Educational Data Mining-Based Decision Support System

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Doctor of Philosophy
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APPROVAL SHEET

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DEDICATION

To my loving Mum

Eulalia

My sisters

Catherine, Jane, Christine and Jaicelle

My wife *Johanna* and kids

Sean, Yuna, Sophia, Yuan and Liam

This humble work is

Heartily dedicated

To all of you.

-Robert

ABSTRACT

Higher Education Institutions (HEIs) are overwhelmed with huge amounts of information with regard to student's enrolment, number of completed courses, course achievement, performance indicators, and other data. This has led to an increasingly complex analysis process of the growing volume of data and to the incapability to take decisions regarding the curricula reform and reconstructing. To address the problems above the study developed a decision-support system, a workable system that could be manipulated to produce designed data. This study utilized developmental research design sign it involved software development. This designed is suited to the research at hand because it developed an educational data mining-based decision support system based on the educational data requirements as to curriculum programs, subject offered in the curriculum, faculty handling the subjects, academic program schedule, and schedule. It was followed by analyses, development of the system and evaluation of the system. The educational data requirements for the developed decision-support system as to curriculum programs are the students' list per course or subject, students' grade, top 10 class standing, class program, teacher's program and schedules. For the subjects offered in the curriculum, the data required are the units, teachers, and numbers of students. The data available in Higher Education Institutions helped in a decision making especially if these data are utilized. The developed Educational Data Mining-Based Decision Support System are capable of providing decisions to teachers and administrators especially on the students' performance. This study recommends to validate the system to other schools. The data input is one of the contributory elements

that affects the equality attribute of the Educational Data Mining-Based Decision-Making Support System, thus it is a necessary requirement that should be complied in the future.

TABLE OF CONTENTS

Chapter 1

THE PROBLEM AND ITS SETTING

Introduction

Education always plays an important role in building up every country around the world. Education enhances productivity and creativity, and promotes entrepreneurship and technological advances to people. In addition, it plays an important role in securing economic and social progress as it improves income distribution (Akbari, 2016).

In fact, most of the institutions and agencies which after for economic and social development requires a certain level of education for their employees to more eligible and professional sound. A college education provides opportunity to people to contribute to the institutions or agencies they work with and be financially and morally dependent to attain their personal goals in life (OECD, 2017). The main objective of higher education institutions is to provide quality education to its students relative to the ever-changing demand of industries. Therefore, it is the mission of colleges and universities to put students in a place in the society based on their personal and professional attributes (Akareem & Hossain, 2016).

With the aim of achieving quality education, educational institutions are faced with the expectations of parents, students, and the society. To respond to this expectation, state colleges and universities must constantly

make precise academic decision to improve its services for its stakeholders. Precise academic decisions will result in an improved academic performance of students. This enormous task of making appropriate and reasonable decisions falls to the educational managers which usually include the school administrators, academic heads, and faculty members (OECD, 2012).

Thus, colleges and universities need to have extensive analysis capabilities of student achievement in order to make appropriate academic decisions. Assessments on student, department programs, and faculty are important in (1) analyzing and discovering strengths and weaknesses of students and programs; (2) planning and enhancing instruction and curriculum; and (3) evaluating and making decisions about students (Mcdaniel, 2017). They have to gain an insight, assess and evaluate students' academic performance, there is a need to carry out statistical analyses at student, course, program, department, school and university levels. They are operating in a very complex and highly competitive environment; accurate and timely information is of paramount importance for informed decision making (Karim, 2011 & Kaslow, 2021).

Student databases at colleges and universities can be very large, depending on the number of students enrolled. Information is often not available to decision makers or the available data have not been evaluated sufficiently to reveal crucial details. Statistics plays an important role in the

assessment and evaluation of performance in academic environments. Data sitting in databases are of little use unless they are processed, converted and expressed in intelligent ways to present decision-makers with valuable information (Michigan Technology University, 2021).

Making such knowledge-driven decision support is helpful for educational managers to make more appropriate and reasonable decisions about student's study and further give support to students. In tackling these problems, resulting systems can provide educational managers with applicable knowledge from educational data. These also allow the educational managers to discover new, interesting, and valuable information about the students (Vo & Nguyen, 2012).

Educational Data Mining (EDM) contributes to a new research field which gained popularity in the modern educational era because of its potential to improve the quality of the educational institutions' systems (Algami, 2016). During the last decade, this area of research field has grown exponentially, spurred by the fact that it enables all educational stakeholders to discover new, interesting, and useful knowledge about students and potentially improve some aspects of the quality of education. EDM allows educators and researchers to draw conclusions from sophisticated questions. D ata mining can provide answers to more abstract questions like" find the students who will exhibit poor performance (Liñán & Juan Pérez, 2015).

The main functionality of data mining techniques is applying various methods and algorithms in order to discover and extract patterns of stored data. These interesting patterns are presented to the user and may be stored as new knowledge in knowledge base. Data mining and knowledge discovery applications have gotten a rich focus due to its significance in decision making (Chamatkar & Butey, 2014). Data mining (DM) and Decision Support Systems (DSS) are well suited technologies to provide decision support in the higher education environments, by generating and presenting relevant information and knowledge towards quality improvement of education processes and management (Bresfelean, Ghisoiu, Lacurezeanu, & Sitar-Taut, 2009).

It is worth noting that data need to be presented in an understandable form which can be achieved through detailed statistical testing. This study aimed to provide a decision-support platform for academic administrators such that data is made available through the use of standard user interfaces, displays, and graphs presented in a tabular form. This is expected to minimize time and effort needed to analyze pages of data since they are presented in similar forms for similar objectives.

The aim of this study was to design and develop an Educational Data Mining-Based Academic Decision Support System which may help equip academic decision-makers with a tool for organizing information access, enabling easier assessment of academic performance, and explaining

potentially new techniques suitable for the evaluation of main academic decisions.

Statement of the Problem

Higher Education Institutions (HEIs) are overwhelmed with huge amounts of information with regard to student's enrollment, number of completed courses,

course achievement, performance indicators, and other data. This has led to an increasingly complex analysis process of the growing volume of data and to the incapability to take decisions regarding the curricula reform and reconstructing. To address the problems above the study developed a decision-support system, a workable system that could be manipulated to produce designed data, and it specifically answer the following questions:

1. What are the educational data requirements for the development of the decision-support system in terms of the following:

1.1 curriculum programs;

1.2 subjects offered in the curriculum;

1.3 faculty handling the subjects;

1.4 number of offered programs per department, and

1.5 grade?

2. What analyses were done to the students' academic performance per department in terms of:

2.1 curriculum programs;

2.2 students in program/course standing (student program elimination, and

2.3 program subjects per student remarks (passing, failing, and blank)?

3. What decision support system was developed for school administrators to trace students' academic performance?

4. What decision support system design was made to assess the level of effectiveness of the developed educational decision support system with respect to the following:

4.1 speed/time;

4.2 general weighted average;

4.3 tracing of honor students by program, and

4.4 top 10 highest grade attained per subject?

Theoretical Framework

The core principle behind DSS also evolved from theoretical work of Carnegie Institute of Technology on the Theory of Organizational Decision-Making (1970) as cited by River Logic (2021) which recognized that, while human instinct and gut feel often resulted in good decisions, there were several situations where gut-driven decision went wrong. Thus, development of DSS using information systems to analyze organizational

data and produce concise information to support decision-making is emphasized in this theory. Over time, and as computer capabilities improved, this approach was expanded to include the use of sophisticated software that modeled processes, allowing users to evaluate the outcomes of various data predictions.

The development of the output of this study is anchored to the Theory of Decision Support System (DSS) Design for User Calibration of Kasper (1996). The said theory prescribed properties of DSS needed for users to achieve accurate standards. According to this theory requisite components to DSS development must include expressiveness, visibility, and inquirability for user calibration. This theory supports the claim of the study to which it specifically addressed user-familiarity or termed as usability and would express possible results through prediction of data.

Conceptual Framework

This section presents the conceptual process of how the system was developed (Figure 1). It starts with the collection of data through database of the school, and extraction of the necessary information for the development of the system such as grade of the students, handled subjects of the teachers, curricular programs, and the subjects offered per program. With this data, some principles, theories and concepts were applied as determined in the

objectives of the study which is to come up with a decision support system through data mining.

Part of the theories applied is by the use of data set cleaning procedure principle to detect and correct or remove corrupt or inaccurate records from a record set, table, or database. This is followed by identifying incomplete, incorrect, inaccurate, or irrelevant parts of the data which are replaced, modified, or deleted by queries. Along with the underlying principles and theories of the study, the developed system also adopts a model in system development life cycle for the development procedure.

