

MDFLUXO: OPHTHALMOLOGY EDUCATION WITH A PDA EFFICACY AND USABILITY EVALUATION

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Abstract: In the last decade, handheld computers, also known as Personal Digital Assistants (PDAs), have become popular among physicians, residents and medical students. We have developed a PDA-software, called MDFluxo, to assist ophthalmologic teaching as a guide. We used a user-centered design to try to diminish usability problems. It's interesting that the literature concerning PDA use on health area doesn't emphasize usability attributes and it's evaluation, which is important to widespread PDA use among health professionals. MDFluxo efficacy was evaluated comparing it to traditional book guide and a non-guide self-learning. Usability inspection methods, such as Think Aloud Method, Nielsen Heuristic Evaluation, QUIS 5.0 adaptation, and Cognitive Walkthrough are being used to identify usability problems. The usability inspection methods help us to identify usability problems and correct them. We evidenced that the students who used MDFluxo improved the resolution of the clinical case when compared to participants which did not use any material as support, however there was no significant difference when comparing the MDFluxo students to students using a book, thus, as a support to ophthalmology learning, MDFluxo is an efficacy tool.

1 INTRODUCTION

In the last decade, handheld computers, also known as Personal Digital Assistants (PDAs), have become popular among physicians, residents and medical students. It is estimated that near 60-70% of the medical students and residents on the USA use PDA for some purpose related to health (Kho *et al.*, 2006). Some equipment characteristics such as: size, mobility, objectivity at offering relevant clinical information can be related to the observed spread (Kho *et al.*, 2006). The main applications used among medical students and residents are: research tools (Sutton, 2004), medical calculators (Honeybourn *et al.*, 2006), bibliographical references (Rudkin *et al.*, 2006), and drugs databases (Stroud *et al.*, 2005). We didn't find papers related to health professionals and medical students PDA usage on Brazil, although we are managing an electronic research to get this data (<http://telemedicina.unifesp.br/palm>).

Widespread use and growth in the use of PDA can be due to it usability. On a recent review (<http://telemedicina.unifesp.br/mdfluxo>) that we have performed, we have evidenced the increasing use of PDA in the health environment, as well as

PDA-software efficiency and effectiveness in the aid of teaching and medical practice. There were few studies regarding PDA-software development centering on health professional opinions. This could generate problem in understanding results, since Nielsen (1993) asserts "is virtually impossible to design a user interface that has no usability problems form the start.

The aim of this paper is to present MDFluxo, for learning ophthalmology based on handheld computers, and its evaluation among medical students. There will also be introduced preliminaries results concerning usability inspection methods we are applying.

2 MATERIALS AND METHODS

The MDFluxo software is based on the book "Federal University of São Paulo (UNIFESP) Guide for Ambulatories Medicine - Ophthalmology" written by Schor *et al.* (2004). In the opening pages Schor *et al.* (2004) mention that the book is both a clinical and surgery manual and that it was created to help medical practice, describing the most common le-

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sions in each human eye segment, followed by anatomical location. Each chapter possesses a flowchart that allows grouping manifestations by their common characteristics. The book offers a total of 55 flowcharts regarding each disease. Each flowchart summarizes the medical knowledge discussed in the current chapter and offers mnemonics to compact the text with objectiveness.

The flowcharts extracted from the book were, first revised by specialists, and then transcribed to eXtensible Markup Language (XML) due to its flexibility, enhanced integration and SOA-oriented services for different environments (Pinto *et al.*, 2006).

On this study, we used Palm OS Simulator[®] version 5.2.1 to simulate a Palm environment on desktop PC. We also used palmOne[™] Tungsten E handheld devices with 320x320 screens. On the desktop PC, we had installed Microsoft Visual Basic[®] 6.0 with the plug-in MobileVB[®] 4.0.0 of the AppForge[®], and database Microsoft Access[®] 2003.

According to general Human-Computer Interface (HCI) literature and our expertise on developing health-applications, a close relationship between health-professionals is vital to avoid failures. Thus, we had chosen a user-centered design process (Norman, 1983) in which we included ophthalmologists, physicians and residents on prototyped development process.

2.1 Usability Inspection

Trying to evaluate the five usability quality components: learnability, efficiency, memorability and satisfaction (Nielsen, 2003), we planned to use the following methods: Think Aloud Method, Nielsen's Heuristic Evaluation, Questionnaire for User Interface Satisfaction (QUIS 5.0) and Cognitive Walkthrough.

A Think Aloud Method (Someren *et al.*, 1994) was applied to ophthalmology specialists, on a laboratorial environment, to evaluate learnability and efficiency in a simulated case-solving.

Nielsen's heuristic evaluation (Nielsen, 1994) was applied by 5 biomedical informatics students to identify problems on the five usability components.

There are two other usability inspection methods that will be applied. We translated to Brazilian Portuguese language and adapted the QUIS 5.0 (Chin *et al.*, 1988). We planed to apply it on several voluntry physicians to assess their satisfaction using MDFluxo. A Cognitive Walkthrough Evaluation Process (Lewis *et al.*, 1990) is being planned to quantify the efficiency, the learnability, and memorability with medical student in a PBL evaluation.

2.2 MDFluxo Comparing

We didn't intend to evaluate MDFluxo as a substitute to the traditional learning. On this paper we compared if MDFluxo is a valid tool to complement the ophthalmologic learning.

One of the authors (Paulo Schor) developed three different, equivalent clinical cases to assess MDFluxo efficacy. Patient's main and secondary complains, personal info, clinical history, and related issues were included on the clinical cases.

