



6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the
Affiliated Conferences, AHFE 2015

PETESE, a pedagogical ergonomic tool for educational software evaluation

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Abstract

Educational software are increasingly developing on the market these recent years. Evaluating their quality is required. Many authors have created evaluation checklists, but few join pedagogical and ergonomic aspects. Moreover, most of them aim helping teachers to select adequate software in their didactics. The present study proposes a tool for educational software of mathematics based on a discovery learning approach (PETESE), and aims highlighting the important development criteria of the software's design process before launching it on the market. The criteria are gathered in the field of education, mathematics and ergonomics, and analyzed through the analysis methodology. PETESE is finally applied to a concrete case, the educative software of mathematic GGBook, a numeric book developed by the Abaco's lab (University of Brasilia) based on the GeoGebra environment and integrating facilities between the graphics and the operations elements. The results of this research show the importance of a specific referential in the creation process of a software of mathematics pointing to elements the software needs to focus better before entering the market.

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Peer-review under responsibility of AHFE Conference

Keywords: PETESE; Educational software; predictive evaluation; pedagogical usability; mathematical software; discovery e-learning

1. Introduction

The third industrial revolution, or technological revolution, highly impacts the life of people worldwide allowing a globalization of information [1]. This leads to the rise of activities using technology and opens new horizons in

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allfields. The combination of education and technology generates growing opportunities both for teaching and learning.

The new technologies of information and communication affect directly the teaching methods, practices and resources. Studies, however, have indicated that working with new technologies is not as simple as imagined, and require preparation, basic skills as well as available material [2]. This results in huge challenges to traditional teaching. While some teachers are reluctant to changing, others enhance teaching and learning by using computer technology.

Among the opportunities of the use of computers in the area of education, educational software have appeared massively on the market. They differ from most other types of software for their clear emphasis on human learning and knowledge acquisition [3]. Educational software have the opportunity to integrate multimedia and interaction both for students and teachers. The educational practices should also emphasize the creation of environments learning, in which students build their knowledge and the teacher guides and encourages the process. Analyzing the resources that are brought through these new technologies is of the utmost importance to capture, treat, organize, systemize, conserve and transmit the information according to the intrinsic pedagogical objectives.

However, according to Garcia and al., a large part of these educational software have been badly organized and poorly documented [4]. Rare are, indeed, the developed tools that define and implement educational objectives together with preserving technical quality patterns. Silva and Vargas explain this by the difficulty of mixing the different areas of ergonomics, TICS, pedagogy and psychology [5]. Yet, a serious analysis of the system is essential to evaluate its qualities and effects before using it in the classroom or at home.

From a historical point of view, the need to measure the quality of educational software results from two older research themes: on the one hand, the evaluation of teaching materials like school textbooks; on the other hand, the evaluation of software and human/machine interfaces [6]. For both areas, formal institutions or even governments have defined the effectiveness and the evaluation criteria. About educational software, however, it is less clear [7]. Therefore several authors started to think about the necessity to define a methodology for its development and evaluation, using some tools of software engineering that include pedagogical aspects.

Many evaluations on educational software can be found in the recent literature. The content coherence and the graphic interface, however, are not always taken into consideration. A good evaluation first should take into account the cognitive aspects as well as the aspects of usability and second should mention the missing aspects. Pedagogical aspects include an evaluation of convenience and the software's feasibility in an educational situation based on the specific situations of the learning process. Technical aspects are based on an evaluation of the usability, in other words, the quality of the interaction user/computer through the interface of the software looking for efficacy and efficiency of the interaction [8].

Our research aims thus to integrate the characteristics of usability with those of learning; where the area of ergonomics focuses on 'learning the system to use it' and learning focuses on 'learning through the system'. Our proposal is a pedagogical usability referential for mathematical software of discovering learning to be used by the instructional designers during the software's design process (PETESE). In order to do this, we have researched which are the elements that should be taken into account while evaluating ergonomics of mathematical software of discovering learning through an analysis of the contribution in the specialized literature in the field on pedagogical usability.

2. Methodology

We worked according to 'anasyntesis', a methodology based on both 'analysis' and 'synthesis' that designate the general process of elaboration of a model, referential or system [9]. Used in various areas, this method is inspired by the works of Silvern [10]. Legendre [11] defines the anasyntesis according to four steps:

- Identification: corresponds to the situation of departure of the research with the construction of the research problematic and the formulation of the problem.
- Analysis: corresponds to the analysis of the theoretical data in order to build the referential through a critical analysis of the content gathered in phase 1.

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