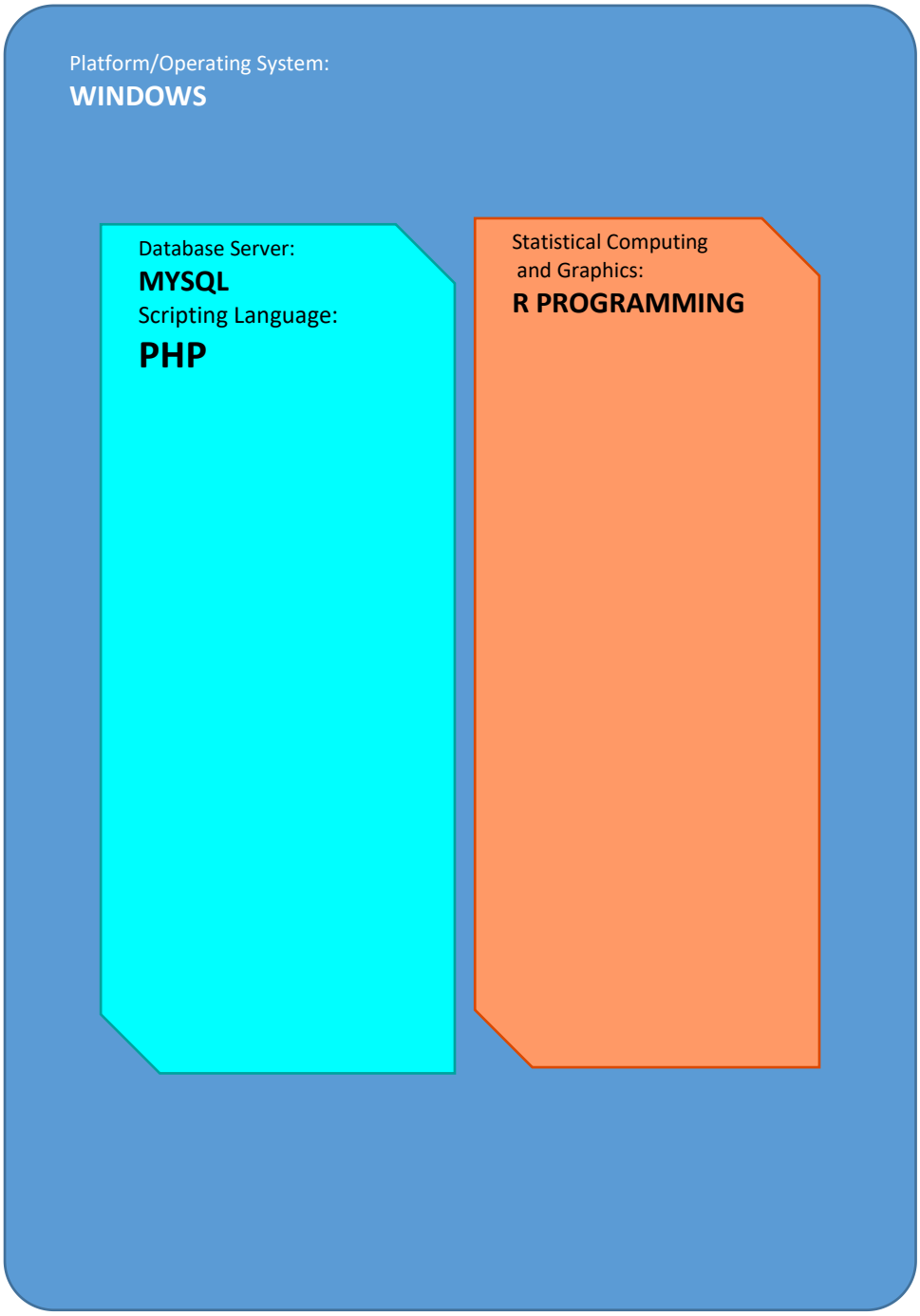


Figure 1. *The Conceptual Framework of the Study*

The model used in this study is the structured system analysis and design method to determine the success of the algorithm implementation through coding and logic programming by a series of prototyping methods. Through this, the system's level of effectiveness was assessed. Moreover, the educational data mining decision support system, as the output of the study, can assess the students' academic performance.

Significance of the Study

This study provides results that are deemed to be of importance to the school administrator, school head, teachers, students, and future researchers.

The Academic Heads and School Administrators. The information that can be extracted from student registration and grades databases is an extremely useful and critically important tool in analyzing student performance which provides understanding of the effects of major academic decisions.

The Faculty. This study is beneficial to faculty members in evaluating students' performance. With the help of the system, it would be easier for the teachers to trace and track student standing in a certain program. Through the system, the faculty would be able to provide transparent ranking because it could be easily generated by the developed system.

The Students. The educational data mining decision support system could help students be aware and be updated about their curricular standing in a particular program. They would be able to determine their General Weighted Average in a specific semester and would be very helpful if a student would be able to attain required GWA for an honor student. Corollary would also help students who have failing grades and help decide to pursue the certain program or transfer to other program suited to their highest grade in a specific semester

The Future Researchers. This study is beneficial to future researchers who plan to delve on studies similar with this study. This could serve as a reference that can provide them necessary inputs in case they opt to work on modifications or updates of this study.

Scope and Delimitation

This study focused on developing a tool that aimed to augment the decision making of school administrators in terms of 1) improving the academic performance of students; 2) providing feedback to support teachers/administrators in decision making about how to improve students' learning; 3) organizing instructional resources more efficiently; and 4) enabling them to take appropriate proactive action.

The system is written in server-side scripting language PHP as the main programming language for program interaction between database

engine with MySQL as the back-end of the system and data-mining engine. R programming is used for statistical computing, graphics, and visualization of data. R programming is also used to build predictive model with Naïve Bayes Algorithm.

Part of the scope is the validation of the developed Educational Data Mining-Based Decision support system in a State University where the data were collected or mined. It was beta-tested during the month of March 2020. The scope of the system validation is based on International Standards Organization (ISO)/International 14 Electrotechnical Commission (IEC) 2510:2011 as to functionality, reliability, 15 usability, efficiency, maintainability, and portability.

Definition of Terms

To provide a better understanding of the paper, the following terms are defined:

Data analytics. Conceptually, this term is defined as the process of analyzing raw data to find trends and answer questions (Lotame, 2019). Operationally, this term is defined as the mathematical computation of the system through its given data.

Database. Conceptually, the term is defined as an organized collection of structured information, or data, typically stored electronically in a computer system, it is usually controlled by a database management

system (Oracle, 2018). Operationally, the term refers to the data sets that the system needs to perform data mining.

Data Mining. Conceptually, this term is defined as the process of discovering patterns in large data sets involving methods at the intersection of machine learning, statistics, and database systems (Unnisabegum, Husaain, & Shaik, 2019). Operationally, this is defined as the extraction of data from the database to have a decision support system.

Decision Support System. Conceptually, this term refers to a set of related computer programs and the data required in assisting analysis and decision-making within an organization (Gitman, McDaniel, Shah, Reece, Koffel, Talsma, & Hyatt, 2018). Operationally, this refers to as the evaluation processed through data analytics by the system.

Decision Tree. Conceptually, it refers to a structure that contains nodes (rectangular boxes) and edges (arrows) and is built in dataset (table of columns representing features/attributes and rows corresponds to records), the nodes are either used to make a decision (Sakkaf, 2020). Same context is used in this study, but it specifically designs and use for educational purposes, it is also called as ID3 algorithm.

Educational Data Mining. Conceptually, this term is defined as a research field concerned with the application of data mining, machine learning, and statistics generated from educational settings (Ray & Saeed,

2018). Operationally, this term refers to the educational tool for deriving a series of data interpretation through decision support system algorithm.

MYSQL. Conceptually, this term is defined as an open-source relational database management system (Moore, 2018). Operationally, this term refers to the repository of the system, wherein the data will be travelling from its front end and back end of the system.

Naïve Bayes Classifier. Conceptually, this term refers to a classification technique based on Bayes' Theorem with an assumption of independence among predictors (Ray, 2017). Operationally, it used in the study to also identified independence predictors as part of the input process of the system development.

Neural network. Conceptually this term is defined as a computer system modeled on the human brain and nervous system (Pagel & Kirshtein, 2017). Similar definition as used in the study.

PHP language. Conceptually, this term is defined as (recursive acronym for PHP: Hypertext Preprocessor) a widely used open source general-purpose scripting language that is especially suited for web development and can be embedded into HTML (Trego, 2017). Operationally, this term is defined as the front end of the system where the user interacts with the system itself.

Prediction. Conceptually, this term refers to a forecast, or a statement about a future event. A prediction is often, but not always, based upon

experience or knowledge (Doring, 2018). Similar context is used for the study.

Prototype paradigm. Conceptually, this term refers to a small scale facsimile of the end product and used for obtaining feedback (Geeks for Geeks, 2020). Operationally, it has similar definition however it is specifically used to develop an educational data mining-based decision support system.

R Programing. Conceptually, this term is defined as a programming language and a free software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing (Hornik, 2017). Same context is used in this study.

Waterfall paradigm. Conceptually, this term refers to a software development process, it emphasizes that a logical progression of steps be taken throughout the software development life cycle (SDLC), much like the cascading steps down an incremental waterfall (Airbrake, 2016). Operationally, it refers the model used in the study in order to develop an educational data mining-based decision support system.

Chapter 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents the related literature and studies after a thorough and in-depth review conducted by researcher. This specifically presents and discusses foreign and local studies, magazines, journals, and some unpublished theses and dissertations that are relevant to the present study.

Related Literature

In the recent years, data mining has attracted a great deal of attention in the information industry and in society as a whole. It has provided wide availability of huge amounts of data which can be turned into useful information and knowledge (Alexander, 2015). The gained information and knowledge can be used for applications which range from market analysis, fraud detection, and customer retention to production control and science exploration (Iberdrola Corporative, 2020).

Data mining can be viewed as a result of the natural evolution of information technology. The database system industry has witnessed an evolutionary path in the development of the following functionalities: data collection and database creation, data management (i.e. data storage and retrieval, and database transaction processing), and advanced data analysis (Bourgeois, 2014).

Moreover, data mining, which is also called Knowledge Discovery in Databases (KDD), is the field of discovering novel and potentially useful information from large amounts of data (Holmes, 2014). Data mining has been applied in a great number of fields, including retail sales, bioinformatics, and counter-terrorism. In the recent years, there has been an increasing interest in the use of data mining to investigate scientific questions within educational research later called educational data mining (EDM), the area of scientific inquiry centered around the development of methods for making discoveries within the unique kinds of data that come from educational settings, and using those methods to better understand students and the settings which they learn in (Baker, 2010).

Whether educational data is taken from students' use of interactive learning environments, computer-supported collaborative learning, or administrative data from schools and universities, it often has multiple levels of meaningful hierarchy, which often need to be determined by properties of the data itself, rather than in advance (Bienkowski & Feng, 2012). In order to achieve the above quality improvement, educational experts need a data mining system that can provide the needed knowledge and insights for the decision makers in the higher educational system (Shymala & Rajagopala, 2006).

Educational data mining could be used for making-decisions especially for the welfare of the school institutions' stakeholders. Issues of time, sequence,

and context also play important roles in the study of educational data. Educational data mining combined with innovative ideas through technology may impact the school arena. This merging of disciplines could be an avenue to develop a Decision Support Systems (Bienkowski, 2012).

