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A social profile-based e-learning model

Research Paper

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ABSTRACT

Many High Education Institutions (HEIs) have migrated to blended or complete online learning to cater for less interruption with learning. As such, there is a growing demand for personalized e-learning to accommodate the diversity of students' needs. Personalization can be achieved using recommendation systems powered by artificial intelligence. Although using student data to personalize learning is not a new concept, collecting and identifying appropriate data is necessary to determine the best recommendations for students. By reviewing the existing data collection capabilities of the e-learning platforms deployed by public universities in South Africa, we were able to establish the readiness of such systems in creating effective personalized learning paths. Results revealed limitations that prevent students from benefiting from effective personalized learning paths. This research applies Design Science Research Methodology (DSRM) to propose a new model that leverages further insight provided by students' social data to enhance personalized learning paths.

Keywords

E-learning, Personalized Learning Paths, Recommendation Systems

INTRODUCTION

During the lockdown phase of the Coronavirus (COVID-19) pandemic, many High Education Institutions (HEIs) migrated to blended or complete online learning (Bank, 2023). This has grown a need to provide equitable access to learning in a virtual environment to ensure no student is left behind. Therefore, personalized e-learning systems have become more relevant to cater to students' diversity (Education, 2020). This has also increased interest in research on enhancing e-learning systems by applying recommendation techniques (Klasnj, et al., 2017; Syed, et al., 2017; Zhong, et al., 2019).

The research aims to implement an e-learning model that enhances the personalization of existing e-learning systems using students' social profile data. The proposed e-learning model uses recommendation techniques to make accurate, relevant, adaptive student recommendations. The scope of this study is limited to e-learning platforms currently employed at public universities in South Africa. This research contributes to the Computer Science body of knowledge by suggesting a new e-learning model which applies artificial intelligence-powered recommendation systems on students' social profile data.

This paper is structured as follows: First, it describes the research methodology applied to this paper, followed by the problem identification and motivation. Then a discussion of the objectives of the solution. After that, an outline of the planned approach to design & development, demonstration and evaluation of the artefacts for the research. then, it ends with a conclusion.

METHODOLOGY

This research follows the Design Science Research Methodology (DSRM). DSRM helps to build a new theory through a system of principles, practices and procedures applied to the Computer Science branch of knowledge (Patel & Patel, 2019). DSRM is a methodology that seeks to improve human knowledge through innovative artefacts that use technology and science to solve problems and enhance environments (Brocke, et al., 2020). This makes DSRM an ideal methodology because it serves the aim of this research study in developing a new model to enhance existing personalized e-learning platforms. Following Geerts' (2011) design, the research process will consist of six activities: problem identification and motivation, the definition of objectives for a solution, design and development, demonstration, evaluation, and communication.

Design science helps the researcher identify the most suitable and practical solutions following observing problems related to the attainment of goals or the functioning of systems (Geerts, 2011). This methodology will assist in proving the relevance of this study to meet real-world needs and provide a rigorous guide to additions to the knowledge base (Peffers, et al., 2006).

Design science attempts to create solutions that serve human purposes (Geerts, 2011). The full research study will produce an artefact created to address the problem, providing a workable solution to an unsolved problem and evaluating the proposed solution's utility, quality, effectiveness and efficiency. The research should represent a verifiable contribution and rigour evaluation. On this paper we discuss the processes to produce the artefact, planned development and design, for future papers these activities will be discussed in details. The following section discusses the DSRM activities as applied to this paper.

PROBLEM IDENTIFICATION AND MOTIVATION

To identify the problem, the author(s) reviewed relevant literature to understand the current e-learning platforms used at public universities in South Africa. The literature review focuses on the state of the current knowledge regarding the challenges faced in e-learning systems. The outcome of the literature review assisted in establishing the value of the proposed solution and in the conceptualisation of the problem in terms of complexity and justifying the value and importance of the solution. The conclusion reached is based on evidence and reasons that led to the objectives of the proposed solution. At this research stage, the author(s) identified that the COVID-19 pandemic significantly increased the reliance on e-learning platforms, which saw most HEIs investing heavily in their e-learning platforms (Asamoah, 2020). There are twenty-six public universities in South Africa (USAF, 2023), all of which use e-learning platforms. The e-learning platforms used are Moodle, Blackboard, Sakai, Brightspace and Canvas.

Though all these universities have e-learning platforms, underlying challenges continue to restrict their effectiveness. Challenges such as high dropout among students, diversity in assessment (Sun, et al., 2008), teaching culture (Medeiros, et al., 2019), time management, diverse learning styles and different backgrounds (Islam, et al., 2015). These are challenges that are not yet solved by the existing e-learning platforms. Furthermore, social factors such as people's behavior, beliefs, motivations, interest, perceptions or eagerness influence the adaptation of e-learning platforms (Setati & Paledi, 2019). Thus, the effectiveness of e-learning platforms is questionable as they are designed as one-size-fits-all learning tools. Yang et al., (2019) suggest that the future of education is in reforming from one-size-fits-all education to personalized learning, which adaptive learning can achieve.

