Courseware Sere: Technical and Didactic Evaluation

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Software packages for educational purposes are increasingly important for classroom use, because they are a valuable way to motivate learning. However, the resources available on the market, with the designation of educational software, often have dubious quality. This leads us to the constitution of a multidisciplinary team with different competencies (Science Education, Educational Technology and Design) aiming the development of educational software for teaching and learning environments and tools to properly evaluate the software quality.
The resource that was developed for this purpose is called Courseware Ser_e - The Human Being and Natural Resources. The system development was based on assumptions of the User Centered Design (UCD) and usability of computerized teaching resources, including the evaluation central role throughout the development process. Courseware Sere development was based on a rigorous evaluation process, based on finding answers related with issues like the positive and/or negative perceptions and suggestions, from a technical and educational perspective of experts, teachers and students. The answers gathered were used in order to improve the usability of this resource.
In this paper we report the final results achieved in the software evaluation made by teachers of the 1st and 2nd basic education cycles. The evaluation concerned the software technical (software and user's manual) and educational (guidelines for the Didactic Exploration – Teacher and guidelines of Records - Student/User) aspects. With the data gathered and results achieved, it is possible to assess the usefulness of the end user's evaluation of educational resources and the quality of the courseware. This evaluation enables to improve aspects related with the usability (navigation and interaction) and enables us to ensure the adequacy of the courseware to the target educational level.

Keywords: educational software/webs, software evaluation, software development process, courseware development, user centered-design.

1. Introduction

The lack of investment in research and development (R&D) in the teaching of Science [1], in particular to Search for Education (SFE) [1, 2] and under the Education for Sustainable Development (ESD) [3,4], made us realize the importance of conception and evaluation of socio-constructivist learning environments, including a Courseware.

It was assumed that the exploration of these environments can lead to a change in the teaching process teaching and learning of science stimulating, among others, the development of diverse skills, such as autonomy, problem-solving and collaboration of users / students [5].

The concern above combined to exploit the educational potential of ICT and the lack of quality resources [6-8] determined the organization of a multidisciplinary team, consisting of elements with various skills (Didactic of Science (DS), Educational Technology (ET), Project Management, Design and Programming), for the development of Courseware Ser_e -The Human Being and the Natural Resources. The team was mainly composed by members of the University of Aveiro in Portugal and Ludomedia - a software development company.

After this brief introduction specifying the reasons that led to the development of Courseware Ser_e, the paper content is the following. Section 2 presents the educational resource with emphasis on its functionalities.

Section3 briefly presents the development methodology adopted. Section 4 analyses the results of the resource's first evaluation step made by teachers of the 1st and 2nd basic education cycles. Finally section 5 presents the paper conclusions and points out possible future work.

2. Courseware Sere

Courseware Ser_e includes several types of software (simulations, inquiry, search,…) with educational activities specified in the exploration guidelines. The activities are targeted at both teachers students (software users). The software objectives are: to promote the understanding of the impact that the human activity has in the natural

resources; to understand that the future of mankind will necessary imply a more responsible attitude towards the currently used energy sources, mainly oil and forest resources. The courseware aims to approach the relationship between human activity and exploitation of natural resources and the environmental, social and economic consequences, of this exploitation.

The Courseware was designed to be used in the classroom, with students of 1st and 2nd basic education cycles (preferably from 8 years), particularly the 3º to 6º schooling years, with the guidance of their teachers, although its exploration can be adapted to other levels of schooling, as well other contexts.

As an introduction to the didactic exploration of Courseware Sere, it is proposed to view an animation (top left screen of Figure 1) in situations that appear problematic for the Human Being related to the depletion of natural resources (centered on forest biomass and oil). The animation serves as a starting point to a phase of problematization guiding of work research in regard to, for example, the use of natural energy resources or the exploitation of simulations on the impact that the increase in population and the levels and patterns of "consumption" of oil may have access to natural resources.

The resources of Courseware Sere, include: an educational software (version on CD-ROM and online, see at: http://sere.ludomedia.pt), the guidelines for the Didactic Exploration – Teacher and the guidelines of Records Sheet - Student/User and User Manual. The software online version allows accessing other resources, such as a library. In the User Manual information related to screens navigation and icons used in the software can be found.