Higher education institutions are nucleus of research and future development acting in a competitive environment, with the prerequisite mission to generate, accumulate and share knowledge. The chain of generating knowledge inside and among external organizations (such as companies, other universities, partners, community) is considered essential to reduce the limitations of internal resources and could be plainly improved with the use of data mining technologies. Data mining has proven to be in the recent years a pioneering field of research and investigation that faces a large variety of techniques applied in a multitude of areas, both in business and higher education, relating interdisciplinary studies and development and covering a large variety of practice. Universities require an important amount of significant knowledge mined from its past and current data sets using special methods and processes. The ways in which information and knowledge are represented and delivered to the university managers are in a continuous transformation due to the involvement of the information and communication technologies in all the academic processes.

Higher education institutions have long been interested in predicting the paths of students and alumni (Luan, 2004), thus identifying which

students will join particular course programs (Kalathur, 2006), and which students will require assistance in order to graduate. Another important preoccupation is the academic failure among students which has long fueled a large number of debates. Researchers (Vandamme, Meskens, & Superby, 2007) attempted to classify students into different clusters with dissimilar risks in exam failure, but also to detect with realistic accuracy what and how much the students know, in order to deduce specific learning gaps (Piementel & Omar, 2005).

Decision Supports Systems (DSS) are computer-based information systems designed in such a way that help managers to select one of the many alternative solutions to a problem. It is possible to automate some of the decision-making processes in a large computer-based DSS which is sophisticated and analyze huge amount of information fast. It helps corporate to increase market shares, reduce costs, increase profitability, and enhance quality. The nature of problem itself plays the main role in a process of decision making. It is an interactive computer based information system with an organized collection of models, people, procedures, software, databases, telecommunication, and devices, which helps decision makers to solve unstructured or semi-structured business problems (Tripathi, 2011).

Decision-making in the field of academic planning involves extensive analysis of large data volumes originating from multiple systems (Mansmann & Scholl, 2011). Academic workload management is concerned with

distributing teaching resources in order to adequately support the university's educational framework such as the faculties, degrees, courses, admission policies, teaching workload, etcetera (Fakieh, 2015) . Furthermore, it is a flexible, interactive, and computerized approach intended to support administrators in their decision making activities and provide direct and personal support for complex and managerial decisions (Turban, Cameron Fisher, & Altman, 1998).

As supported by Bara and Lungu (2011), improving decision support system with data mining techniques enhances the learning process; grows the efficiency of the decision making process; offers support in the decision making process and allows the decision maker control over the entire process; offers support in all stages of the decision making process; offers support for decision makers in solving structured or un-structured problems; offers support for a user or for a group of users and etcetera.

The reviews of literature showed possibilities of how interdisciplinary between educational data mining and computer software enhances the educative process through decision-making. It is the gap that needs to be filled in, to use the school data both on the side of the faculty and students, find out what should be improved in the curricular offering programs and decide to make changes on it (Algarni, 2016). This is the era of technology and maximizing its utilization in education is one of the most innovative ideas a computer-programmer could contribute.

Related Studies

In a study of Naqvi (2015) entitled Factors Affecting Students' Performance: A Case of a Private College, a sample of 300 students (225 males, 75 females) were selected from a group of colleges affiliated to Punjab University of Pakistan. They hypothesized that student's attitude towards attendance in class, study hours, family income, and mother's age and educational background are significantly related with student performance. Using simple linear regression analysis, it was found that the factors on mother's education and student's family income were highly correlated with the student academic performance.

This study's Educational Data Mining-based Decision Support system share similarities and differences with Navqi (2015). He focuses only on a limited sample number of students and the student performance based on their daily activity. It also emphasizes that mother's educational background has a significant toward its performance. In contrast, this present study has a larger coverage of data because it caters to the whole database for the past five years of the academe. With this large amount of data, the system can predict the students' performance for the past five years. It gives a clear view and give more decision support to the school administrator.

The paper of Sun (2010) entitled Student Learning Result System Based on Data Mining also used similar principle. It aimed to put forward a rule

discovery approach suitable for student learning results for the evaluation and applying it to the practice to improve student evaluation process. The value of research on student learning result evaluation system is to help teachers and students surpass the ivory towered and alienating traditional classroom teaching model, and face the rapidly developing real-life environment and the ill-structured learning environment and adapt to current teaching realities.

Similarly, the objective of this study is to cater the available data used in data mining to project the evaluation results of the students' performance. Similar with the study, this present study would help school administrators for fast evaluation process of students.

Another published paper entitled Classification Model of Prediction for Placement of Students by Kumar-Pal & Pal (2013), discusses data mining methodology that can analyze relevant information results and produce different perspectives to understand more about the students' activities. Their study shares similarity with the present study because in designing the educational data mining, different techniques were applied to discover useful information for displaying results of student's evaluation. Both systems use several techniques and approaches to generate the desired output. They also adopt different algorithm models for computing the data logically like decision tree model and Naïve Bayer model to name a few.

In the study entitled Data Mining: A prediction for performance Improvement using Classification, Bhardwaj and Pal (2011) stressed that it is

highly important to evaluate and predict students' academic performance in academic settings because these play a vital role in guiding students towards becoming a great leader. Similarly, this current study also used data mining classification techniques. Using this approach, the system provides a result in a form of table or graph that will be used as the bases for predicting student's evaluation and for coming up with a decision support.

The study of Kovacic (2010) entitled Early Prediction of Students Success: Mining Students Enrolment Data presented a case study on educational data mining to identify the extent to which the enrolment data can be used to predict student's success. The algorithms CHAID and CART were applied on student enrolment data in the information system of Open Polytechnic of New Zealand to get two decision trees classifying successful and unsuccessful students. The accuracy obtained with CHAID and CART was 59.4 and 60.5 respectively. Likewise, with this study, educational data mining-based decision support system can also predict the population of the students enrolling every semester based on the data mining. Moreover, it can classify each department and course.

Another study entitled Educational Data Mining-a case study by Manek, Vijay and Kamthania (2016) showed how data mining algorithm can help discover pedagogically relevant knowledge contained in a database obtained in an educational institution's database. They stressed out that this finding would be useful to the school leaders and the teachers in managing

and understanding the students' academic performance. The related study shows great similarity with the present study wherein the data in the school's database were used in understanding, managing, and analyzing student's performance through the logical process of data mining. In this way, the school administrators and the teachers can directly give an assessment with regard to students' academic standing.

In a study conducted by Abu Saa (2016) entitled Educational Data Mining and Students' Performance Prediction, he discussed the importance of data mining especially in predicting students' performance. In his study he discusses that using data mining will draw interesting pattern of knowledge that will lead to student's performance. This current study also uses a pattern of extracting knowledge from the database wherein the decision support system algorithm displays the results through graphs and other visual representation of predictions. The predictions made by the decisions support system include the number of enrollees per academic year for the past couple of years whose statistical computation of data can be shown through graphs or tables.

A published paper titled, Using Naïve Bayes Algorithm to Students' bachelor Academic Performance Analysis of Razaque, Soomro, Shaikh, Samo, Kumar and Dharejo (2017) examined students' details by different elements such as earlier semester marks, attendance, assignment, discussion, lab work was of used to improved bachelor academic performance of students, and

overcome difficulties of low ranks of bachelor students. It was extracted useful knowledge from bachelor academic students' data collected from department of Computing. Subsequently preprocessing data, which was applied data mining techniques to discover classification and clustering. In this study, classification method was described which was based on naïve byes algorithm and used for Academic datamining. It was supportive to students along with to lecturers for evaluation of academic performance. It was cautionary method for students to progress their performance of study.

The abovementioned work of Razaque et al. (2017) is very much similar of the current study since it both utilized the use of Naïve Bayes Algorithm for educational data mining especially as to various activities conducted in classroom to improve academic performance. However, the current has system quality attributes which also applied the said algorithm for teachers' data specifically on decision-making like failing or passing.

The study of Pandey and Sharma (2013) on A Decision Tree Algorithm Pertaining to Student Performance and Analysis and Prediction, in this study four different decision tree algorithms J48, NBtree, Reptree and Simple cart were compared and J48 decision tree algorithm is found to be the best suitable algorithm for model construction. Cross validation method and percentage split method were used to evaluate the efficiency of the different algorithms. The traditional KDD process has been used as a methodology. The WEKA (Waikato Environment for Knowledge Analysis) tool was used for analysis

and prediction. Results obtained in the present study may be helpful for identifying the weak students so that management could take appropriate actions, and success rate of students could be increased sufficiently.

The study of Pandey and Sharma (2013) is very much similar to the current study since it uses various programming algorithm which is used for analysis. It similarly highlighted how data mining and the used of software could identified weak students to support decision aspect of school management though it differs on some area like on the side of teachers' data for decision-making, it would be very helpful for comparison purposes.

Zhang, Zhao, and Yeom (2020) also conducted study relevant to the research at hand entitled Decision Tree Algorithm-Based Model and Computer Simulation for Evaluating the Effectiveness of Physical Education in thesis, in this paper, the forest algorithm and the decision tree algorithm are mainly used to analyze students' physical education information, course exam results, and student learning data and relevant feature attributes from the online teaching platform. The study aimed to generate decision trees using the decision tree algorithm for the purpose of generating classification rules, based on which we can find factors that are important to students' physical education performance and form data basis for improving teaching quality to help teaching management and teachers improve teaching methods and adjust teaching strategies.

Further, it specifically achieved their objectives by constructing a model for assessing the effectiveness of student teaching, the steps of which include data collection and preparation, data preprocessing (data cleaning, conversion, integration), model construction (algorithm training), and algorithm optimization, as well as realizing the simulation results of the model. At the same time, the importance of the relevant attributes of the model is analyzed, and some measures are proposed to improve the universities: the standard of physical education teaching and the corresponding strategies for improving teaching methods. The mainstream development environment is chosen to ensure the complete operation of the project system that integrates learning, operation, and evaluation.

The above-cited study of Zhang et al. (2020) is very much similar on the focused of the study. The usage of decision-tree algorithm model with data cleaning, conversion, and integration are some of the techniques also made for the current study to identify relevant attributed that would contribute to decision-making aspect of the user or receiver. On the contrary it differs further on the specific course, the previous focused on Physical Education only but the present study focused on various courses in several curriculum programs.

Various studies about educational data mining decisions support system shows how educational data is very important today in assessing the students' performance that leads to the decisions of school leaders for a better

projection and prediction of students' performance. This would also result in developing a better system of evaluating students.

