Application of the Cognitive Walkthrough Method to Evaluate the Usability of PhET Simulations Package to Teach Physics

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ABSTRACT

The use of simulators and customized applications for educational use opens new possibilities in the teaching and learning process of the most varied disciplines through computer-mediated interactions. In this context, teachers are developing digital material considering this powerful tool. And the use of educational apps and simulators has increased significantly with the spread of the internet in schools. However, the evaluation of the effectiveness of these applications is complex and incipient. This article presents a proposed interface usability assessment for the use of simulators with elementary school students using a customized version of the PSSUQ, along with an evaluation by the cognitive walkthrough method. The interface chosen was the simple pendulum simulator used as part of the PhET simulations package. The results indicated satisfactory usability of the application, although some limitations and usability difficulties were found.

KEYWORDS
Cognitive Walkthrough, Evaluation of Educational Tools, PhET Simulations Package, Simulators

1. INTRODUCTION

The authorial role of teachers is increasingly becoming evident with the increased use and need for creation of digital educational materials. Buzato (2006) states that thinking on new technologies as ways to improve the world is to think of education. In this context, the “teacher-author” is included in a model with great technological complexity, with social, cultural and educational implications. Mesquita (2013) points out that the teaching expertise includes the disciplines, programs and materials, and a set of competences related to the organization and management and of specific didactics related to the context in which the teaching-learning occurs.

The recent technological changes bring challenges for teachers and developers of educational software, calling for a definition the educational objectives to be achieved, the target audience and the incorporation of the fundamentals of the theory of learning (Falkembach, 2015). The use of simulators and customized applications open new possibilities in the teaching and learning process of the most varied disciplines through interactions mediated by computers. Hirsh-Pasek et al. (2015)
define educational software as applications designed to promote active, engaged, meaningful and socially interactive learning.

According to Barroso, Felipe and Silva (2006) there are four characteristics essential to the effectiveness of the learning process: (a) active and not passive engagement of students in the learning process; b) use of groups using collaborative work; c) interaction with return or “feedback”; d) presence of connections to real-world situations compatible with students’ daily life.

One crucial issue for teachers that develop and employ digital materials is the usability of interfaces. The usability is the degree that the interface is sufficiently clear to students, and supportive in the learning process, the rather than inhibiting it. A good interface supports a greater engagement, collaboration, feedback and connection to the real world.

Barroso, Felipe and Silva (2006) state that as happens with traditional educational tools and materials, it is difficult to assess the use and efficacy of computer-based tools for education, and this is a problem also in programs computer with educational focus. Hirsh-Pasek et al (2015) point out that students are in the core of a vast, unplanned experiment, encircled by digital technologies that were not available a decade ago. They point out that educational apps are largely unregulated and untested, and by January 2015 stood at 80,000 in Apple’s App Store alone, thus the evaluation of educational apps is an urgent and important task.

Accordingly, the main objective of this work is to evaluate the usability of an interface developed for the physics teaching using a simple pendulum simulator by applying a questionnaire to verify the satisfaction with the use and to perform a usability analysis using the cognitive walkthrough (CW) method to identify opportunities for improvement and anticipate student difficulties while using the interface. This article is divided into six sections, the first is this introduction. The second section presents the theoretical foundation for the study, while the third section briefly introduces the research method. Fourth section describes the procedures, while fifth section presents results and analysis. The sixth and final section presents the conclusions of the study.

2. THEORETICAL FRAMEWORK

A computational interface conveys a large amount of information and must be designed in accordance with accessibility guidelines with focus on usability. The designer communicates with the user through the interface, and must clearly communicate his design intentions and the logic that determines his behavior. Usability evaluation refers to the methods to examine aspects related to an interface. A usability-oriented system must have an interface where the task can be performed without drawing attention to the interface, in which users do not have to spend time and energy on learning and dealing with the interface, but only in doing the task they want to perform.

According to Cybis (2000) a usability problem exists when a characteristic of a system slows down, impairs or impedes the execution of a task. This type of issue occurs during the user’s interaction with the system, and may annoy, embarrass or traumatize users, leading to the abandonment of that system. This is especially critical for educational software, since problems can lead to students’ lack of interest and engagement in digital learning activities (Hirsh-Pasek et al, 2015). Therefore, the evaluation of the usability of an interface is imperious and should be performed at all stages of development, deployment and operation of a system.

Rogers, Sharp and Preece (2011) explain that the evaluation of an interface is a systematic process to collect data to analyze how users use an artefact to execute their tasks in a computational environment. The authors highlight two categories of evaluation: a) tests performed with users, divided into observational or prospective methods and b) tests with evaluators or specialists, known as inspection (or analytical) methods that do not require the participation of users. The analytical methods are related to inspecting the interface against a series of pre-established criteria, aiming to identify design issues, usually requiring less resources, being faster than methods requiring user
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