The educational software is divided into two non sequential main phases: Phase 1 - Oil and Phase 2 – Forests. The teacher/student can choose by which of the phases and activities he wants to start the exploration.

Fig. 1 Courseware Ser_e example screenshots

Regarding activities and for example, in some screens the user is led to reflect on where and how they used natural resources (oil and forest), throughout a research process and making records in tables or graphs. The screen of figure 1 containing a world map is an example of how are recorded the oil production or levels of consumption that exist in various parts of the world.

Fig. 2 Guidelines for didactic exploration

The guidelines were developed to support the operation of the software. In the guidelines for the Didactic Exploration – Teacher different activities are proposed, structured as follows: 1) Activity Purpose; 2) Exploration Context; 3) Exploration Methodology. The guidelines for students are composed mainly of record sheets.

3. Development process and methodology

The courseware development methodology used by the team sought to answer research questions related with the implementation of user-centered software development methodologies.

Quality factors, such as, usability, the involvement of end users in various stages of development and multidisciplinary teams, are some of the assumptions of the UCD that is the base of the development methodology of Courseware Ser_e.

To reduce the development time and cost of, two of the main UCD disadvantages [9], the team chose to involve the end users (teachers and students) only in the resource evaluation task. The resource (particular the storyboard) was also subjected to evaluation by experts outside the team [5] which is considered essential, regardless of the adopted methodology. Figure 1 synthesizes Courseware Ser_e development process.

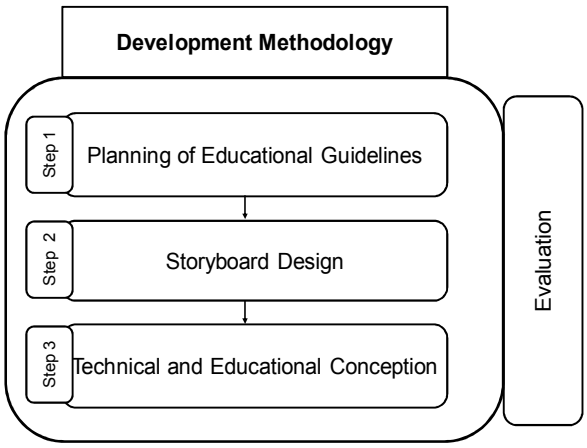


Fig. 3 Development process of Courseware

Courseware Ser_e development process includes four main steps:

- Step 1, Planning of educational guidelines: understand the achievement of a document by researchers in DS and ET with the degree of education / public-target of resource, the themes and educational purposes, as well as aspects related to architecture, navigation and the screen's design of the resource, said above. This step also included the trademark and patent registration, and, among others, agreements associated on copyright.

- Step 2, Storyboard design: brought up at this step are the preliminary ideas of educational activities and disciplinary content, defined in the previous step, the aspects of software interaction, particularly the navigation and interface, with the collaboration of a designer and a programmer of the company. How [10] or [11], it is considered that the design of scenarios resulting from this step was essential to understand the context of use of the resource and to represent some of the interactive situations of software.

- Step 3, Technical and educational conception: this step was divided into two sub-steps that held in simultaneously. The technical part was composed by the software design and programming and the user guide development. The educational part requested a specification in detail of aspects, beyond those already specified in the storyboard, as the initial animation and guidelines for the teacher and student. During this task, the multidisciplinary team tested and adjusted the content of the guidelines to the desired software screens' exploration. This step involved the permanent collaboration of all team members.

- Evaluation step: aiming to assess both the resource and its development process, this step crosses all steps above. At the end of step 2, the storyboard evaluation was performed by external elements to the multidisciplinary team, namely: end users, teachers of the 1st basic education cycles, and researchers at ET and DS. In addition to numerous internal evaluation and testing sessions of the resource, currently, the team is again performing a new evaluation step, now focused on the Courseware first version as well as on the development process.

