC for the project construction.

The course content was developed with support from Virtual Department of the Federal University of Ceará (UFC), which supervised the implementation of interactive tools, such as forums, logbook, email. According to the pedagogical document, available on e-proinfo, we can

highlight from the material the following categories:

*Web class:* Each Web class has a schedule of 8 hours with texts, videos, animations, simulations and interactive activities.

*Activities:* There are interactive activities at the discussion forum, logbook and library, where the student can rethink about concepts presented in each module and apply in their context.

*Library:* Area where some of the activities asked during the Web class are recorded, in text or images, saved and sent to the tutor to assess.

*Forum:* Collaborative spaces where the learner and the tutor can comment, oppose arguments, send questions or suggestions for class. In this space the tutor is responsible for mediate and promote interaction among participants. As a requirement the student must participate in 2 forums.

*Supplementary Material:* Additional information about the class content with videos, text, images, additional material to the student to deepen their reading.

*Videos e Animations:* Included in the material as motivating, as an activity or a trigger for ideas.

According to observation grids we found the crossing between the objectives dealt by Neves (2003) and the categories developed in the project and analyzed by Souza and Carvalho (2011) which also endorses the importance of the dialogic process the structure of classes with content and appropriate activities to the audience.

To expand the studies and endorse the concept of construction of educational resources, we present in the following table the analysis of the elements found in the project.

Table1.

*Actors in the production process and excerpts of their assignments*

Coordination	<p>Monitored teams according to the project structure, the content proposed for the Entrepreneurship and DICT area.</p> <p>The fundamental task was to monitor the activity schedule because, since many actors were involved, depending on the response of the network of work developed, it has been frequently adapted.</p> <p>It was also essential in the continuing evaluation of LO, to solve delays in construction of the material.</p>
Supervisors	<p>According to the report from the Instructional Designer "the process of comings and goings of the material is taking a long time".</p> <p>These professionals were responsible for compliance with the tasks on time and for the initial definition of the style sheet with the thinning of programmers, graphic designers content makers return and the final work on the transposition and textual revision.</p> <p>However due to delays and a lack of affinity with team members (in the first module), there was a removal of supervisors, with the Coordination assuming this role until the end of the Project.</p>
Content Makers Teachers	<p>The content makers' action was isolated. During an initial meeting the Project objective was presented, as well the delimitations for the production content (regarding to pages, images and videos). In the gear, each content maker forwarded the material for the repository on the environment e-proinfo and for the Group e-mail, waiting for the Instructional Designer feedback.</p>
Instructional Designer	<p>The modelling and graphical representation presented on the Web, counted on the approximation of the design team and programmers to fortnightly check of the layout, interfaces and visual identity.</p> <p>Many materials have been published with the structure of screens, balloon characters, scenarios and animations, even with crashes and, often, it was the coordinator of tutoring who gave feedback about failures and some bug, as in the testimony:</p> <p>"I suggest modifying the style guide and fix the animation class 1 because it is not legible, not suitable for the public".</p>
Programmers	<p>Developed a work on free software worked on the mailing list to keep up with the changes in the development of object.</p>
Coordinators of Tutoring and Tutoring	<p>The process of communication among members of the development team, which according to Moreira (2009) endorses the implementation of the project, was developed among professionals from different fields. This situation enabled feedback and avoided rework. The meetings were made with the coordinators of tutoring to assess the status of the implementation of the material process with students.</p>

### Excerpts from theory to the practice

The excerpts of the reports in this study enabled the crossing of theory presented by Almeida (2003), Moreira (2009), Wiley (2000), Oliveira (2008), Neves (2005) and Filatro (2004), researchers in the field of educational technology who substantiated studies of digital educational resources and allowed the analysis of the assignments and

profiles for the development of content for Digital Agents Project.

As Moreira (2009) emphasizes, the teams go beyond the professional interrelationships, participants end up building their roles according to the needs, to their relationship with others, with a variation between the prescribed and assumed role, emerging the assignments for each member.

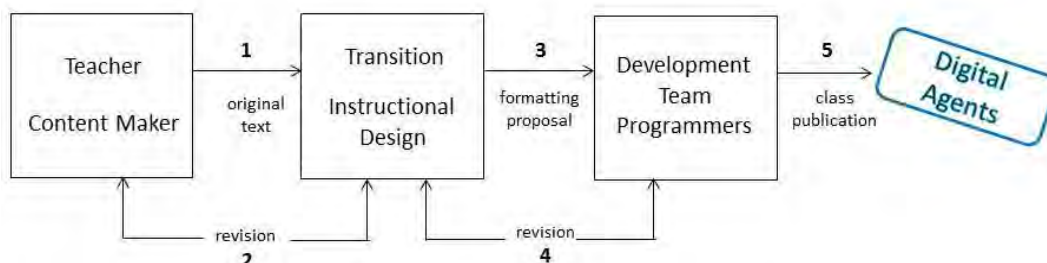


Figure 2. Workflow for the content development team

Relying on direct observation and immersion in the context of the project, a difficulty with time optimization was triggered, due to the diversity of staff and to the different workspaces. It was found the need to carry fortnightly meetings with the development team with the purpose to claim a continuous thinning of the team to support networks that were formed, with the commitment and participation of each member.