Chapter 3

METHODOLOGY

This chapter presents the methods, strategies, data analysis, and evaluation of the designed system. It also delineates the different structures and processes that governs the development of the system.

Research Design

This study utilized developmental research design since it involved software development. This designed is suited to the research at hand because it developed an educational data mining-based decision support system based on the educational data requirements as to curriculum programs, subject offered in the curriculum, faculty handling the subjects, academic program schedule, and schedule. It was followed by analyses, development of the system and evaluation of the system.

In particular, the specific research design was used on this study as shown in the design process diagram shown in Figure 2. The paradigm used in the systems analysis and design was based on the hybrid of the Prototype Paradigm and the Waterfall Paradigm. This was found to be useful for this particular development due to the complex nature of data to be presented. The particular methodology used for the system development is the Structured Systems Analysis and Design Methodology (SSADM)

which is used in projecting and analyzing information systems. By using the SSADM, data and control flow in a system can be determined and shown in the systems analysis phase.

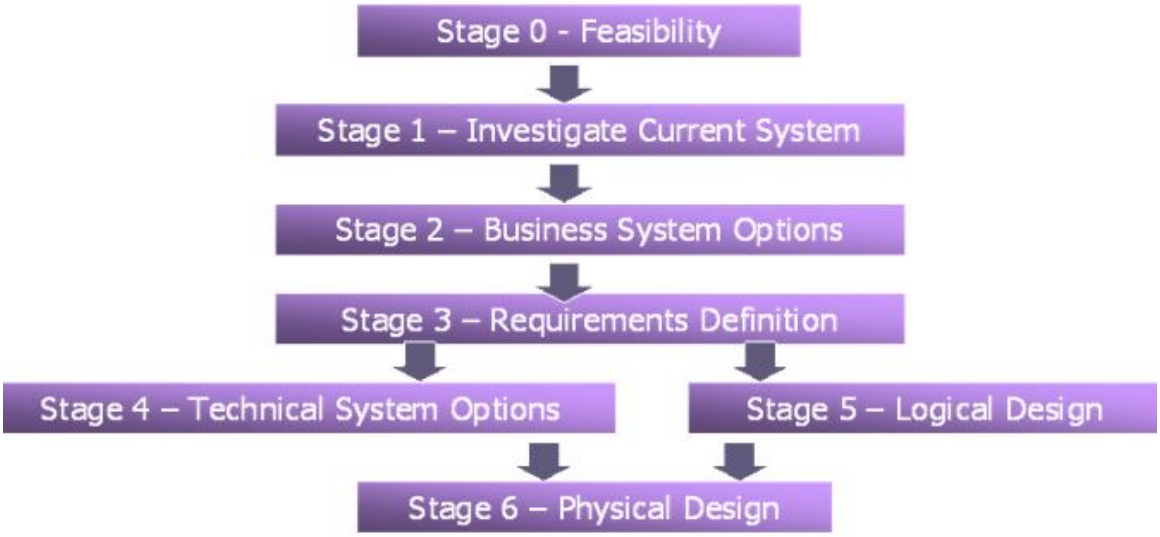


Figure 2. ***The System Paradigm***

SSADM application development projects are divided into five stages. The first stage is the investigation of the current environment. The study was conducted in Samar College with large data sets with each data set having more than ten years of students' academic records. The researcher's objective was to discover valuable information amongst these databases. The second stage was on the business system options. Performing discovery process was doable by an end user because through automation, a list of available discovery options, Data Mining or Machine Learning, is visible to the end users. End users have the capability to switch on different data sets categorized by academic year and identified by course or program under its

respective departments. Interface using web platform can best provide program access to the end user which require no installation on a client's computer. Stage 3 is on requirements specification. The software platform was developed using the combination of different programs, namely: MySQL, Apache Http Server, PHP and R programming language.

MySQL is a database engine that holds the database presented in a logical structure of data organized by tables. Apache Http Server is web server software in which the web user interface is hosted. Along with the apache, server side scripting language like PHP (Hypertext Preprocessor) has the capability to communicate with other programs like MySQL and R. R is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing. This program is installed on server that performs the Machine Learning and Data Mining work. Web communicates to R, sending Data Mining or Machine Learning requests. Output is brought back to the database server and displays the result through client's web interface.

Importing school data in a school's database is undoubtedly massive as it contains past records of graduated and currently enrolled students. Basically, during the development of information system, database is composed of different matrices like tables which store data separately. Database structure is divided into different tables with established relationships which are according to rules that are designed to protect the

data, to make the database flexible, and to remove redundancy and inconsistent dependency. This approach offers flexibility and scalability to a program without affecting its transaction speed. This process of organizing data in a database is called normalization. But upon importing school's database into the system, the denormalization process takes place. It combines all the separated data from different tables and consolidate them into one single record.

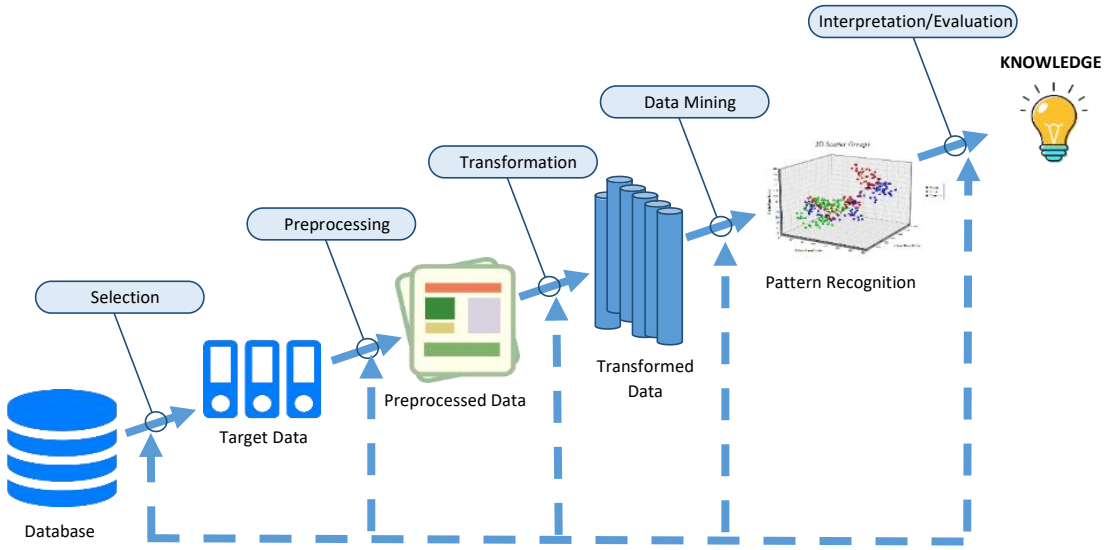


Figure 3. ***The Process of Extracting Knowledge from Data***

The fourth stage is on the technical system options. Initially, the datasets contained valueless attributes, missing instances, inadequate attributes' data types, and other problems that raise the necessity of preparing it first before feeding it to the analysis phase. Therefore, the datasets were passed through the following preparation stages. Dataset cleaning irrelevant attributes from imported database (like: Model code,

assessment status, Status, course description, and Bachelor institution) were removed. After that, students with incomplete records, like those who had no grades' details in most of their courses or those who did not have any course records were excluded from the list. Grades were inspected and decoded into possible acceptable values such as those shown in Table 1.

Table 1

Classification of Students According to Grade

Grade Range	Student Classification
1.5=> and <=1.0	Excellent
1.9=> and <=1.6	Very Good
2.4=> and <=2.0	Good
3.0=> and <=2.5	Average
5.0=> and <=3.1	Bad

In preparation for future classification of students, existing students with grades were classified based on their final grades. This was used as training data in Data Mining Classification Algorithm in R. To classify students, a query command was sent to MySQL server. Figure 4 shows Students' Program Standing Offered school programs, courses which require minimum grade in order for a student to remain in the program,

```
UPDATE `rd2` SET `Student Classfication` = 'Excellent' WHERE
`rd2`.`Grade` >= 1 and Grade<=1.5;

UPDATE `rd2` SET `Student Classfication` = 'VeryGood' WHERE
`rd2`.`Grade` >= 1.6 and Grade<=1.9;

UPDATE `rd2` SET `Student Classfication` = 'Good' WHERE
`rd2`.`Grade` >= 2.0 and Grade<=2.4;

UPDATE `rd2` SET `Student Classfication` = 'Average' WHERE
`rd2`.`Grade` >= 2.5 and Grade<=3.0;

UPDATE `rd2` SET `Student Classfication` = 'Bad' WHERE
`rd2`.`Grade` >= 3.1 and Grade<=5;
```

course otherwise the student is advised to enroll to another course and permanently eliminated out of the program.

Figure 4. ***Student Classification Query***

Students' program standing was identified based on their final grades (see Table 2). Existing program standing was used as a training data in Data Mining.

Table 2

Student Standing according to Grades

Grade Range	Student Standing
1.0=> and <=1.9	For Retention
2.0=> and <=5.0	For Elimination

As to student standing query Figure 5 shows the command for the said system attribute.

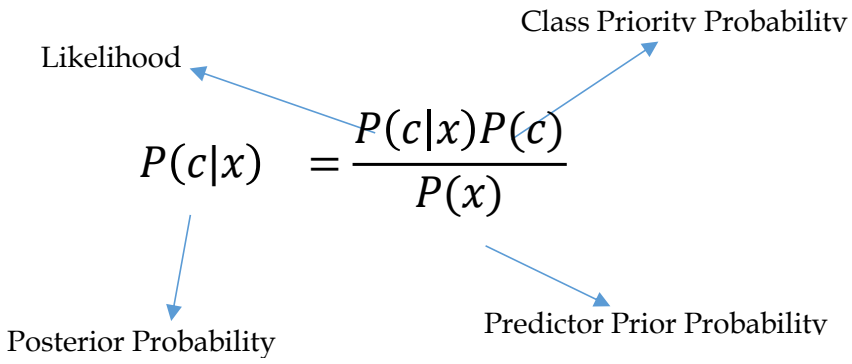
```
UPDATE `gradesheet` SET `standing` = 'For Retention' WHERE
`gradesheet`.`FinalGrade` >= 1 and FinalGrade<=1.9;

UPDATE `gradesheet` SET `standing` = 'For Elimanation' WHERE
`gradesheet`.`FinalGrade` >=2 and FinalGrade<=3;
```

Figure 5. ***Student Standing Query***

Then next stage 4 is Technical system options Data mining is the practice of searching large stores of data to discover patterns and trends that go beyond simple analysis. In this study, student academic records were the source of data sets which were treated with various algorithms and techniques. These data sets have more than 800,000 of records from different programs under different departments in more than ten years of archives.

