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(RESEARCH ARTICLE)

Classifying relevant video tutorials for the school's learning management system using support vector machine algorithm

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Abstract

Today many schools, universities and institutions recognize the necessity and importance of using Learning Management Systems (LMS) as part of their educational services. This research work has applied LMS in the teaching and learning process of Bulacan State University (BulSU) Graduate School (GS) Program that enhances the face-to-face instruction with online components. The researchers uses an LMS that provides educators a platform that can motivate and engage students to new educational environment through manage online classes. The LMS allows educators to distribute information, manage learning materials, assignments, quizzes, and communications. Aside from the basic functions of the LMS, the researchers uses Machine Learning (ML) Algorithms applying Support Vector Machine (SVM) that will classify and identify the best related videos per topic. SVM is a supervised machine learning algorithm that analyzes data for classification and regression analysis by Maity [1]. The results of this study showed that integration of video tutorials in LMS can significantly contribute knowledge and skills in the learning process of the students.

Keywords: Learning Management Systems (LMS); Machine Learning (ML) Algorithms; Support Vector Machine (SVM); Video Tutorials; Classification; Regression Analysis

1. Introduction

The management and operations of educational activities in academic institutions were revolutionized because of rapid development of Information and Communications Technology (ICT). Introduction of ICT different methodologies in the learning environment became one of the most significant factors in the teaching and learning process as part of the educational system today. Application of information technology tools in classroom learning and methodology for teaching, helps to improve the quality of education in schools, universities and institutions. One of the greatest contributions of Information and Communications Technology is the birth of the Internet. The Internet is now becoming a vital channel of information for many people because of its speed and efficiency in delivering information especially in the field of education. The Internet has made online learning possible and many educators and school administrators are interested in online learning educational environment in enhancing and improving the student learning outcomes, particularly in higher education institution by Castro and Tumibay [2]. Learning management system (LMS) has become popular because of its potential in providing more flexible access to content and instruction at any time, from any place.

Today, higher education institutions face many challenges, including the increasing number of students in their education. LMS can be useful for adjusting increased enrollment, varying lessons, and supporting student learning by Dobre [3]. The adoption of LMS is a notable phenomenon in higher education institutions. According to an Educause Center for Analysis and Research (ECAR) survey, 85% of faculty use an LMS, with 56% using it on a daily basis, and 83% of students use an LMS, with 56% using it in most or all courses by Berking and Gallagher [4].

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Higher education institutions benefit from using an LMS in the following ways: (a) instructor and student access to learning content anytime and anywhere, (b) a centralized source of learning, (c) tracking and reporting tools to enhance student learning and performance, (d) increased efficiency in student activities such as assignment submission, (e) increased communication, and (f) learning analytics by Brown, Dehoney and Millichap [5]. Today, teaching and learning comes in different methods. Integration of online video tutorials in learning management system will be one of the new learning method that can improve the student's competencies and capabilities. Online video tutorials is becoming more prominent in the world of education. Videos in education make it possible to overcome practical real-world constraints and explore far greater possibilities provided by digital space. It can promote student-centered learning within the classroom and home. Videos can be integrated in online learning management system and can be combined with other services using machine learning algorithms. The combination of video with other learning services has great potential to provide the students an integrated online learning space. The use of video for learning has become widely employed in the past years. Many school, universities and digital libraries have incorporated video into their instructional materials by Giannakos, Chiorianopoulos, Ronchetti, Szeadi and Teasley [6].

Online video tutorials offer several benefits. The video tutorials can provide assistance and can be viewed on a student's own time at any hour of the day. The video tutorials can be viewed as many times as necessary, until the students understand the lessons. There are some students who can easily understand a lesson when they read the materials and taking time to digest it. While others may learn better through video tutorials or interactive instructional materials. These methods can all be taught simultaneously through the use of online learning management system. This may be particularly helpful for students who wish to learn independently and those students who are married already, have children, involved in part time or full time jobs and other responsibilities to meet the needs in their lives.

Bulacan State University (BulSU) is one of the biggest educational institutions in Region III. The University is committed to provide education that is accessible to all deserving and qualified students and promote relevant and quality education that is internationally recognized and industry responsive programs set in a 21st century learning environment. Like other academic institutions, BulSU is also offering a Graduate School (GS) that provides thirty five (35) programs including Master of Science in Information Technology (MSIT). GS is considered as one of the leading unit of BulSU in terms of its population. According to the BulSU-MIS department, the GS currently has 2,202 enrolled students with 68 adjunct faculty members and 28 part-time faculty members. The GS was established in the year 1977. With its humble beginnings, GS reached its status now as one of the largest and excellent unit in the university through the cooperation of the administration, its faculty members and students. The GS envision itself not only on excellence in producing globally competitive graduates, but also to ensure that they are ready to respond to the changing needs of the society.