From UNIFESP and Faculdade de Ciências Médicas de Santos – Centro Universitário Lusiada (FCMS-UNILUS), fourth and fifth year medical students were divided in three groups. The first group used MDFluxo as a didactic support, the second group used the Guide of Ophthalmology book (Schor *et al.*, 2004) and the last one group didn't use any didactic material as support to solve the clinical case.

Each participant was required to answer three questions: the diagnostic hypothesis, etiology for them, and conduct. To each right answer, half right and wrong it will be attributed values 1, 0.5 and 0 respectively and the accomplishment of the trial was timed.

The students' response was corrected and the data tabulated in an electronic spreadsheet. For each question of the test (diagnostic hypothesis, etiology, conduct) the grades and time spent to answer were evaluated. We used the Friedman's test (Siegel, 1988) to verify the variance among the groups.

3 RESULTS

The MDFluxo project resulted in 22 prototype versions, each one built considering the physicians opinion, regarding flowcharts content, usability attributes, including layout design. We evidenced great differences between initial and final prototypes, as shown in Figure 1 and Figure 2 respectively.

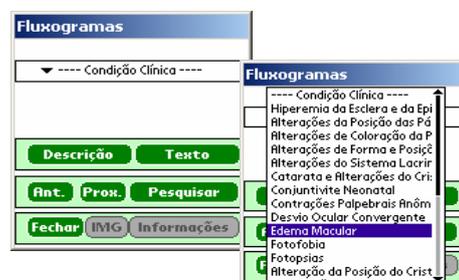


Figure 1: Two screenshots from 5th prototype, with several buttons and few information.



Figure 2: Two screenshots from 22th prototype, with more information and improved navigability.

3.1 Usability Inspection

Some preliminaries results of usability inspection that we are conducting are listed below:

1. We diminished the amount of options present on preliminary releases to clear the screen.
2. There were no icons on the system. Icons increases the mapping with the real world.
3. The exclamation point (“!”) used for “View info on the Author” and the button “Close” have not a consistent use on the system.
4. The red color is often used in the system for normal instruction of pure text, however, this color should be used only for critical alerts.
5. It is not obvious that the “Eye Segment” is selectable.
6. There were grammar and writing mistakes on titles and menus and generated texts.
7. For the “gender” and “age” we used Select Box, which does not follow the WIMP standard.
8. The “Instructions” option doesn’t offer a step-by-step manual, but a short explanation on each button function. The names “Instructions” and “Project Information” are not appropriated to their meaning.
9. In some screens the user could not click on the text and change it, however, this feature was wrongly enabled.
10. Error reports were shown several times, such as “Form was unable to load” and “subscript out of range” during the system loading.
11. The “Help” function is only presented on the starting screen. During navigation there is no other “Help” button or “Return to Home/Main”.

3.2 MDFluxo Comparing

The descriptive statistic, which describes the study results, is present on Table 1. On this table we present average results for the groups that used MDFluxo on PDA, book and the group that didn’t use anything for each question and time.

Table 1: Descriptive statistics containing average values for each studied feature.

	Diagnostic hypothesis	Etiology	Conduct	Time	General Result
PDA	0.600	0.350	0.450	16.980	1.400
Book	0.650	0.325	0.425	14.420	1.400
Without nothing	0.475	0.050	0.125	12.220	0.650

Applying Friedman’s test to verify statistical differences in the values presented on Table 1, we evidenced that using PDA leads to a better etiology resolution and conducts when compared to group that doesn’t use any material.

Beyond what has been stated, there was no significant result for resolution of diagnostic hypothesis in comparison to the other two groups. In the analysis among the medium time required for the accomplishment of the clinical case among three groups, the use PDA as reference material was better than the book and without the aid of any material. However it should be taken into consideration that the students did not receive previous training for the use of the software.

On Table 2 we present the statistical difference in diagnostic hypothesis, etiology, conduct, time and general result for MDFluxo comparing to book and students with nothing.

Table 2: Analysis of variance according to Friedman’s test. (*) p-value > 0.050 (without significance).

Diagnostic hypothesis	Etiology	Conduct	Time	General Result
$\chi^2_{calc} = 1.720$ ($p < 0.423$)	$\chi^2_{calc} = 9.140$ ($p < 0.010$)	$\chi^2_{calc} = 6.140$ ($p < 0.050$)	$\chi^2_{calc} = 8.400$ ($p < 0.015$)	$\chi^2_{calc} = 4.630$ ($p < 0.099$)
	PDA & Book > Without nothing	PDA > Without nothing	Book > PDA & Without nothing	*

4 CONCLUSIONS

There are many boundaries on PDA-software development, especially when we consider the health environment and its applications. For MDFluxo project, these restraints only reinforced the role of the participating user during the development process. A weak mnemonic gap could have been created because, due to the PDA screening limitation, flowcharts are showed in parts, instead of the whole, as in the book. However the group that used PDA-software MDfluxo achieved better result than the group that did not use any material for the resolution clinical case.

The participants that used PDA-software MDFluxo did not have any difficulties to navigate through the different. However the amount of flow-charts presented by the software did not correspond to the users' expectations.

The ophthalmologic clinicians and students found MDFluxo as a portable, quick, and intuitive guideline and a method of learning on managing clinical cases. Improvements, such as considering the usability on the development process, could turn the PDA into a more useful resource to physicians, enhancing the assistance of patients.

A research was accomplished in medical database with objective of finding in the medical literature representations of ophthalmologic information similar to the representations of the PDA-software MDFluxo that were extracted of the book of Schor et al., (2004). However, it was not found similar studies it to allow accomplishing comparisons with the results of this study.

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