Classification used in writing for algorithm script in RStudio. The researcher employed a classification technique called Naïve Bayes which is based on Bayes' Theorem with an assumption of independence among predictors. The study employed an algorithm that uses Bayes' theorem to classify objects known as Naïve Bayes Classifiers which assume strong or naive, independence between attributes of data points. Popular uses of naive Bayes classifiers include spam filters, text analysis, and medical diagnosis. Naïve Bayes model is easy to build and particularly useful for very large data sets. Bayes theorem provides a way of calculating posterior probability P(c | x) from P(c), P(x) and P(x | c). As shown by the equation in Figure 6:



$$P(c|X) = P(x_1|c)\ x\ P(x_2|c)\ x...x\ P(x_n|c)\ x\ P(c)$$

Figure 6. ***Naïve Bayes Theorem***

Above,

- $P(c|x)$ is the posterior probability of *class* (c, *target*) given *predictor* (x, *attributes*).
- $P(c)$ is the prior probability of *class*.
- $P(x|c)$ is the likelihood which is the probability of *predictor* given *class*.

- $P(x)$ is the prior probability of *predictor*.

In developing a model using Naïve Bayes Classifier, a test sample of data set was pulled out from the database categorized by course/program on a selected academic period. It was assigned to a variable and. Figure 7 shows the structure of the data set.

```
$ sid          : chr  "ID − 22752" "ID − 22752" "ID − 24548" "ID − 24548" …
$ course       : chr  "Bachelor of Science in Civil Engineering" "Bachelor of Science in Civil Engineering
$ period       : chr  "1st Semester 2019 − 2020" "1st Semester 2019 − 2020" "1st Semester 2019
                      − 2020"  …
$ class        : int  11244 10260 10244 10245 10246 10249 11242 10286 10290 10293 …
$ dept_code    : chr  "COENG" "COENG" "COENG" "COENG" …
$ department   : chr  "College of Engineering" "College of Engineering" "College of Engineering"  …
$ subject_code: Factor w/ 23 levels "CE 1","CE 2",…: 2 15 15 13 12 8 9 6 20 7 …
$ subject      : chr  "Hydrology" "Calculus 1" "Calculus 1" "Mathematics in Modern World" …
$ instructor   : Factor w/ 13 levels "INS − 050","INS − 161",…: 6 6 6 1 12 13 2 10 13 11 …
$ grade  : Factor w/ 21 levels "1","1.2","1.3",…: 20 21 21 14 4 20 20 21 13 21 …
$ date         : int  737430 737430 737430 737438 737446 737436 737429 737430 737436 737431 …
$ sClass       : Factor w/ 6 levels "","Average","Bad",…: 2 3 3 1 4 2 2 3 5 3 …
$ standing     : Factor w/ 3 levels "","For Elimanation",…: 2 1 1 2 3 2 2 1 2 1 …
```

Figure 7. ***The Dataset Structure***

The code shown in Figure 8 is a code fragment which shows how a Naïve Bayes classifier is written in RStudio. Line 151 which uses sample function divided the observation into 70/30 proportion. The bigger portion was used for training the model; whereas, the remaining 30 per cent was used for testing. A Naïve Bayes model is created at line 154. The column sClass on the data set serve is the determinant and sid, instructor, subject_code, dept_code are the predictors as rules. The classifier-training algorithm used these pre-classified examples to determine the set of parameters required for proper discrimination. This model was trained

using training data on line 155 and result was checked based on its accuracy using confusion matrix function. The Figure below shows 82% accuracy rate on the model's training phase. Those values that are boxed under the reference table values are the total number of correct classifications; while the rest are all mis-classification.

```
151.  ind <- sample(2, nrow(tb), replace = TRUE, prob = c(0.7, 0.3))
152.  train <- tb[ind == 1,]
153.  test <- tb[ind == 2,]
154.  naiveBayes_model <- naiveBayes( sClass ~ sub + instructor + subject_code + dept_code, data = train)
155.  pred <- predict(naiveBayes_model, train )
156.  confusionMatrix(pred, train$sClass)
157.  pred1 <- predict(naiveBayes_model, test)
158.  confusionMatrix(pred1, test$sClass)
```

Figure 8. ***Algorithm Model Code Fragment***

Along with accuracy result, figures 9 (*Model Training Accuracy Result)* and 10 (*Model Testing Accuracy Result*) present the Confusion Matrix and Statistics. Once learning and classification of the model was completed, adjustments on its predictors was made to improve its accuracy. If the accuracy was acceptable, the rules could be applied to the new data tuples.

```
Confusion Matrix and Statistics

          Reference
Prediction  Average Bad Excellent Good VeryGood
  Average       301  11         3   18       11
  Bad             3  83         0    5        1
  Excellent       4   3        50    2        1
  Good           31   0         1  120       16
  VeryGood       15   3         6    9      101

Overall Statistics

               Accuracy : 0.8208
                 95% CI : (0.7924, 0.8468)
    No Information Rate : 0.4436
    P-Value [Acc > NIR] : < 2.2e-16

                  Kappa : 0.7514

 Mcnemar's Test P-Value : 0.008605

Statistics by Class:

                     Class: Average Class: Bad Class: Excellent Class: Good Class: VeryGood
Sensitivity                  0.8503     0.8300          0.83333      0.7792          0.7769
Specificity                  0.9032     0.9871          0.98645      0.9255          0.9506
Pos Pred Value               0.8750     0.9022          0.83333      0.7143          0.7537
Neg Pred Value               0.8833     0.9759          0.98645      0.9460          0.9563
Prevalence                   0.4436     0.1253          0.07519      0.1930          0.1629
Detection Rate               0.3772     0.1040          0.06266      0.1504          0.1266
Detection Prevalence         0.4311     0.1153          0.07519      0.2105          0.1679
Balanced Accuracy            0.8767     0.9086          0.90989      0.8523          0.8638
```

Figure 9. ***The Confusion Matrix-Model Training Accuracy Result***

```
Confusion Matrix and Statistics

          Reference
Prediction  Average Bad Excellent Good VeryGood
  Average       262  14         2   16       12
  Bad            35  78         0    5        1
  Excellent       7   3        48    2       29
  Good           32   1         2  112       12
  VeryGood       18   4         8   19       76

Overall Statistics

               Accuracy : 0.7218
                 95% CI : (0.6893, 0.7527)
    No Information Rate : 0.4436
    P-Value [Acc > NIR] : < 2.2e-16

                  Kappa : 0.6235

 Mcnemar's Test P-Value : 2.27e-05

Statistics by Class:

                     Class: Average Class: Bad Class: Excellent Class: Good Class: VeryGood
Sensitivity                  0.7401    0.78000          0.80000      0.7273         0.58462
Specificity                  0.9009    0.94126          0.94444      0.9270         0.92665
Pos Pred Value               0.8562    0.65546          0.53933      0.7044         0.60800
Neg Pred Value               0.8130    0.96760          0.98307      0.9343         0.91976
Prevalence                   0.4436    0.12531          0.07519      0.1930         0.16291
Detection Rate               0.3283    0.09774          0.06015      0.1404         0.09524
Detection Prevalence         0.3835    0.14912          0.11153      0.1992         0.15664
Balanced Accuracy            0.8205    0.86063          0.87222      0.8271         0.75563
```

Figure 10. ***The Confusion Matrix-Model Testing Accuracy Result***

The model was then tested on the data set that was not part of the training data set at line 157. Accuracy was also checked using confusion matrix function on line 158.

Then the next stage was the logical Design on Predicting Students' Performance**.** Machine learning (ML), seen as the subset of AI, is the study of computer algorithms that have shown improvement throughout the years. ML algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to do so. Schools has large database which holds the

past academic records of students. These records can be used to create a mathematical algorithm which will be utilized in ML.

This study used a Random Forest classification algorithm consisting of many decision trees. It uses bagging and features randomness when building each individual tree in trying to create an uncorrelated forest of trees whose prediction by committee is more accurate than that of any individual tree.

Additional algorithm maybe added to expand system's capabilities, since the EDMDSS will be built in a modular way that algorithms is stored outside of the program's source code, then may be modified later on in the future.

Instrumentation

For the system evaluation, the researcher conducted a beta-testing to 20 potential users (10 teachers and 10 deans), the use of standard system quality attributes from International Standards Organization (ISO)/International Electrotechnical Commission (IEC) 2510:2011 as to functionality, reliability, usability, efficiency, maintainability, and portability. It has five Likert Scale, where 1 stands for very poor; 2 for poor; 3 for fair; 4 as good, and five as excellent. For the interpretation of the overall for each quality attributes it follows this range: 1.00 – 1.50 mean rating is described as

Very Poor (VP); 1.51 – 2.50 as Poor (P); 2.51 – 3.50 as Fair (F); 3.51 – 4.50 as Good (G) and 4.51 – 5.00 as Excellent (E).

Validation of Instrument

The instrument of the study was content validated through expert research experts in Information Technology, they provided corrections on the appropriateness of quality attribute indicators for the developed system. This study resort to this instrument because the instrument is already based on the standardized checklist form accessed for free from the website of International Standards Organization (ISO)/International Electrotechnical Commission (IEC).

Data Gathering Procedure

Database is the critical component of this study. The researcher acquired copies of databases from both Samar State University (SSU) and Samar Colleges. These databases were examined for its database structural compatibility and completeness of its data. Upon comparison, each database has common data fields, namely: encrypted instructor_id (encrypted), student_id (encrypted), subject, school year, semester, and grades. For the speed of time the system generated the results, for the general weighted average tracing of honor students by program, and top 10 highest grade attained per subject were all be dependent to the input data provided by the data holder.