In order to accomplish this vision, the researchers conducted a study entitled "Integrate related Video Tutorials into the School's LMS using Machine Learning Algorithms" to support the teaching and learning process of the BulSU Graduate School since the researchers are also a faculty member of the Graduate School Program. The researchers believe that the Internet can provide an effective, efficient and reliable source that the educators and the students could look up from time to time.

2. Related Work

Abeer and Elaraby [7], conducted a similar research study that mainly focuses on generating classification rules and predicting students' performance in selected course program based on previously recorded students' behavior and activities. The researchers processed and analyzed the previously enrolled students' data in a specific course program across 6 years (2005–10), with multiple attributes collected from the university database. As a result, this study was able to predict, to a certain extent, the students' final grades in the selected course program, as well as, "help the student's to improve the student's performance, to identify those students which needed special attention to reduce failing ration and taking appropriate action at right time".

Huang and Fang [8], performed a study that used machine learning techniques to predict student academic performance in engineering courses. In this study, the input features included course grades from all semesters and the output variable was exam scores. The researchers observed that SVMs are suitable for predicting an individual student's performance and that multi-linear regression is suitable for forecasting the performance of all students in a course.

Acharya and Sinha [9] forecast students' performances using machine learning techniques (C4.5, sequential minimal optimization (SMO), Naive bayes, 1-NN (1-Nearest Neighborhood), and MLP (multi-layer perceptron) with input features (gender, income, board marks and attendance). They applied correlation-based feature selection (CBFS)

techniques to improve the model performances and determined that SMO achieves a higher effective average testing accuracy (66%) than using other methods.

Marbouti, Diefes and Madhavan [10], used logistic regression, support vector machines (SVMs), decision trees (DTs), ANNs and Naive bayes classifier (NBC) to identify at-risk students in advance of the next course. This study used input features, such as grades, attendance, quizzes, weekly homework, team participation, project milestones, mathematical modeling activity tasks, and exams from an offline course. Analysis of the results found that the NBC algorithm provide satisfactory accuracy (85%).

Liu and d'Aquin [11], used a supervised learning algorithm to predict student's performance. They investigated how demographic variables and online learning activities affect student's performance. Furthermore, they used the k-prototypes clustering algorithm to find the group of weak students who needed additional help from the teacher. They concluded that the successful groups of students mostly came from privilege and most of these students complete their higher education.

Fukkink, Trienekens, and Kramer [12], specifically investigated the integration of video feedback into education instruction and training. The study aimed at evaluating the influence of using video feedback in professional instruction and training through workshops and training sessions. The study indicated significant effect on student interaction, networking and engagement skills as they completed the training assignments and video lectures. The study randomly assigned video and traditional learning methods to different groups and utilized questionnaire and surveys to collect and analyze results. It was found that video feedback is effective, to a strong statistical margin, for improving professionals' interaction skills.

Grunewald, Yang, Mazandarani, Bauer and Meinel [13], discussed about, automatic video indexing and video search in huge lecture video storage. To offer visual guidelines segmentation of video and key frame detection technique is used. In this keyword extraction is used. Video retrieval and video search systems such as Google, YouTube, and Bing etc. reply on available textual metadata like, title, genre, person, and brief description etc. Generally, this kind of metadata has to be created by a human to ensure a high quality. OCR and ASR algorithm are applied to OCR text lines that are adopted in the subsequent keyword extraction process, by which both video-and segment-level. It captures every knowledge change between adjacent frames as well as it also captures real slide transitions.

3. Methods

This study utilized descriptive method of research and focused on the students and educators who will be using this system. According to Bhat [14], "Descriptive research is defined as a research method that describes the characteristics of the population or phenomenon that is being studied. This methodology focuses more on the "what" of the research subject rather than the "why" of the research subject." Descriptive research aims to explain current issues or ongoing problems through process of data collection that will enable them to describe the situation more completely. Also developmental research has been employed in this study because according to Richey, Klein and Nelson [15], it is a study of designing, developing and evaluating instructional programs, processes and products that must meet criteria of internal consistency and effectiveness of the system that are evaluated accordingly.

