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Integrating FAHP and TOPSIS to evaluate mobile learning applications for mathematics

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Abstract

Growing number of mobile learning applications particularly for mathematics (MLAM) have dramatically changed the way individuals learn mathematics in recent years. However, due to abundant number of applications, MLAM users encounter with difficulty in choosing the right application for their choice. The manual selection of these applications is tedious, time consuming and in most instances effectuated premature selection. There is also lack of research about determining the quality of MLAMS and users heavily rely on the information provided either by the application store ratings or by content of the developer which serve largely commercial purposes. Therefore the aim of this study is twofold; to propose quality and user satisfaction model and to evaluate MLAMs by applying multi-criteria FAHP and TOPSIS methods together. The criteria were defined based on the combination of technical and non-technical aspects of the applications. The ISO 9126 model was used for the evaluation of technical aspects while user satisfaction was used for evaluating non-technical aspects. The weight of each criterion identified in the framework was determined through FAHP and MLAMs were ranked based on preference with TOPSIS and methods respectively. Mathsway, Malmaths, Cymaths, Mathematics and Mathspapa are the applications chosen as sample MLAMs Play Store based on high top 5 highest user ratings. According to the ranking results by TOPSIS method, the learning application Mathematics was ranked first, then Cymaths, Mathway, Malmaths and Mathspapaas last. The proposed framework could be extended to serve as a model for evaluating mobile application in general. The adoption of combining FAHP and TOPSIS methods yielded to less time consuming and more effective optimizations as a result selecting the most suitable MLAM. The integration of these methods could significantly improve the evaluation of MLAMs by minimizing the manual expert evaluation.

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Keywords: Mobile learning application for mathematics(MLAM); FAHP; TOPSIS; ISO 9126; user satisfaction.

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1. Introduction

Nowadays, mobile devices fill gaps of a traditional learning process, through their particular features. It is necessary to provide a quality management process in order to insure a certain degree of quality for mobile learning services. In education, quality is a concept that characterizes the output. Since the quality is more important than in any other process the way educational processes have been conducted has been evolving by implementing new techniques, methods, concepts and technology. Within the last decade, diverse mobile learning applications were developed which support teaching mathematics in the different areas such as mathematical analysis, geometry, statistics, algebra, and other areas of its discipline (Drigas & Pappas, 2015;Handal et al., 2013). Larkin (2013) emphasized that although mobile learning applications are widely used in the educational arena, research regarding their effectiveness particularly in the area of mathematics is scarce. He also remarked that there exist couple of impediments in identifying the quality of mobile learning applications due to lack of research, information provided by the application store merely serves commercial purposes and the considerable amount of time is spent in determining the quality of a mobile learning application which especially mathematics teachers/instructors could not invest. There exist couple of frameworks claims to assess the quality of m-learning applications (Boja et al. 2011; Boja&Bătăgan, 2011; Parsons 2006;Highfield&Goodwin, 2013; Pocatilu&Boja,2009). Some of these sources investigated technological quality while other pointed out the content quality of m-learning applications. Up to this date none of these frameworks are used to assess technical and non-technical aspects together so far. One of the major burdens of quality mobile learning application selection is the diversity of these applications which makes it difficult to compare one over the other. For this purpose, multi-criteria decision making is used in various studies particularly for the assessment of quality. It was indicated in numerous researches that it is more effective approach to integrate two MCDM methods, fuzzy AHP and TOPSIS for selecting from alternatives against the stated criteria (Ballı&Korukoğlu,2009; Brajković et al.,2015;Volarić et al., 2014;Torfi et al., 2010).

Volarić et al. (2014) conducted a study on integrating FAHP and TOPSIS when making a suitable selection of learning applications based on the revised blooms taxonomy framework. Initially they utilized FAHP approach for deciding the weights of the criteria with their respective estimated values for the applications. Afterwards, they utilized triangular fuzzy number as a part of FAHP approach for deciding the advantages of one criteria to another. At that point the TOPSIS approach was utilized to decide the last positioning of the applications. They stated that the mix of FAHP and TOPSIS techniques empowers instructor to effectively choose a more appropriate interactive media applications for learning. Ballı and Korukoğlu (2009) developed a fuzzy framework for the selection of most suitable operating system based on the FAHP and TOPSIS approach. The weights were first determined and then the selection of the most appropriate operating system was done using the FAHP and TOPSIS approach respectively. Torfi et al. (2010) they proposed a fuzzy MCDM model to evaluate user alternate choices with regards to its preference. They combined Fuzzy Analytic Hierarchy Process (FAHP) and Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS) the model involves weighting the criteria and ranking respectively. Hence, in order to make a more effective evaluation using the MCDM approach, FAHP and TOPSIS are usually combined together determining and weighting the criteria is carried out by FAHP method and then TOPSIS method used for ranking. The primary aim of this research is to establish a new framework for assessing the quality of mobile learning applications. Secondly this study intends to measure quality of listed mobile learning applications for mathematics by using this framework through using MCDM analysis employing FAHP and TOPSIS methods together.

2. Methodology

2.1. Evaluation Model

The proposed selected criteria (see Figure 1 below) to measure the overall quality and user satisfaction of the mobile learning application for mathematics is based upon technical and non-technical aspects of the applications since the technical quality characteristics alone cannot always guarantee user satisfaction. For the technical perspective, the International Standard Organization ISO 9126 quality model was adopted to evaluate internal, external and quality in use metrics. Internal metrics don't require executing a software whereas external metrics are