All these data were taken after securing all the necessary documents since it is part of the data privacy law to ask permission from the data holder. Further, for the beta-testing, the researcher also sent letter to the respondents prior to the conduct of actual testing of the system, since it is conducted during pandemic time, the researcher did a one-on-one beta testing through time schedule with the potential user and have the system rated upon completion of the testing. This is one way to follow health protocols. Further, all the data collected observed anonymity and confidentiality. The data collected was tallied and interpreted accordingly especially on the aspect of acceptability of Educational Data Mining-Based Decision Support System.

Data Analyses

For the data analyses, descriptive and inferential statistics were used. As to the developed system, built-in statistical data analyses in the R-programming were utilized such as regression to come up with the model, mean and weighted average for projection of the generated results on students' ranking and performance for a specific semester. When it comes to beta-testing, descriptive statistics such as mean and weighted mean were also used to reflect the overall score of the potential users with regards to the system quality attributes.

Ethical Consideration

The researcher sent letters and secured approval from the School President of Samar College to obtain an encrypted copy of the school database which contains records of grades, schedules, students (except names), and subjects from summer of 2004 up to 2nd Semester 2019. Similar communication letter was sent to the University President thru the Vice-President for Academic Affairs to request permission for the conduct the study in SSU and to acquire a copy of database (records) excluding encrypted personal information. All entrusted data were handled with extreme confidentiality in accordance with National Research Standard and Republic Act 10173 – Data Privacy Act of 2012 and in compliance with Samar State University Ethical Review Committee.

Chapter 4

PRESENTATION, ANALYSES AND INTERPRETATION OF DATA

This chapter presents the discussion of the results and assessment of the developed project on educational data mining-based discussion support system.

Educational Data Requirements for Academic Decision-Making

Curriculum Program. Figure 11 shows the data analyses of students' grades in the program standing under the College of Education for the period of 1st semester school year 2019-2020. Out of 14 programs offered by the college, a total of 3183 occurrences were displayed. The distribution may be analyzed as follows: "Bachelor of Early Childhood Education" shows the result with total grade subjects for elimination of 95 and 24 a total grade for retention of the program; "Bachelor of Elementary Education" shows the results of number of subjects grades for elimination with a total value of 355, and 642 grade for retention while 239 has a blank grade. "Bachelor of Livelihood Education" shows a total result of 63 and 76 for grades elimination and retention respectively with 11 blank grades. "Bachelor of Physical Education" display results of 131 of grades subject for elimination and 55 results for retention while 18 has blank grades. "Bachelor of Secondary Education major in English" has a result of 115 subject grades for elimination

and 373 for retention while 43 got blank grades. “Bachelor of science major in Social Studies” has a result of subject grades of 50 for elimination and 225 for retention while 150 has blank grades. Statistical summary also shows the total

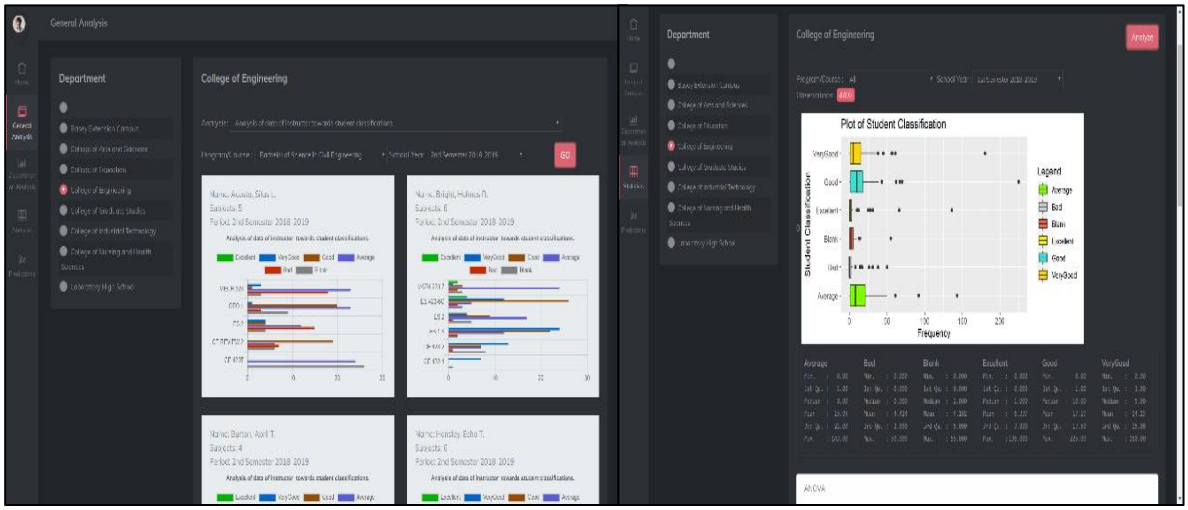
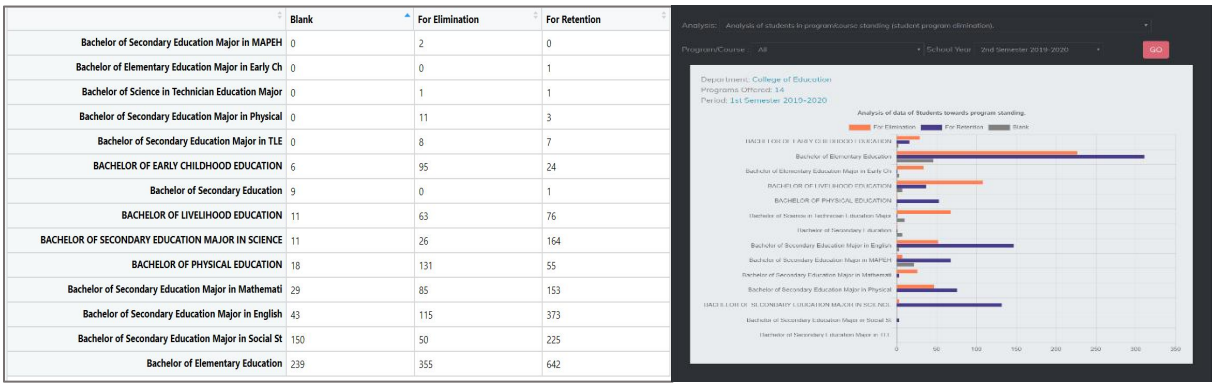


Figure 11. ***Analysis of Student Standing in a Program***

Subjects Offered in the Curriculum. Students’ grade remarks can be analyzed through a well distributed statistical table shown in Figure 13 which shows the analysis of subjects in College of Engineering for the program of Bachelor of Science in Civil Engineering for the 2nd semester of school year 2018-2019. Out of the 130 students in enrolled in the subject of Geology of Engineers 97 students got a passing grade, 25 students got a failing grade, and 8 students got a “blank” grades. Similarly, in the subject Computer Fundamentals and Programming, out of 130 enrolled students, 112 got a passing grade, 6 students got a failing grade, and 12 students got “blank” grades. Under the subject Engineering Economics, out of the 125 enrolled students, 104 got a passing grade, 16 got a failing grade, and 5 students have

blank grades. The same with the subject in PE 2- Games and Sports which has 116 enrolled students with 61 of them who got a passing grade, only 2 students got a failing grade, and 53 students are in still in progress of getting a blank grade.



	Blank	For Elimination	For Retention
Bachelor of Secondary Education Major in MAPEH	0	2	0
Bachelor of Elementary Education Major in Early Ch	0	0	1
Bachelor of Science in Technician Education Major	0	1	1
Bachelor of Secondary Education Major in Physical	0	11	3
Bachelor of Secondary Education Major in TLE	0	8	7
BACHELOR OF EARLY CHILDHOOD EDUCATION	6	95	24
Bachelor of Secondary Education	9	0	1
BACHELOR OF LIVELIHOOD EDUCATION	11	63	76
BACHELOR OF SECONDARY EDUCATION MAJOR IN SCIENCE	11	26	164
BACHELOR OF PHYSICAL EDUCATION	18	131	55
Bachelor of Secondary Education Major in Mathemati	29	85	153
Bachelor of Secondary Education Major in English	43	115	373
Bachelor of Secondary Education Major in Social St	150	50	225
Bachelor of Elementary Education	239	355	642

Figure 12. ***Analysis of Students' Remarks per Subject Offered in the Curriculum***

Faculty Handling the Subjects. Figure 14 presents the generated result of the developed system. In the figure the names of the faculty are reflected with several colors and the percentage of students under them. The system could generate the names of faculty handling the subject per college, semester, school year, year level, and program.

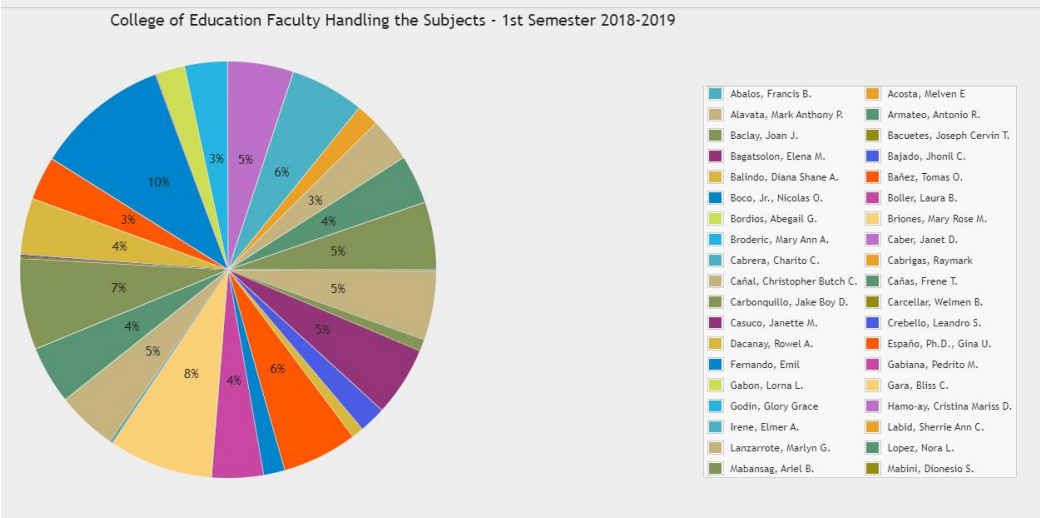


Figure 13. *System Analysis on Faculty Handling the Subjects*

Academic Program Schedule. Figure 14 displays the system generated results on the academic program schedule. The system could generate even the offered programs in the last 15 years or 20 years, it depends on the data input to the system.