4. Study Design

The figure below is the conceptual framework of the study which presents the process of the system development. The study was presented using the three dimensions of conceptual paradigm: the input, process and output. The first frame is the Input stage that involved the gathered information from BulSU Graduate School, the user requirements, the user information and the system contents in order to develop the system. System development requirements were also considered that include the hardware requirements and software requirements. Books, selected theories, related literature, related studies, internet articles and online researches were also reviewed. The second frame is the Process stage. In this study, the researchers was adopted the Fayyad knowledge discovery process model (KDD) analysis. Data gathering, distribution of survey questionnaire and interview guide, analysis and interpretation of the result are also part of the process stage for the completion of the research. Lastly, for the Output stage, this were the developed system, "Integrate Related Video Tutorials into a School's LMS using Machine Learning Algorithms".

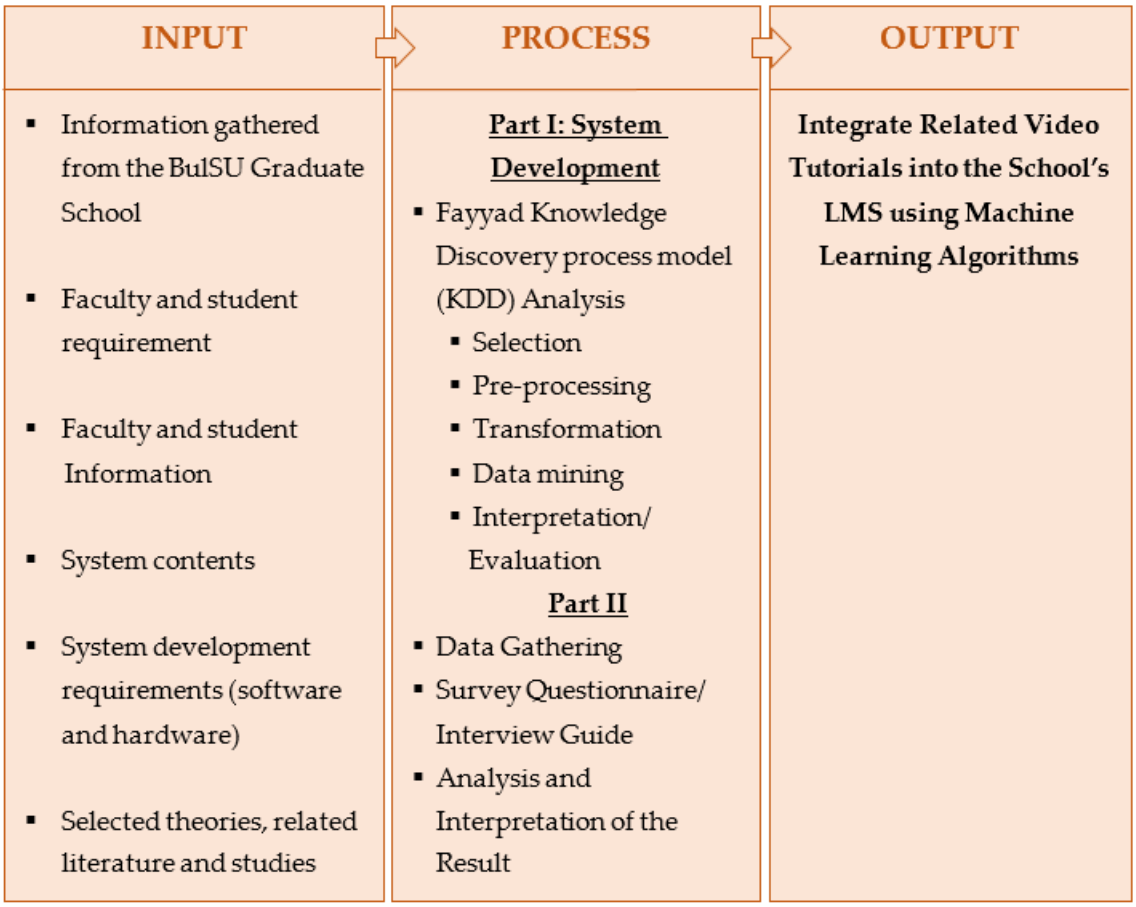

Figure 1 Conceptual Process of the Developed System

For the system development, the researchers used Fayyad knowledge discovery process model (KDD) which involves identifying a valid, potentially useful structure in data. The KDD is the process of making low-level data into high-level knowledge. It is an iterative or cyclic process that involves the process steps of Selection, Pre-processing, Transformation, Data mining and Interpretation/Evaluation by Fayyad, Piatetsky-Shapiro, Smith, and Uthurusamy [16].

