Multi-criteria decision making approach in E-learning: A systematic review and classification

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ABSTRACT

Academic research on E-learning has increased extensively over the past few years. Although, many multi-criteria decision making methods have been proposed to evaluate and examine the effectiveness of E-learning, there is a lack of study concerning systematic literature review and classification of research in this area. Regarding this, five major databases including ScienceDirect, Emerald, Taylor and Francis, IEEE, and Springer have been selected and a systematic methodology proposed. Consequently, a review of 42 published papers appearing in 33 academic journals and international conferences between 2001 and 2015 have been obtained to achieve a comprehensive review of MCDM application in E-learning. Accordingly, the selected papers have been classified by the year of publication, MCDM techniques, and journals and conferences in which they appeared. In addition, the significant criteria in evaluating E-learning were found. This study supports researchers and practitioners in effectively adopting MCDM techniques regarding E-learning evaluation and provides an insight into its state-of-the-art.

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1. Introduction

E-learning, a term introduced in 1998 by Jay Cross, founder of Internet Time Group, has become extremely popular [125,47,96]. In general, E-learning is an innovative approach in education delivery via electronic information frameworks for enhancing the quality of teaching and learning [153,16,60,10]. Lara et al. [84] expressed that E-learning is the use of Internet by learners in order to learn specific information and content. Whereas, Bhuasiri et al. [10] defined E-learning as utilizing modern Information and Communications Technology (ICT) and computers to deliver data, instructions, and learning contents. E-learning can appear in different forms of designation and use synonymously as web-based learning, online learning, course-learning, virtual classrooms learning, and digital collaboration learning [134,30,141,71,150,70].

Moreover, E-learning brings advantages to world organizations and stakeholders. Based on the previous literature and research, main advantages of E-learning that highly motivate users in efficiently learning contents include: access flexibility, on-demand availability, personalized instruction, timely content delivery, content standardization, increased convenience, accountability, self-pacing, confidence, and interactivity. Further advantages of E-learning lie behind cost reduction, consistent delivery of learning materials, and enhancement of tracking for universities [35,33,121,155,161,75,55,92]. Moreover, further research indicated that E-learning systems decrease costs of classroom equipment, training, printed materials, traveling, and labor [24,142,129,121,152,155,160].

World governments have been emphasizing and investing in E-learning services among social and public education with the purpose of expanding E-learning systems as a new method of effective education. According to Bates [8], E-learning has been supported by governments due to the economic competition, lifelong learning, social equality and accessibility, better education, cost effectiveness, commercializing of education and geographic reasons. The overall European Commission's E-government Action

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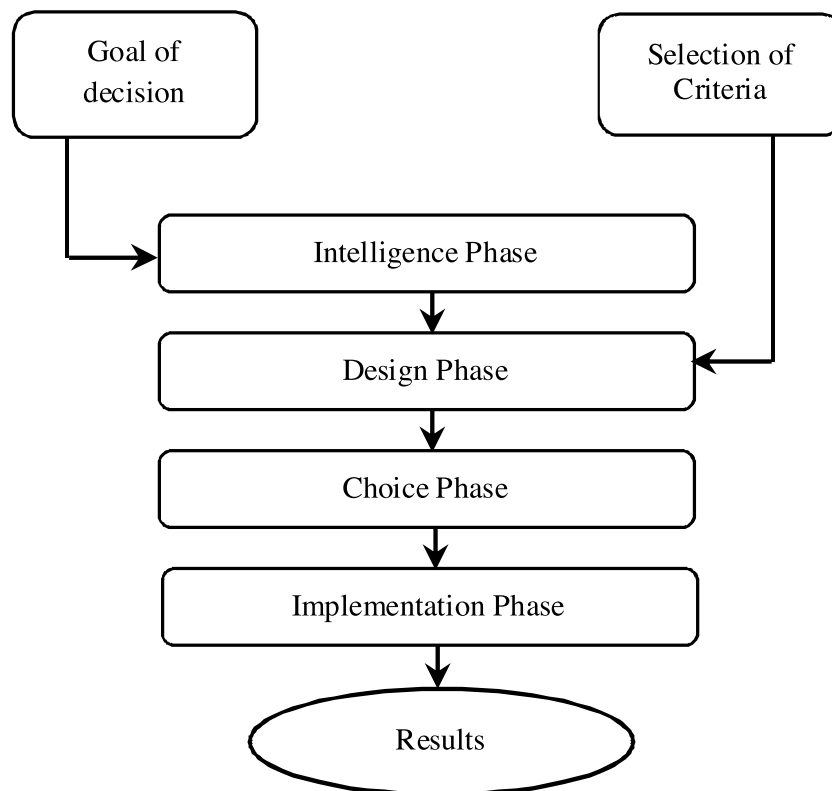
Fig. 1. MCDM main phases.