Academic Program Schedule – First Semester, School Year 2017-2018

ScheduleCode	Semester	SchoolYear	SubjectCode	DayCode	DeptCode	TimeBegin	TimeEnd	RoomCode	InstructorID
00001	2	2018-2019	CA 2	M/W	B.S.Crim	Dec 30 1899 7:30A	Dec 30 1899 9:00A	402	fcc1f72f262bcbd577a2447cee18764
00001	3	2018-2019	Hum 1	Daily	B.S.Crim	Dec 30 1899 1:30P	Dec 30 1899 3:00P	302	aa689ccf5a4594d7c06c65a50bf25dc
00002	2	2018-2019	CA 2	TTH	B.S.Crim	Dec 30 1899 7:30A	Dec 30 1899 9:00A	402	fcc1f72f262bcbd577a2447cee18764
00002	3	2018-2019	Hum 1	Daily	B.S.Crim	Dec 30 1899 3:00P	Dec 30 1899 4:30P	302	aa689ccf5a4594d7c06c65a50bf25dc
00003	1	2018-2019	CoCJE GE 1	TTH	B.S.Crim	Dec 30 1899 12:00P	Dec 30 1899 1:30P	401	91f145d8fc2117e2aa35d3aeee86f40
00003	2	2018-2019	CA 2	TTH	B.S.Crim	Dec 30 1899 3:00P	Dec 30 1899 4:30P	405	fcc1f72f262bcbd577a2447cee18764
00003	3	2018-2019	SocSci 3	Daily	B.S.Crim	Dec 30 1899 9:00A	Dec 30 1899 10:30A	303	54d6d0c6f84c51a9d342a701ff656aa
00004	1	2018-2019	CoCJE GE 1	MW	B.S.Crim	Dec 30 1899 10:30A	Dec 30 1899 12:00P	301	d5fc6931fd64e3f1fcebb5425d00014
00004	2	2018-2019	CA 2	TTH	B.S.Crim	Dec 30 1899 9:00A	Dec 30 1899 10:30A	404	fcc1f72f262bcbd577a2447cee18764
00004	3	2018-2019	SocSci 3	Daily	B.S.Crim	Dec 30 1899 10:30A	Dec 30 1899 12:00P	303	9b9f61043b8207928dc0e060b9ac584
00005	1	2018-2019	CoCJE GE 1	MW	B.S.Crim	Dec 30 1899 9:00A	Dec 30 1899 10:30A	305	92e43802ed22ee877ff65fb9cb8a749
00005	2	2018-2019	CDI 1	M/W	B.S.Crim	Dec 30 1899 1:30P	Dec 30 1899 3:00P	402	9a1f6e393f02ae772dba5ddefbdd98c
00005	3	2018-2019	SocSci 4	Daily	B.S.Crim	Dec 30 1899 5:30P	Dec 30 1899 7:00P	301	47a3b75997cf1ad270af5e60cd8764d
00006	1	2018-2019	CoCJE GE 1	TTH	B.S.Crim	Dec 30 1899 4:30P	Dec 30 1899 6:00P	401-	d5fc6931fd64e3f1fcebb5425d00014
00006	2	2018-2019	CDI 1	TTH	B.S.Crim	Dec 30 1899 3:00P	Dec 30 1899 4:30P	404	9a1f6e393f02ae772dba5ddefbdd98c
00006	3	2018-2019	SocSci 4	Daily	B.S.Crim	Dec 30 1899 9:00A	Dec 30 1899 10:30A	302	43b5d2fe37baab26b15cb810db26fa8
00007	1	2018-2019	CoCJE GE 2	TTH	B.S.Crim	Dec 30 1899 7:30P	Dec 30 1899 9:00P	304/	83f67a2818387d57834945fe4cba426
00007	2	2018-2019	CDI 3	M/W	B.S.Crim	Dec 30 1899 7:30A	Dec 30 1899 9:00A	404	0d02add5490fbf49a5f6423c2a79f00
00007	3	2018-2019	Lit 1	Daily	B.S.Crim	Dec 30 1899 1:30P	Dec 30 1899 3:00P	301	33c5211491b70767e8cf2cd1bce625f
00008	1	2018-2019	CoCJE GE 2	TTH	B.S.Crim	Dec 30 1899 9:00A	Dec 30 1899 10:30A	305-	92e43802ed22ee877ff65fb9cb8a749
00008	2	2018-2019	CDI 3	M/W	B.S.Crim	Dec 30 1899 4:30P	Dec 30 1899 6:00P	402	0d02add5490fbf49a5f6423c2a79f00
00008	3	2018-2019	Engl3	Daily	B.S.Crim	Dec 30 1899 7:30A	Dec 30 1899 9:00A	301	a561fae10e7adfd3ce26c9b901411a5
00009	1	2018-2019	CoCJE GE 2	TTH	B.S.Crim	Dec 30 1899 7:30P	Dec 30 1899 9:00P	303	0114fdf8df0240a80bb14618ad61961
00009	2	2018-2019	CDI 3	TTH	B.S.C	Dec 30 1899 7:30A	Dec 30 1899 9:00A	404	0d02add5490fbf49a5f6423c2a79f00
00009	3	2018-2019	Engl4	Daily	B.S.Crim	Dec 30 1899 10:30A	Dec 30 1899 12:00P	301	93f9640e535dbc0e2ec4f5d1850a56b

Figure 14. *Number of Offered Programs per Department*

Grade. It could be gleaned from Figure 16 the General Weighted Average (GWA) refers to the average grade gotten from all the semesters that have been taken. While" average" refers to the average grade gotten from all the units registered for the current semester. To get the students' average per semester, the system uses the formula A x B= C where A is grades received from the course, B is the number of units (i.e.3-5 units per subject), and the C is the product of the two data. Then, the system will compute the average by computing the quotient of C which is the summation of product of A and B, then divide it by the total number of units registered for the semester (e.g. 15 or 18 units).

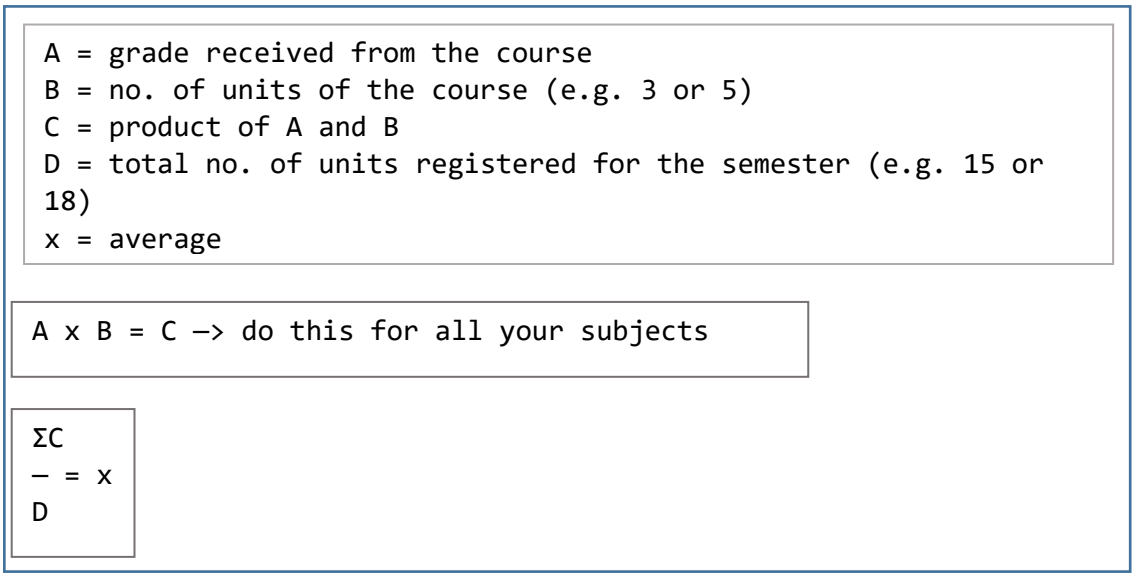


Figure 15. ***The Computation of Student Average in a Semester***

In computing the GWA, the summation of grades is multiplied by its number of units and divided it by the total number of units registered from all the semesters spent in the university. Figure shows the grades of a student

from first semester and second semester. In the first semester the average is 1.98, while on the second semester the average is 2.01 The student's GWA in the school year 2010-2011 is 2.0.

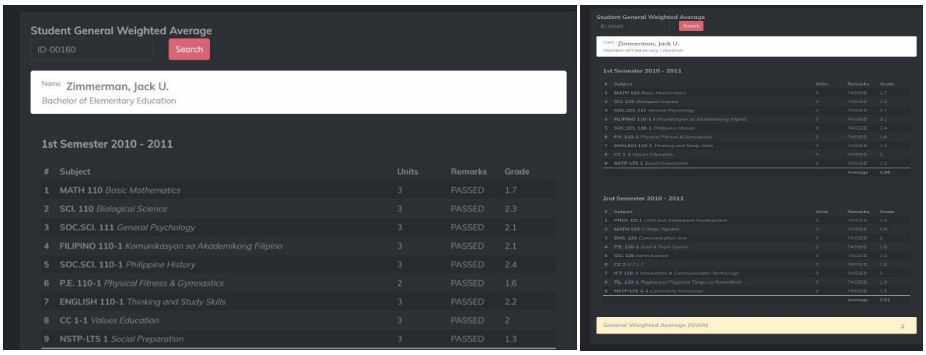


Figure 16. ***Analysis of Student Average Grade and General Weighted Average***

Part of the data requirement also is to generate the top 10 performing students per subject as shown in Figure 17.