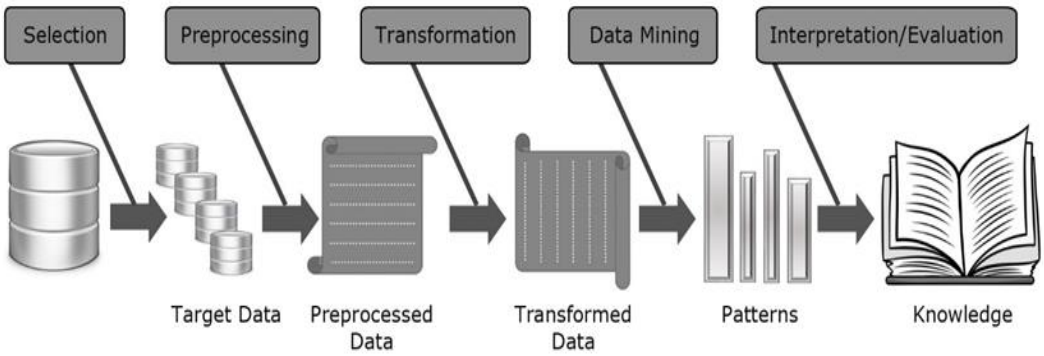

Figure 2 Stages of Knowledge Discovery Process

In this study, the researchers apply support vector machine (SVM) algorithm that can classify the video tutorials according to the inputted parameters. The system provides flexible and efficient searching methodology for students. This searching is based on classification of various elements of the developed system such as, keywords, annotations, links, resources, video title, and time. In Selection step, it retrieve the data which is relevant to the analysis task. Selection and integration of the target data from possibly many different and heterogeneous sources. The target dataset which is created in this selection will undergo analysis as data in the real world is incomplete, noisy and inconsistent. Like when the student start searching the video tutorials for a specific topic, it starts by extracting the relevant keywords like title,

description, reviews, and length of the video. In Pre-processing step, the dataset which is inputted during the selection step will be pre-processed to handle databases which are highly susceptible to noisy and inconsistent data due to huge size, complexity and their likely origin from multiple heterogeneous sources. Data preprocessing select relevant data with respect to the data mining task in hand. Through SVM algorithm students are able to search videos according to the different parameters. When students wish to search videos depending or specifying such type of parameters then the SVM algorithm will classify the videos from large set of videos that are correlated with search parameter. Data integration task integrate multiple databases, files and others. Transformation step transform data into forms appropriate for mining by performing smoothing, generalization, normalization, aggregation, discretization and feature construction operations. Data mining involves choosing the data mining task and use the data mining algorithms to generate patterns. At this stage, SVM algorithm will generate the recommended video list for the search topic. In interpretation/ evaluation step, the mined patterns and models will be interpreted. The best related video list at this point is the result of data mining process. Evaluation of the results of data mining will be done in statistical validation and significance testing.

4.1. System Architecture

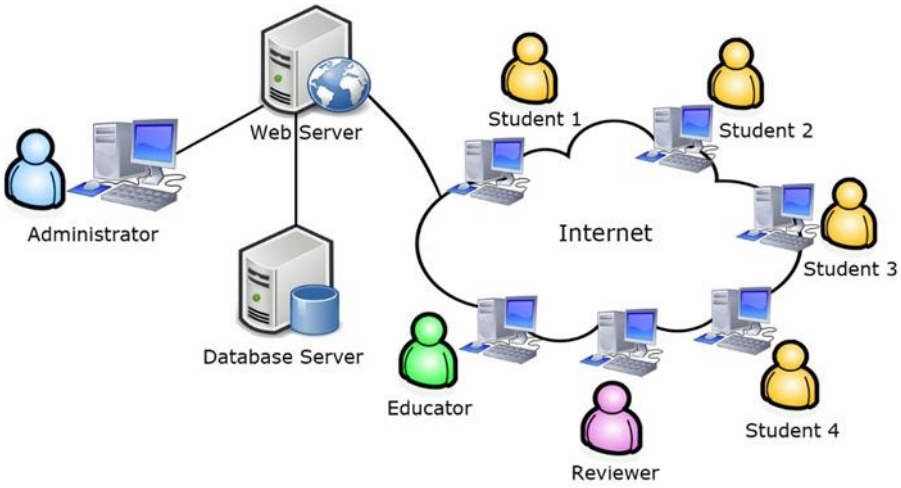

Figure 3 Diagram of Learning Management System (LMS)

