ORIGINAL ARTICLE

Exploring the Usability of Mobile Apps Supporting Radiologists' Training in Diagnostic Decision Making

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Abstract

Purpose: The objective of this study was to conduct a usability evaluation of mobile apps for supporting education and training in radiologic diagnostic decision-making processes.

Methods: Of 381 mobile apps available at two major stores (Google Play and iTunes), eight iOS apps were selected for laboratory-based usability tests. Six staff radiologists completed eight app-specific task sets, using a think-aloud strategy. The triangular methods approach included quantitative performance measures, System Usability Scale (SUS), and qualitative thematic analysis using heuristic usability principles of usability issues.

Results: Overall, radiologists achieved higher than 70% success, with favorable SUS scores, in completing the tasks for seven of the eight apps. However, task success rate and SUS score had a weak relation ($r = 0.23$), indicating that the perceived usability may not reflect the holistic usability of the app. Task analysis and self-report revealed 108 usability issues, which were condensed to 55 unique issues and categorized by nine usability themes and mapped to ten usability heuristics. Nonintuitive functionality (eg, nonintuitive or misleading labels) was the most frequent theme observed, leading to inefficient navigation. These usability findings were consistent with the 13 improvements the radiologists suggested.

Conclusions: This study demonstrates the feasibility of usability evaluation of radiology mobile apps and suggests potential improvements in the development of radiology mobile apps. This study also suggests that proficiency with mobile devices may not be equivalent to being an expert user, proficient in using the apps.

Key Words: Usability, mobile app, decision making, education

J Am Coll Radiol 2015;■:■-■. Copyright © 2015 American College of Radiology

INTRODUCTION

Mobile Apps in Radiology Education and Training

More than 85% of physicians in the United States use smart phones and 53% use tablets daily in their practice areas [1]. There are four major app stores (iTunes, Google Play, Windows, and BlackBerry), but the majority of apps are offered through the iTunes and Google Play stores. In February 2015, the iTunes App Store contained approximately 32,000 medical mobile apps, whereas Google Play's app store had about 23,000 medical apps [2,3]. Medical apps fall under many different categories, including reference apps, such as the *Physician's Desk Reference* app, medical calculators, and apps designed to access electronic health records or personal health information [4].

There are numerous potential and realized benefits of mobile device use in health care settings. In radiology,

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The authors have no conflicts of interest related to the material discussed in this article.

research studies have shown that mobile apps may have positive effects by providing facilities for diagnostic reading [5], decision support [6], medical books [7], interactive encyclopedias [8], and journal reading [9].

Lack of Usability in Radiology Apps

Recent increases in the functionality of apps have come at the expense of their "usability." Usability is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction, in a specified context of use of the system" [10]. Although functional evaluations of mobile apps receive much attention, few usability evaluation studies have been conducted, especially for health care mobile apps [11]. Although many health care-related mobile apps are available for consumers, only 28% of smart phone users and 18% of tablet users report being "very satisfied" with the quality of these apps [1]. In other words, most apps are hard to learn and inefficient and unsatisfying to use. As such, it is estimated that 95% of downloaded mobile apps are abandoned within a month [12], and 26% of apps are used only once, possibly because of the lack of attention to usability [13]. Poor health care system design may lead to increased cognitive load [14], medical errors [15], and decreased quality of patient care [16]. The objective of this study was to evaluate the usability issues radiologists encounter when they use mobile apps that are designed to support training in diagnostic decision making.

METHOD

Study Setting

University of Missouri Health Care is a tertiary care academic medical center. The Department of Radiology includes more than 28 highly trained clinicians and researchers and successful training programs of more than 25 resident physicians. This study incorporated the strengths of an interdisciplinary team of experts in health informatics (M.S.K. and M.K.M.) and clinical radiology (M.R.A., K.J.L., K.L.I., and V.S.). This study was approved by the institutional review board.

Selection of Radiology Apps

Two online stores with major market share (Google Play [Google, Mountain View, California] and iTunes [Apple, Cupertino, California]) were searched on July 10, 2014, by screening apps' titles and descriptions. Apps were excluded if they (1) only provided access to reference material, (2) were designed solely for trivial medical calculations, (3) were designed for specific commercial vendor products,

(4) were designed for use by a specific hospital or clinic only, or (5) were written in a language other than English. Of 381 apps identified as eligible, 21 were selected for potential usability evaluation. Finally, the team selected 8 iOS (Apple) apps that are available for the iPad device (Apple) for this study (Table 1). The iOS platform and iPad device were chosen because of wide acceptance in the radiology community in the United States [17,18]. Links to the apps studied are provided in Table 1.

Usability Evaluation

Participants and Sampling Frame. Estimates of the sample size for a usability test are based on how many of a fixed number of usability issues can be uncovered by users (problem discovery rate) [19]. On the basis of a review of

Table 1. Names of the apps for usability test, seller, price, and store links

1. Case Review for iPhone and iPad (Elsevier, iOS free)
https://itunes.apple.com/us/app/case-reviews-for-iphone-ipad/id522176594?mt=8
2. AART Ultrasound Cards Lite (Virtual Flashcards, iOS, Android free)
https://play.google.com/store/apps/details?id=com.virtualflashcards.aartsonolite
https://itunes.apple.com/us/app/arrt-sonography-ultrasound/id749310888?mt=8
3. Dexnote (DexNote, iOS free)
https://itunes.apple.com/us/app/dexnote/id536419130
4. Brain MRI Sectional Walker (Ryo Matsuda, iOS $9.99)
https://itunes.apple.com/us/app/brain-mri-sectional-walker/id755407893?mt=8
5. Diagnostic Radiology - Dynamic Approach to Abdominal Radiology (BestApps, $44.99)
https://itunes.apple.com/us/app/diagnostic-radiology-dynamic/id523516157?mt=8
6. MED Imaging Case (Olivier Decrock, iOS $1.99, Android free)
https://play.google.com/store/apps/details?id=com.medimagingcase&hl=en
https://itunes.apple.com/us/app/medimaging-case/id531101017?mt=8
7. Radiology Assistant (Wouter Veldhuis, iOS $5.99, Android $7.32)
https://itunes.apple.com/us/app/radiology-assistant-medical/id383464901?mt=8
https://play.google.com/store/apps/details?id=nl.radiologyassistant.android&hl=en
8. Radiology Head (3D4Medical.com, iOS $2.99)
https://itunes.apple.com/us/app/radiology-head/id692751041?mt=8