Evaluating X-TEC Model with QEF

Paula Escudeiro
Departamento de Engenharia Informática, Instituto Superior de Engenharia do Porto,
Rua Dr António Bernardino de Almeida, 431, 4200-072 Porto, Portugal

and

José Bidarra
Departamento de Ciências Exactas e Tecnologia, Universidade Aberta,
Rua Escola Politécnica, 147, 1269-147 Lisboa, Portugal

ABSTRACT

This paper explores the capabilities of a framework, Quantitative Evaluation framework (QEF) based on learning technologies to make Instructional Design (ID) interoperate with Learning Environment (LE), so that the ID can be measured quantitatively.
The paper addresses concerns raised with academics, instructional designers about the teaching/learning software delivered via information technologies and used in schools and universities.
A number of criteria are presented and discussed, both for formative and summative evaluations.
The framework will be deployed in a real learning project, with different LE. Users involved in this project will provide various feedbacks to enhance quality and relevance of the framework.

1. INTRODUCTION

In an attempt to evaluate many e-learning software programs, one of the biggest problems has proven to be handling the number of variables which potentially impact on the effectiveness of the software program and deciding what constitutes dependent, independent and irrelevant variables in a given situation.
In this study we based in the standard of reference ISO 9126 (Scalet et al, 2000). ISO 9126 is an international standard for the evaluation of software. The objective of this standard is to provide a framework for the evaluation of software quality. We have based our study on some of the criteria of this standard.

Evaluation of teaching/learning software consists of two types: formative and summative. Formative methods of evaluation are used when a project has been decided and work has begun on the design and development of the various parts. It consists of a series of methods to determine whether the project can work as planed or it can be so ad hoc that consists mainly of obtaining the opinions of the users of a series of screens.
Summative methods of evaluation occur when the finished product is examined and can be benefited from hindsight.
Although both types of evaluation are important, and should be conducted at appropriate times throughout the life cycle of any educational program, they are less effective for the started purpose when they occur in isolation from evaluators teaching philosophy and preferred methods. Some software examples may be considered to be more sophisticated than others because, for example, the screens are more visually interesting or require more student input, those programs may actually be examples of the reproductive/transmitting method of teaching.
Bain and MacNaught examined the ways in which academic faculty view students learning. They suggest that academics hold certain views on the way s in which students learn and therefore tend to adopt one of the following teaching approaches: a reproducing/transmitting/expository conception which tends to encourage, reproductive learning; a pre-emptive orientation, sensitive to past student learning difficulties, focused on explanations; a conversational or transformative conception, understanding is constructed by the student with the assistance of the teacher (Bain & MacNaught, 1996).

All these approaches can be found in educational software. For example, the reproducing/transmitting/expository conception can be found in software which provides drill-and-practice or the short explanation, selection of readings and student input-to-exercises model used in many Web-based subjects or in some examples of electronic books or simulations. The pre-emptive orientation, in which the academic knows much about the learning difficulties past students have exhibited, can be found in interactive multimedia as well as in games, simulations and problem-solving courseware. The conversational approach may be found in multimedia exploration-on-a-microworld examples and in simulations and games where the students interact with both software and people to construct knowledge and receive feedback on their thinking.

2. EVALUATION APPROACH

The case analysed in this paper is a funded quasi experimental project designed to develop understanding of a evaluation learning environment in which individuals working in different kinds of development environments might work together using Techno-Didactical Extension for Instruction/Learning Based on Computer (X-TEC) (Escudeiro Paula and Bidarra José, 2006).

The evaluation approach named Quantitative Evaluation Framework (QEF) has been around for the last 7 years and refers to the development of indicators of performance which are based on ISO 9126.

The evaluation process started with a careful planning phase. It has included the purpose of the evaluation and stakeholders; the audience for the evaluation (community of practice, commissionaires, yourselves); what will be the timing for our evaluation (when should evaluation take place, coincidence with the school periods-semester, life cycle of projects); Who should be conducting the evaluation (external evaluators, internal evaluators, combination).

A simple question for any educational software should be, can this product actually teach what it is supposed to? It is a simple question to ask, but often is difficult to answer because the product may have so many beguiling features. It requires the evaluator to recognize his/her own view of the way in which students learn, to relate that view to the learning objectives of that portion of the course and to determine how and whether those objectives are carried out in the software.

Focusing the research work on the development of knowledge and understanding about the process of adoption and use of X-TEC platform in the development of educational software, our goal is to find out how this model increases the quality of the development and what are the main conditioning factors, either facilitating or limiting.

3. PERFORMANCE INDICATORS

Educational software quality is evaluated on a three dimensional space.

The dimensions of our Cartesian quality space are: Functionality; Efficiency and Adaptability.

The quality space aggregates, in the dimensions – Functionality; Efficiency and Adaptability – a set of factors that measure the relevant characteristics of an Educational Software Development Models (ESDM).

The Functionality dimension reflects the characteristics of the educational software related to its operational aspects. It aggregates four factors: feasibility, inviolability, easy of use and integrity

The Efficiency dimension aggregates four factors: data structure, programming structure, learning objects, imperfections recovery.