This figure shows the process of learning management system (LMS). The main purpose of the LMS is to provide the formal learning for registered students where they can access the different course materials, documents, presentations and videos over the internet. The LMS served as a virtual classroom that can enable interactions between students and the classroom, student-student peer interactions, student-educator interactions and reviewer interaction. The LMS provides core services that support the four key principles of online learning best practices namely; presentation of learning objects, facilitating interactions, collaborative learning, and providing prompt feedback. The administrator of the LMS is responsible for the system management, and other management functions among educators, reviewers and students for the whole system. The educator is responsible for creating courseware into the system for the student. A student is responsible for managing assignments and tests while reviewer is responsible to check and validate the different video tutorials search by the students.

4.2. Design of User Functional Role

Figure 4 shows the design according to the user interface based on the functions of each user. These are divided into four (4) categories namely, administrator, educator, reviewer and student. The detail of the design is shown below.

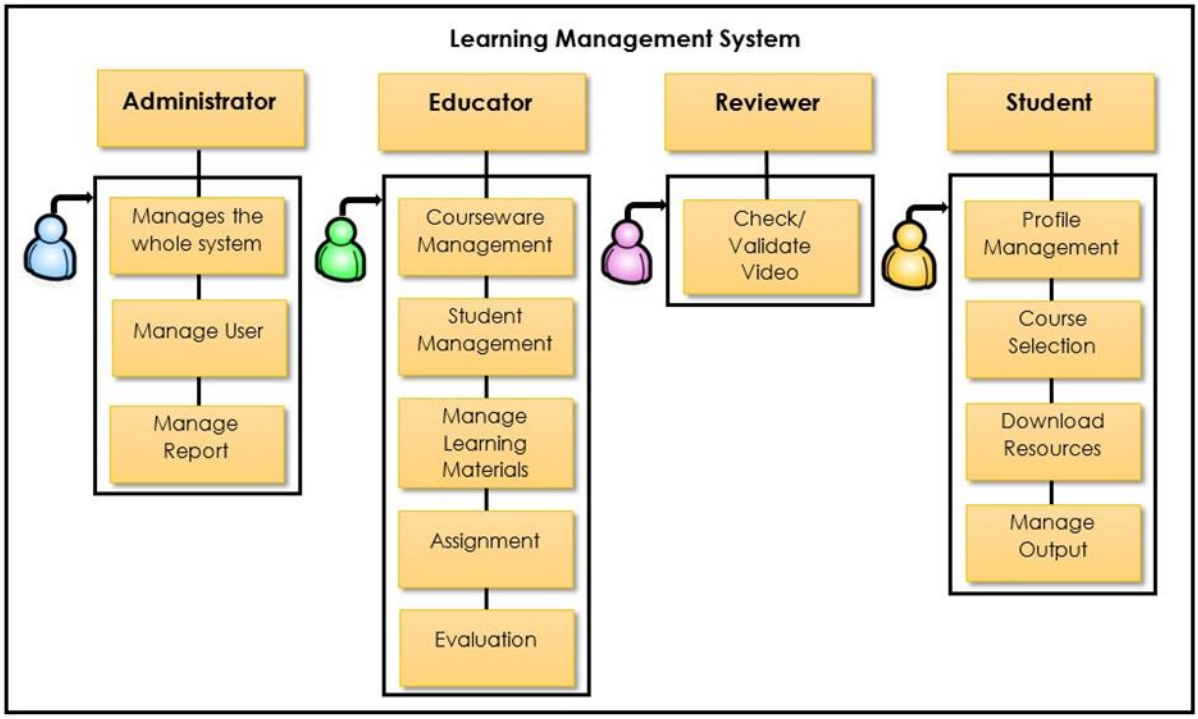

Figure 4 Structure of the Developed System

The developed system were divided into four primary users. The administrator is the one who are responsible to manages the whole system, manage the different users like educator, reviewer and student. While, most of the contents (learning materials) of the website were come from the educators. The educator is the one who are responsible to the courseware management, student management, giving assignment & evaluation to the student. Likewise, all these contents were consumed by the students. Aside from that, profile management, course selection, manage download resources and manage output are the responsibility of the student. While the role of the reviewer is to check and validate all the recommended list of the search video before it will be uploaded to the LMS. Additionally, there are collaboration and feedback modules that will allow the educators and students to exchange ideas/feedbacks continuously.