4. Survey results

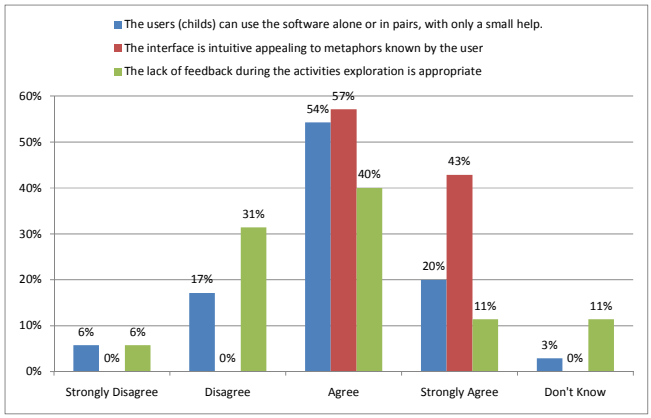
At the end of step 3, the work of the multidisciplinary team focused on the technical and didactic evaluation of the first Courseware Ser_e version (available on the web http://sere.ludomedia.pt). The process involved mainly teachers of the 1st and 2nd basic education cycles.

To evaluate the first version of the courseware, the questionnaire has been implemented through the organization of several workshops. The workshops were practical sessions with a maximum duration of 120 minutes, in which the teachers in groups of two to three elements had two activities to explore one of the courseware phases. Each workshop included a group of potential heterogeneous users of the resource. The tool consisted of 3 parts: the first part of the evaluation questionnaire is divided in two groups with closed questions about the educational potential of Courseware Ser_e: (a) the first list of issues related to user interaction with the software; (b) the second concerns aspects on activities designed for didactic use. The second part is targeted at open answers and aims to achieve a synthesis on the relevance and potential evaluation of educational Courseware Sere. Finally, the third part, is seeking comments about the working session and evaluation tool.

The comments made by groups, during exploration, are recorded directly in online space mentioned above.

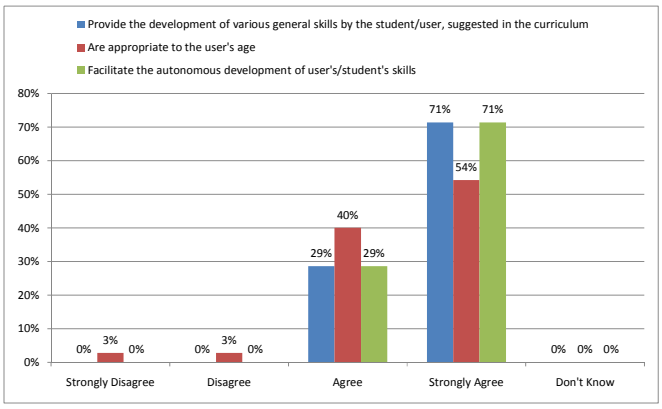
The first evaluation was performed using a group of 35 teachers. A simplified Likert scale was used for the closed answer questions (1- Strongly disagree, 2 – Disagree, 3 – Agree, 4 - Strongly Agree, 5 – Don't Know).

Graph 1 Results from three questions concerning technical aspects.



Concerning the technical aspects we decide to evaluate only the three questions displayed in graph 1- By the analysis conducted most of the users (children) may use the software with only a small help. 74% of the inquired teachers answered agree or strongly agree to this question. This result may be concerned with the fact that the software contains mostly graphical elements similar to other programs that the students are used to use, like, for example, PowerPoint or Microsoft word. This conclusion is emphasized by the fact that all students answered that the interface is intuitive appealing to metaphors1previously known (57% answered "agree" and 43% answered "strongly agree to this question").

Graph 2 Results from three questions concerning didactic aspects.



[1] A metaphor in this context is a representation of something, like for example "X"being a symbol enabling to close a window.

Another interesting result is that 51% of the teachers believe that the lack of automatic feedback during the activities is appropriate. However, 11% of the teachers answered "Don't know" to this question and thus more tests seem to be needed to corroborate and further validate this conclusion.

In what concerns didactical aspects, 71% of the inquired completely agree and 29% agree that the software activities enabled the student to gain the new competences suggested in the curriculum. 94% of the inquired considered that the activities were appropriate to the student's age. However, only 54% strongly agree that the activities are adequate to the student's age. The survey enabled us to conclude that most of the teachers believe the resource enable the student to gain competences in a very autonomous way. 71% of the teachers answered "strongly agree" to this question and the rest (29%) answered "agree".