Through this dimension we measure the system's ability for presenting different views on the course content with minimum effort.

The Adaptability dimension is the aggregation of five factors: flexibility modularity, reusability, scalability and maintainability. Through them we can measure to what extend the scenario and course content are efficacious – whether they are focused and able to present different instructional design theories and different learning environment in a common platform.

The quality for a given system coordinates may be obtained through the application of one of several aggregation forms. We will compute these coordinates as the average of the factors that contribute to it; the average is simple and gives the same relevance to all factors.

4. PEDAGOGICAL MODEL

The proposed methodology was based on a descriptive case study research.

The evaluation process was setup to answer the following questions: how do higher education students react to the development of educational software with X-TEC model and how does the affects their learning process?

The proposed thesis stated that students, when faced with a new model for the development of educational software react by adapting their learning process and improving the learn efficiency.

The target audience chosen was students from the last year of the graduation course in Information Systems of Engineering College of Porto Polytechnic attending the discipline Multimedia Information Systems in an average of 25 students per year.

The X-Tec model was created to support the student learn behavior. The figure below shows the pedagogical model used in the Multimedia Information System classes during the study based on Vaz Carvalho pedagogical model (Vaz Carvalho 2001).

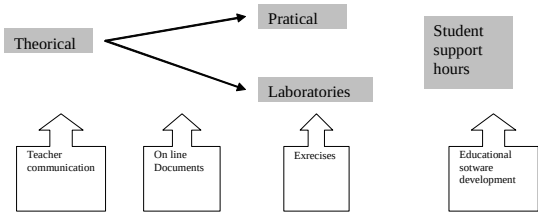

Fig 1: Pedagogical model

The X-TEC model presents two overlapping extensions: instructional design and learning environment. This model promotes an interaction between these two extensions, allowing the deployment of a common development, platform fig 2, and allows the student to choose their learning behaviour according to pedagogical model.

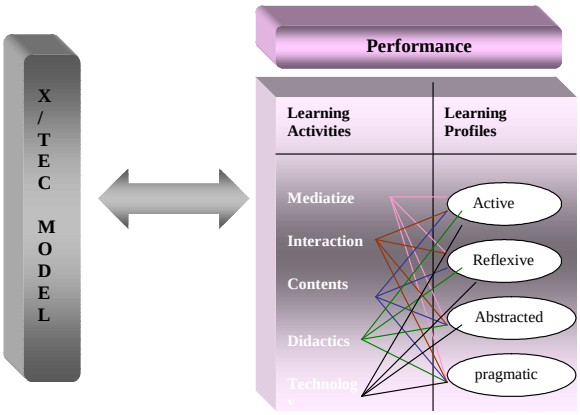

Fig 2: X-TEC conceptual model

5. QEF- IMPLEMENTATION PLAN

Focussing the research on QEF and X_TEC model the project at Information Systems of Engineering College of Porto Polytechnic attending the discipline Multimedia Information Systems reached the following project goals:

- The X-Tec model material was applied within a traditional academic environment;
- The evaluation was guide by a series of qualitative and quantitative metrics to provide precise and detailed implementation. These metrics measured the efficiency, adaptability and functionality of the overall learning/teaching process concerned with educational software development.
- Existing material resulting from previous projects was used.

In order to:

- Find out how this method determines the innovation process of developing educational software;
- Analyze how does it contributes to improve the quality of educational software;
- Verifying how does the students reacted to a new development model in order too produce educational software;

5. CASE DEFINITION

The process being developed according to the graduation course in Information Systems of Engineering College of Porto Polytechnic attending the discipline Multimedia Information Systems started in 1999 and, after several preparatory steps, the decision for implementation was taken in the beginning of 2000/2001 academic year.
Data collection covering the phase of the adoption process began in 2000/2001 and gathered relevant documents, reports, meeting notes, and educational software products. The discipline results were analyzed since 2000 until to 2007, and therefore the decision to develop a CASE tool based on X-TEC model was taken in July 2007.

CONCLUSION

The work presented in this paper describes our experience moving from a standard graduate program to an e-leraning approach. This approach presents two overlapping extensions: the instructional model and the learning environment. The instructional model is related to the instructor/educational software and the learning environment is associated with the student/educational software. The X-TEC model promotes the interaction between these two extensions.
The results we have achieved lead us to believe that using X-TEC to support the design and development of learning systems improves the quality of the final product. The QEF seems reliable and may used, not only to evaluate the final system quality, but as well to evaluate a system quality evolution through its lifecycle.
The design and the development of the learning tasks are based on conceptual models, such as X-TEC model and QEF framework, specially designed to support effective evaluation as a solid base for a renewed curriculum.
The online conception and development of educational software using X-TEC, along with its evaluation with QEF improves the access to graduate classes such as Multimedia Information Systems on Information Systems of Engineering College from Porto Polytechnic.
This work is focused on the development of high quality of educational software.

At a more general level, we have presented an overview of the results we have achieved with the QEF approach to evaluate the educational software developed by the students in their classes
The results of these experiments seem positive.