Plan for the period of 2011–2015 intends to facilitate the transition of administrations to a new generation of E-government services at local, regional, national and European levels [36]. In addition, effective E-learning implementations and quality improvement have been the main challenges in the developing countries [139,76,10,48,136,128,58,12,113,50,6].

Although E-learning has been developing for several years, the evaluation of E-learning is still a crucial task for organizations. The term "evaluation" is referred to as the process by which people judge about value and worth of materials [114]. According to Tzeng et al. [147], the main reason for evaluating E-learning is to understand the effectiveness, efficiency, and appropriateness of a course of action. The evaluation of E-learning enables E-learning managers and decision makers to highlight good or bad actions, identify errors, correct mistakes, detect risks, achieve optimum investment, and consequently it allows individuals to learn efficiently [119]. Over the last years, a considerable number of studies using different kinds of evaluation methods have been conducted in order to evaluate E-learning by examining related influencing criteria. [102,22,94,103,106,31,148,100].

During the evaluation of E-learning, criteria show multiple and sometimes conflicted attributes. Moreover, the criteria evaluation becomes much more accurate if the opinions of experts and managers are considered. This type of evaluation assists to find the most influential criteria in respective areas [146,32,79,77,78]. An alternative to that is Multi-Criteria Decision Making (MCDM) which is an efficient approach for evaluating multiple criteria. MCDM supports experts and managers to balance and weight various factors in order to simplify and clarify decisions for managers [65,37]. Hence, the MCDM approach has been recently considered an appropriate and effective method for evaluating E-learning. Over the last decade, many researchers have adopted different MCDM methods to determine and prioritize different aspects of E-learning [63,51,81,10,5,91,89,162,147].

However, further research is required for E-learning evaluation using MCDM techniques, since E-learning is still broad and the application of MCDM in this domain is less mature compared to its usage in other research areas. Therefore, existing papers on E-learning which applied MCDM methods need to be reviewed in order to provide an outlook towards the next generation of E-learning. In this research, we reviewed and classified academic journal and international conference papers which used MCDM techniques in E-learning evaluation published between 2001 and 2015. The purpose of this literature review is to provide an overview about the application of MCDM methods in E-learning.

The reminder part of this manuscript is divided into the following sections: an introduction of MCDM and its specific methods is presented in Section 2. The research methodology used in this study is explained in Section 3. Sections 4 and 5 focus on summarizing the previous related works and finding the significant factors respectively. In Section 6, based on different indices, selected papers are classified and presented. Finally, discussions, conclusions, and future works are presented in Sections 7 and 8, respectively.

We hope that this research will accentuate the importance of MCDM application in E-learning and provide researchers and practitioners with insight into state-of-the-art in E-learning evaluation.

2. Multi-criteria decision making

MCDM is a collection of methodologies to compare, select, or rank multiple alternatives that typically involve incommensurate attributes [61,82,85]. MCDM approach deals mainly with different classes of decision problems such as classification, sorting, and ranking to support experts and decision makers in finding consistent and robust solutions for multi-criteria problems [140,68,108]. MCDM is one of the decision methodologies that has been extensively used in complex areas like science and industry, in which