Courseware Ser_e evaluation, in its generality was very positive. However in the open questions answers some less positive remarks are made by some of the teachers:

- Some graphical elements are not very perceptive;
- The interactivity of some screens should be increased;
- Some contents presented may be too complex for students of the first cycle;
- The vocabulary used may be difficult to understand for some students.

5. Conclusion and Future Work

In this paper development methodology of Courseware Ser_e was briefly presented considering the UCD assumptions on its development. This can make a difference in the educational resource quality and usability.

With the findings of the evaluation, we hope to further validate this assumption. The same data will also help us to improve future versions of the courseware giving greater autonomy to the user (student) in the exploration of the resource, as well as increasing its suitability to the same range age. Thus, we agree with Nielsen [12] that the most basic and useful evaluation is carried out with end users (representative participants). The evaluation using the questionnaire above, provides a clear measure and objective user view about the suitability of the software to their tasks [13], if done so contextualized in real conditions or very close to their environment use and with representative elements end-users to whom it is intended.

References

[1] I. P. Martins, Educação e Educação em Ciência: Universidade de Aveiro (2002).

[2] A. Cachapuz, J. Praia & M. Jorge, Ciência, Educação em Ciência e Ensino das Ciências. Lisboa: Ministério da Educação (2002).

[3] L. Schmidt, C. G. Vieira, F. M. Almeida, J. Pato, J. V. Malheiros, J. M. Figueiredo, L. Vasconcelos, L. Morbey, L. R. Álvares, M. Lapa, M. Gomes, M. H. Correia, P. Antunes, P. Partidário, R. Mota, R. Vargas, T. Fonseca & T. Goulão. Década das Nações Unidas da Educação para o Desenvolvimento Sustentável (2005-2014). Contributos para a sua dinamização em Portugal. Retrieved 9 January 2009, from http://www.unesco.pt/pdfs/docs/LivroDEDS.doc (2006).

[4] UNESCO, Draft International Implementation Scheme for the UN Decade of Education for Sustainable Development [online]. Retrieved 15 January 2009, from http://unesdoc.unesco.org/images/0014/001403/140372e.pdf (2005).

[5] C. V. Guerra, Avaliação do storyboard e da metodologia de desenvolvimento do Courseware Sere. Dissertação de Mestrado não publicada, Universidade de Aveiro, Aveiro (2007).

[6] S. Ball, ICT that works. Primary Science Review, 76, 11-13 (2003).

[7] C. Murphy, Literature Review in ICT and Primary Science. A report for NESTA Futurelab. . Retrieved 2 December of 2006, from http://www.futurelab.org.uk/download/pdfs/research/lit_reviews/Primary_School_Review.pdf (2003).

[8] J. Osborne & S. Hennessy, Literature Review in Science Education and the Role of ICT: Promise, Problems and Future Directions. Retrieved 15 November 2006, from http://www.futurelab.org.uk/download/pdfs/research/lit_reviews/Secondary_School_Review.pdf (2003).

[9] C. Abras, D. Maloney-Krichmar & J. Preece, User-Centered Design. In S. Publications (Ed.), Encyclopedia of Human-Computer Interaction. Thousand Oaks: Sage Publications (2004).

[10] P. S. Bassani, L. M. Passerino, P. R. Pasqualotti & M. I. Ritzel, Em busca de uma proposta metodológica para o desenvolvimento de software educativo colaborativo. Novas Tecnologias na Educação, 4(1), 1-10 (2006).

[11] C. Carvalho, Conceitos básicos para o desenvolvimento de cursos multimédia - Manual do Formador (1ª ed.). (Sociedade Portuguesa de Inovação, Porto, 2003).

[12] J. Nielsen, Usability 101: Introduction to Usability. Retrieved 22 February 2009, from http://www.useit.com/alertbox/20030825.html. (2003).

[13] P. W. M Van Veenendaal, Erik: Questionnaire based usability testing, in Proceedings of European Software Quality Week, Brussels, November, 1998.