ACKNOWLEDGEMENTS

The author would like to thank the Polytechnic Institute of Oporto and GILT (Graphics, Interaction and Learning Technologies) for making possible this work.

REFERENCES

[1] A.B. Smith, C.D. Jones, and E.F. Roberts, "Article Title", Journal, Publisher, Location, Date, pp. 1-10.
[2] A. Dias Figueiredo (2005), Context Engineering: And is Development Research Agenda, Universidade Coimbra, 2005
[3] Allesi, S. e Trollip (1985), S. Computer Based Instruction: Methods and Development, Prentice Hall, Inc. Englewood Cliffs, New Jersey, USA, 1985
[4] Bates Tony, (2000), A. W. Tony Managing Technological Change: Strategies for College and University Leaders. San Francisco, 2000
[5] BloomBertram B. Mesia, and David R. Krathwohl, (1964), Bloom B. S. Taxonomy of Educational Objectives,: The Affective Domain & The Cognitive Domain. New York: David McKay Co Inc.
[6] Booch, (1994), G. Booch, Object Oriented Analysis and Design With Applications, Second Edition, Benjamin/Cummings, Menlo Park, Califórnia, 1994.
[7] Clark 1994, Gery, (1994), Gery, GJ Making CBT happen. Boston: Weingarten.
Clark, RE Media will never influence learning. Educational Technology Research and Development
[8] Coad and Yordon, (1991), P. Coad and E. Yourdon, OOA –Object Oriented Analysis, 2nd Edition, Prentice Hall, Englewood Cliffs, New Jersey, 1991
[9] Crossley, K. e Green (1990), Le Design des Didacticiels: Guide Pratique pour la Conception de Scénarios Pédagigiques Interactifs. ACL-Editions, Paris France 1990.
[10] Darby, M. R., Zucker, L. G., and Armstrong, J., 2002. Commercializing Knowledge: University Science, Knowledge Capture, and Firm Performance in Biotechnology. Management Science, 48, 138-153.
[11] Eckerson (1995), Eckerson, Wayne W. "Three Tier Client/Server Architecture: Achieving Scalability, Performance, and Efficiency in Client Server Applications." Open Information Systems 10, 1 (January 1995): 3(20).
[12] Escudeiro, Paula; Bidarra José, (2006), X-TEC: Techno Didactical Extension for Instruction/Learning Based on Computer – A new development model for educational software, Setúbal, Portugal, WEBIST 2006.
[13] Finch (1986) Finch, J. Research and Social Policy. Falmer.
[14] Gagné, (1996), Gagné, Robert M. and Medsker, Karen L. (1996). The Conditions of Learning Training Applications. Florida: Harcourt Brace & Company.
[15] Harland 1996 Harland, J. Evaluation as realpolitik. In Scott D & Usher R (Eds), Understanding Educational Research. Routledge.
[16] Jacobson, (1992), Jacobson, Object Oriented Systems Engineering, Addison-Wesley, 1992.
[17] Keller/Back (2004), Keller, M.; Back, A.: Blended-Learning-Projekte im Unternehmen, Learning Center der Universität St. Gallen, St. Gallen, 2004
[18] Laurillard, Diana (2002). Rethinking University Teaching, 2ª Ed., Parte II, "Analysing the Media for Learning and Teaching" (79-172). London and New York: Routledge/Falmer.
[19] MacNaught, 1996. The use of computer software especially in relation to identified academicsi teaching methods.
[20] Merrill, (1981), Merrill, M.D., Kowallis, T., & Wilson, B.G. Instructional design in transition. In F. Farley & N. Gordon (Eds.), Psychology and education: The state of union
[21] Minken, I., Stenseth, B. E Vavik L., (1998), Educational Software. ULTIMA-Gruppen A/S, Haden, Norway, 1998
[22] Oliver 2000, Oliver M, Evaluating online teaching and learning, Information Services and Use, vol 20 (2/3)
[23] Pressman Roger S., (2001), Pressman, Roger S. Software Engineering a Practitioner's Approach, 5 th Edition, McGraw-Hill Companies Inc, 2001
[24] Purinima Valiathan, (2005), ASTD-Linking People, Learning & Performance. Learning circuits- American Society for Training & Development
[25[Rumbaugh et al, (1991), J. Rumbaugh, M. Blaha, W. Premerlani, F. Eddy, and W. Lorensen, Object Oriented Modeling and Design, Prentice Hall, Englewood Cliffs, New Jersey, 1991.
[26] Scalet et al, 2000, ISO/IEC 9126 and 14598 integration aspects: The Second World Congress on Software Quality, Yokohama, Japan, 2000.
[27] Timmers (2000), Timmers, P.: Electronic Commerce: Strategies and Models for Business-to-Business Trading. Wiley.
[28] Vaz de Carvalho, (2001), C., Machado, A. A Virtual Environment for Distributed Leraning in Higher Education, 20th ICDE World Conference on open Learning and Distance Education Dusseldorf, April 2001

[29] Yourdon, (1998), E. Yourdon, Managing the System Life Cycle, 2nd Edition, Yourdon Press/prentice Hall, Englewood Cliffs, New Jersey, 1998.