Findings from the literature review strengthen the motivation for personalizing e-learning platforms using students' social profile data. The researchers have remarked that the e-learning platforms must analyze richer student data to generate more meaningful adaptive learning and teaching. While there is some form of personalization on these e-learning platforms, some lag behind others. The review of the five e-learning systems has also highlighted a recurring theme that how any adaptive learning is designed can lead to students' confusion and frustration (Liu & Matthews, 2012). Design must consider that adaptive learning is the personalization of learning according to the student's unique combination of attitude, browsing behavior, motivation, performance, learning styles, background or preferences (Chen, 2008; Palanivel & Kuppaswami, 2014). Thus the success of any personalized e-learning system heavily relies on its ability to adapt and adjust as students' needs change (Bunting, et al., 2021).

The literature review also highlighted a gap in personalized learning paths on these five e-learning systems as none fully met the design principles of adaptive e-learning models as defined by Kabudi (2021), which emphasizes the importance of including adequate information about students and depth of knowledge of student's social data. In most cases, the e-learning systems focus on the data derived from the course content, delivery and structure. The literature review also remarked that no research focuses on the data derived from the social profile of the students and how that data can be used to support students' specific needs better and improve critical thinking. This suggests that the data collected within the e-learning systems alone is insufficient for informed learning and teaching.

DEFINITION OF THE OBJECTIVES FOR A SOLUTION

This activity defines what the artefact will accomplish due to the identified problem. A literature review of emerging recommendation techniques is done to determine a solution. The findings result in a theory base that informs the architecture of the proposed solution to define and know what is feasible.

Personalization can be achieved using recommendation systems powered by artificial intelligence. As used for online streaming, social media or e-commerce, recommendation systems are tailored to suggest information to users based on their profiles, personal interest, or preferences. There is a global growth in the improvement of e-learning platforms with personalized recommendation using recommendation systems (Mohamed, et al., 2019). Recommendation technology plays a significant role in e-learning as e-learning platforms need to adapt to specific needs of learners with relevant resources (Zhong, et al., 2019; Tarus, et al., 2017).

E-learning platforms can be personalized using learning paths. A learning path is a set of learning activities a student needs to perform to achieve knowledge (Caputi & Garrido, 2015). It is essential for meeting each student's behavioral approach to learning (Sun, et al., 2008). Learning paths can be used to analyze students' behavior patterns within an e-learning environment and classify students into specific categories to support their needs better (Joseph, et al., 2022), thus providing a feedback mechanism for lecturers to revise their approach as necessary. E-learning platforms that generate personalized learning paths for students would elevate universities to be able to accommodate students from diverse backgrounds. These may be from computer-illiterate students to students acquainted with programming skills.

Other researchers propose the inclusion of additional student background information, such as demographics, self-study activities, previous training experience, and learning demand when formulating personalized learning paths (Bessadok, et al., 2021; Yamani, et al., 2022; Liu & Matthews, 2012). Effective personalized learning paths will require access to varied student data that looks at the student at a micro level and all other levels.

This research recommends learning paths for students using their social profile data. The recommendations will be computed using recommendation techniques that provide accurate, relevant and adaptive recommendations. This proposed e-learning model should not be limited to a specific type of e-learning platform but should be reusable to any other e-learning platform.

DESIGN AND DEVELOPMENT

Based on the objectives of the solution, a prototype will be implemented to enhance e-learning platforms. The prototype will pay specific attention to students' social profiles and the LMSs identified. This activity includes the development of the artefact for the proposed model and producing new knowledge, which leads to a demonstration. This will also have an iterative search process based on the evaluation feedback of this activity. At this research stage, we evaluate the ease of use, robustness and fidelity to the natural world phenomena (Brocke, et al., 2020). This will determine the artefact's desired functionality and architecture. The full evaluation of this activity is not part of this paper's scope. To complete this activity, we require knowledge of the theory that can be used to produce a solution.

DEMONSTRATION

The plan follows the Brocke, et al. (2020) methodology to implement a prototype that demonstrates a recommendation-based model to address the objectives mentioned earlier. The demonstration will show that when the social-profile-based e-learning model is implemented in existing e-learning platforms, it will present accurate recommendations relevant to students' needs. Adequate knowledge of how to use the artefact is required, deduced from design and development activity.

EVALUATION

For this activity, we will search for an evaluation technique using a literature review of existing evaluation techniques for recommendation based models to evaluate the research. The metrics(which will be addressed in future works) will compare the demonstrated results with the objectives of the solution. The metrics will also assess that the recommendations on the e-learning system are accurate and improve the quality of the recommendation list. The metrics analysis of the knowledge produced by the artefact leads to an observation of the effectiveness and efficiency of the solution to the problem. This activity requires knowledge of relevant metrics and evaluation techniques; thus, we'll define the form of the evaluation that provides appropriate empirical evidence and logical proof (comparison, literature survey). A decision will be made to either iterate back to the design if the results don't solve the defined problem or proceed to the next activity (communication). We may conclude to leave the research here for further improvements in future. The conclusion to this activity forms part of the last activity for DSRM, which is to communicate disciplinary knowledge.

CONCLUSION

This paper discusses how DSRM will be applied to produce a social-profile based e-learning model. The activities of the DSRM guides the authors to identify the problem by examining the current state of e-learning platforms used at public universities in South Africa. The review reveals a gap in the design of personalization of learning paths because the data collected within these e-learning environments is insufficient. The problem identify leads to a proposed solution of a social-profile based e-learning model which will further be discussed as future works. The research will produce a new e-learning model that uses recommendation systems to personalize learning paths using students' social data. When the research is complete, an e-learning prototype will be used to demonstrate the proposed model.

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