5. Study Participants

The primary respondents of the study are the Dean of the Graduate School, the College Secretary, Faculty Members, Students of the MSIT Graduate School program who are officially enrolled in MS 601 (Advanced Database System), MS 602 (Advanced Operating System and Networking), IT 606 (Advanced Software Development), IT 609 (Client Server Application Design), IT 610 (Strategic E-Business) and IT 615 (Advanced Computer Techniques) and IT experts and programmers. They were requested to answer the survey questionnaire to evaluate the developed system. Total number of respondents and evaluators are presented in Table 1.

Table 1 Respondents and Evaluators of the Study

	Frequency (N)	**Percentage (%)**
Dean, Graduate School	1	2%
College Secretary	1	2%
Faculty Members	10	20%
Students	33	66%
IT Experts and Programmers	5	10%
Total	50	100%

As shown in table 1, the respondents are randomly selected. The Dean of the Graduate School, the College Secretary, ten (10) selected Faculty Members who are handling MSIT program and Computer Education subject, thirty three (33)

Students, and five (5) IT Experts and Programmers. Before gathering and collecting all the needed and required data, the researchers sought the permission to conduct this research study from the Dean of the BulSU Graduate School. With the permission of the Dean and the respondents, the researchers administered the survey questionnaire to the students, faculty members, IT experts and programmers who were asked to assess the acceptability of the developed system. The system evaluation tools were composed of the different items to describe the acceptability of the developed system in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The instrument that was used in this study was adapted and developed based on the ISO 25010 quality standard. It was divided into three (3) sections. Section A, asked about the Evaluator's Profile, Section B about the instruction on Software Evaluation and Section C for the different indicators, it was divided into eight (8) criteria. It was a 5 point Likert scale ranging from excellent (5), very good (4), good (3) fair (2) and poor (1). To ensure the reliability and validity of the data that were gathered, the researchers clarified questions or inquiries of the respondents regarding the instrument. To ensure the welfare of the respondents, the researchers strictly observed the ethical standards in conducting the research and the accomplished survey questionnaires were collected and compiled for summary tabulation, interpretation and analysis.

6. Statistical Analysis of Data

Analysis and interpretation of data, the following statistical tools were utilized: (1) frequency and percentage distribution in identifying the classification of the respondents; and (2) weighted mean in determining the level of the system's acceptability concerning the different system criteria. To facilitate the interpretation of the weight mean score of the responses, the upper and the lower limit of scale was adopted using 5-point Likert Scale as shown below:

Numerical Rating	Descriptive Interpretation
4.51 – 5.00	Strongly Agree
3.51 – 4.50	Agree
2.51 – 3.50	Moderately Agree
1.51 – 2.50	Disagree
1.00 – 1.50	Strongly Disagree

7. Results

The result of the evaluation of the developed system from the BulSU administrator, faculty members, students, IT experts and programmers with regards to ISO 25010 criterion of functional suitability, performance efficiency, usability, reliability, security, maintainability, compatibility and portability got an overall mean score of 4.89. The result indicate that the level of acceptability, all of the mentioned criteria interpreted as "Strongly Agree" by the respondents during the system evaluation.

Table 2 Summary Table for the Level of Acceptability of the Developed System

Software Criteria	Computed Mean	Descriptive Interpretation
Functionality Suitability	4.88	Strongly Agree
Performance Efficiency	4.87	Strongly Agree
Compatibility	4.89	Strongly Agree
Usability	4.90	Strongly Agree
Reliability	4.89	Strongly Agree
Security	4.88	Strongly Agree
Maintainability	4.89	Strongly Agree
Portability	4.92	Strongly Agree
Overall Mean	4.89	Strongly Agree

4.51 – 5.00 Strongly Agree; 3.51 – 4.50 Agree; 2.51 – 3.50 Moderately Agree; 1.51 – 2.50 Disagree; 1.00 – 1.50 Strongly Disagree

8. Conclusion

By blending ICT with face-to-face traditional pedagogy, the quality of teaching and the level of students' achievement can be improved. LMS platform is indeed, a great tool that can enables the educators to organize, manage and deliver learning materials to their students by Kampa and Kaushik [17]. Through its features, LMS platform can makes the teaching and learning process more comfortable and convenient. Further, other features of the LMS can help the students to develop more their critical thinking skills and problem solving, communication, collaboration, and creativity. The results of this study showed that integration of video tutorials search tool in LMS can significantly contribute knowledge and skills in the learning process of the students.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflicts of interest regarding the publication of this paper.

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