One of the analysed members of the team was the Instructional Designer, as can be seen in the of the following statement excerpt: "The style guide is almost finished, we need to check the location of the characters, animations, as well as the suitability of metaphors". This approach has been permitted through the virtual environment, the mailing list, providing mobility and speed in the process. But even with these resources there were still rework due to the large volume of information in a short period of time. However, it is important to note the bridges established among people of different areas, who learned collaboratively.

Continuous validation of the material was a constant concern, as it can be assessed by the testimony of the researcher and project participant:

... when the material came for the Portuguese staff, there were still gaps to be defined as animation, boxes. In this gear feedback, in the check list, the material still showed errors in testing, needing a rework of the review team, and soon after programming to solve some bugs that were only visualized after the use of the material".

Similarly, testing occurred among students, still during the construction of the material, as soon as it was finished it was available online to be validated with students.

In this case, the coordinator of tutoring was the link between students, tutors through the fortnightly meetings, passing the report bugs with the material, to be appropriate to the content. According to the following testimony, we can realize the control and constant care with the implementation of activities: "Use the Planner to plan your lessons and set the schedule of classes and activities throughout the project. Download the program from: <http://live.gnome.org/Planner/Downloads>" [Excerpt from a testimony of the Coordinator of Tutoring].

As Palange (2007) explains, it is crucial team members to identify faults, problems, and obstacles to put a course online. According to the creator of the course "it was this careful look at the review that made the necessary improvements to the material, it was essential to the continuing partnership".

At the end of the project, to assess the material a questionnaire was carried out with students involved, with the aim to know if the material was suitable. Regarding to Course Design, category that is being analyzed, we concluded that from 112 students, a total of 96 (86%) categorized the course design between excellent and good, that is, 45% excellent and 41% good (Figure 3), which is also shown in the testimonials when they mention who identified themselves with the characters, with the songs, with the proposed activities, with all the resources and the language used by the material.

Also diagnosing the adequacy of content, the result was very positive (only 6% contested the appropriateness). The problematic was placed on the activities, according to statements during lessons, as it always raised issues, a strategy used by the Tutor for students to think a little bit more about what is around them, thus, valuing the

resources in a cultural perspective as in another way to see the world. According to what is explained by Litto and Ant (2009), emphasizing that the in the construction of a virtual material

The concern is with the student and with the possibility that he might have to apply that knowledge, to deepen aspects they want, work cooperatively in teams, interact with other teacher and other students, to participate in online discussions, to express their opinion. (p. 385).

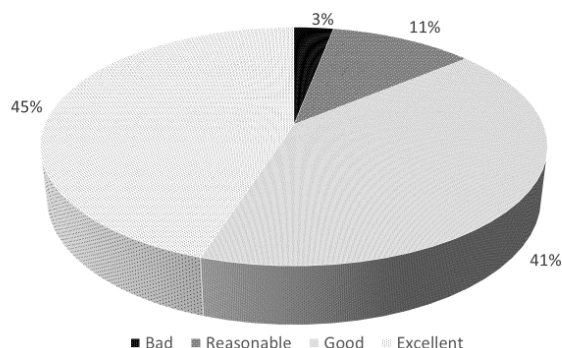


Figure 3. Opinion of students on the course design

### Final remarks

With this training we are at the beginning of a long road, especially by the constant need to improve the processes of material production. We know that the model is complex and requires preparation of the team, as well as a pedagogical study of what is to be achieved. However, it reinforces that for use of any digital educational resource is necessary that team members learn to work with diversity, to broaden the interaction between those who create and those using the LO.

In team work, a factor that influenced the speed in solving problems was the communication process, since, according to the creator of the course, no email was no longer responded, as in the planning aspect, the content, as the implementation with students. As Anderson (2004) recommends, the material was not developed separately, besides a team working collaboratively, it was it was validated with students, and the construction team participated in this continuous feedback. This process was supported by the use of interactive tools such as discussion group and social networks, which promoted greater interaction with the teacher, other students and a demonstration of the effective contribution of the course.

For coordination of a work of this type it was fundamental the agility of communication, which is demonstrated by the synergy of the team members, from planning, production and testing. However, we can deduce the need to expand the training of educators in this area, so they are not only standardizing, but they can build new opportunities with Streaming Audio, Streaming Video,

Push Technologies and Data Channel, Audio Chat and VOIP (Voice over IP), Web Whiteboarding, Instant Messaging, Wireless Technologies, Peer-to-Peer Sharing, Learning Objects and Virtual Reality (Anderson, 2004), tools belonging to the student's universe that can promote learning.

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