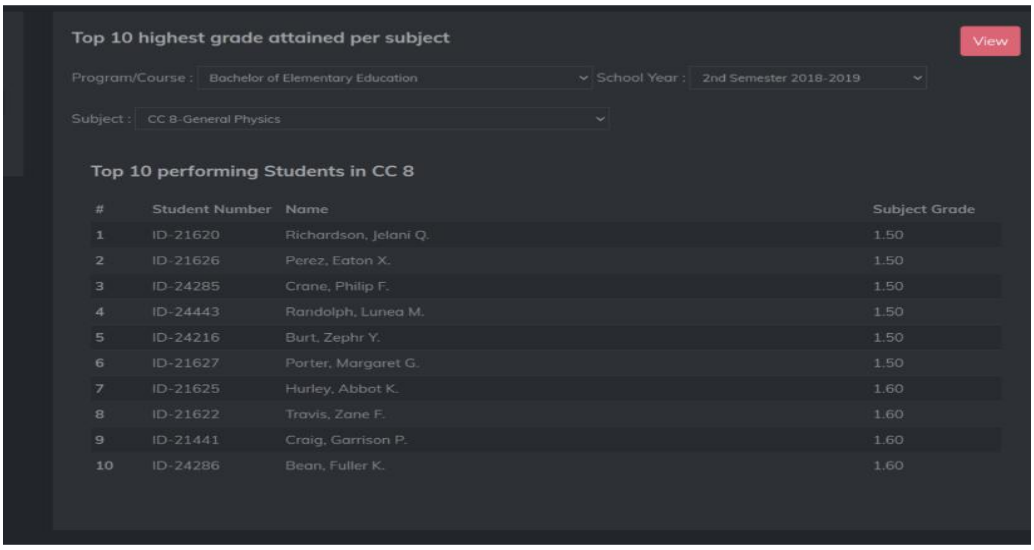


Figure 17. ***Top Performing Student in a Subject***

With those samples presented in above figures, the developed system would be very helpful to teachers and parents, students earning better grades to get higher GPAs. They would do well to identify the individual student's unique strengths and commendable performance. It is a big help to the institution that they can filter out the top performing students in their classes or in their respective programs so they can identify as early as first year students who have the ability to perform well in class. With this data, the institution can easily classify the scholastic records of students which will eventually inform the institution the students' strengths, weaknesses, and capabilities.

System General Environment

The goals of this project have been achieved. Having a huge data and applying a data mining technique to process data in an intelligent way is a wealth. Educational data mining-based decision support system's goal is to evaluate academic performance of students and present the academic performance evaluation, such as display of curriculum programs offered by the institutions, subjects offered per programs, teachers handling the offered subjects, and the students' grades.

An object-based software package, called the Educational Data Mining-Based Decision Support System, was designed and developed which sought to provide a flexible and sophisticated environment for presenting the proposed

ideas and a flexible infrastructure for future expansion. This software facilitates the analysis by providing a user-friendly environment, useful graphical charts, easily readable tables, opportunity to different point of views to the analysis, and sharing of information. Moreover, the package is designed with many useful features like `student search engine' which helps the user to find personal and academic information about any student records in the university database. Finally, update ability of the data used by the package was developed, allowing use of new data added to the university database during each new academic semester.

The minimum capacity of the developed system depends on the input or available data, the more complete the input data the more the system provide accurate results. If this developed system is implemented the administrator must be strict to faculty when it comes to grade submissions. As to speed/time in terms of rate of time in which the results can be produced using this developed system, it depends on the specifications of the desktop or laptop that will be used. The higher the specifications the faster it generates expected results.

Analyses for Students' Performance

The general analysis menu shows the different ways in which student performance data can be analyzed and presented for academic decision-making like, such as students rating classification can be: Excellent, Very Good,

Good, Average, Bad. General analysis also shows faculty handled subjects and student classification distribution, total number of failing students per subject, display of students general weighted average (GWA) and the top 10 good performing students per program and per subject. Displaying the number of students versus academic term and terms spent at the university/college on a departmental basis.

These analyses are localized according to their department or program/course relative to the selected period. It also includes the automatic computation of a student's average for every semester and the overall GWA. With the computation of average grade of a student and his/her GWA, the system can display the result of the academic standing of the student specifically by filtering the list of honor rolls of students per program. It also displays the standing of student performance retention in the program. This analysis is displayed in graphs or tables.

Statistical analysis of educational decision suport system was used in achieving the effectiveness level of the system in terms of speed of time in computing GWA of every student. The system can effeciently display the result of the queries by simply typing the student number and the department where he/she belongs. Then, the system will display the list of subjects that the student is enrolled. The system has the capabilites to compute students' GWA and the average of students' grades per semester.

Types of Analyses Available. The types of analyses made available by the software are the following: (1) analysis of instructor's rating for students towards student grade classifications; (2) analysis of students in program/course standing (student program elimination); (3) analysis of Program's Subjects per Student Remarks (Passing, Failing and Blank); (4) analysis of student average and general weighted average; (6) analysis of student's performance evaluation based on class standing, and (7) analysis on top performing students

All these types of analyses were run at 1% margin of error and 82% accuracy rate on the model's training phase (refer to Figure 8 on page 34) with model testing accuracy result of 72%. The accepted percentage for a model is with 10% margin of error with 70% accuracy since input errors could reach from 20 to 30 percent (Brownlee, 2020). Similar scenario with the current developed system. The input data affects the generated results; it is not a system error but on the completeness of reports.

System General Environment Used for Decision-Making

The goals of this project have been achieved. Having a huge data and applying a data mining technique to process data in an intelligent way is a wealth. Educational data mining-based decision support system's goal is to evaluate academic performance of students and present the academic performance evaluation, such as display of curriculum programs offered by

the institutions, subjects offered per programs, teachers handling the offered subjects, and the students' grades.

An object-based software package, called the Educational Data Mining-Based Decision Support System, was designed and developed which sought to provide a flexible and sophisticated environment for presenting the proposed ideas and a flexible infrastructure for future expansion. This software facilitates the analysis by providing a user-friendly environment, useful graphical charts, easily readable tables, opportunity to different point of views to the analysis, and sharing of information. Moreover, the package is designed with many useful features like `student search engine' which helps the user to find personal and academic information about any student records in the university database. Finally, update ability of the data used by the package was developed, allowing use of new data added to the university database during each new academic semester.

The minimum capacity of the developed system depends on the input or available data, the more complete the input data the more the system provide accurate results. If this developed system is implemented the administrator must be strict to faculty when it comes to grade submissions.

As to **speed/time** in terms of rate of time in which the results produced using this developed system, it depends on the specifications of the desktop or laptop that would be used. The higher the specifications the faster it generates expected results.

System Evaluation (Beta Testing)

Tables 3 to 8 provides data on the evaluation of faculty and deans on the System Quality Attributes as to functionality, reliability, usability, efficiency, maintainability, and portability of the developed Educational Data Mining-Based Decision Support System.

The descriptions for each mean of quality attribute indicator is adopted from the Five-Likert Scale of International Standards Organization (ISO)/International Electrotechnical Commission (IEC) 2510:2011 where, 1.00 – 1.50 mean rating is described as Very Poor (VP); 1.51 – 2.50 as Poor (P); 2.51 – 3.50 as Fair (F); 3.51 – 4.50 as Good (G) and 4.51 – 5.00 as Excellent (E).

Functionality. As can be gleaned in Table 3, the quality attribute indicator "The proposed system is precise in its results" has the lowest weighted mean for both the faculty and deans which has a numerical score of 4.50 interpreted as good based from ISO/IEC (2011), it is the aspect that need to be improved since it matters a lot when it comes to input part of the system.

Table 3

System Quality Attributes as to Functionality

Quality Attribute' Indicators	Faculty (Mean Score)	Deans (Mean Score)	Combined (Mean Score)
1. The proposed system has available all function required for its execution.	5.00 (E)	5.00 (E)	5.00 (E)
2. The proposed system is	4.80	4.20	4.50

precise in its results.	(G)	(G)	(G)
3. The proposed system interacts with specified modules.	5.00 (G)	5.00 (E)	5.00 (G)
4. The proposed system complies with standards, laws, etc.	5.00 (E)	5.00 (E)	5.00 (E)
5. The proposed system has secured access through password.	4.90 (E)	4.90 (E)	4.90 (E)
Grand Weighted Mean	**4.94 (E)**	**4.82 (E)**	**4.88 (E)**

Though quality attribute number 2 is rated good, four out of five indicators are rated excellent with ranges fall from 4.51 to 5.00 which projected a combined mean of 4.88. This beta testing result indicate that the developed system conforms with the standards as to functionality. It served its purpose to help in the decision-making.

Reliability. For this system quality attribute along reliability, as can be viewed in Table 4, the mean rating of the two groups pegged at 4.51 – 5.00 in which according to ISO/IEC standards the reliability of the developed system is excellent. This is supported by the combined means of both users from faculty and deans' groups since three out of three system quality attribute indicators are with descriptive letter E, which refer to excellent reliability of the developed system regardless of the groups who rated the system and the number of indicators provided. Meaning, the system provides excellent results.

Table 4

System Quality Attributes as to Reliability

Quality Attribute' Indicators	Faculty (Mean Score)	Deans (Mean Score)	Combined (Mean Score)
1. The proposed system reacts appropriately when failure occurred.	5.00 (E)	5.00 (E)	5.00 (E)
2. The proposed system informs user concerning invalid data entry.	5.00 (E)	4.90 (E)	4.95 (E)
3. The proposed system is capable of recovering data in the event of failure.	4.90 (E)	5.00 (E)	4.95 (E)
Grand Weighted Mean	**4.97 (E)**	**4.97 (E)**	**4.97 (E)**

Usability. When it comes to system quality attribute, usability. It is presented in Table 5, the results described that the Educational Data Mining-Based Decision Support System is with excellent usability, the elements of informational components (indicator 1), navigational component (indicator 2) and input controls (indicator 3) are featured in system. This claimed is supported by the mean rating of the two groups pegged at 4.51 – 5.00 in which according to ISO/IEC standards, the usability of the developed system is excellent. This is supported by the combined means of both users from groups of faculty and deans since three out of three system quality attribute indicators are with descriptive letter E, which again into excellent usability of the developed system.

Table 5

System Quality Attributes as to Usability

Quality Attribute' Indicators	Faculty (Mean Score)	Deans (Mean Score)	Combined (Mean Score)
1. It's easy to understand the concept and application.	5.00 (E)	5.00 (E)	5.00 (E)
2. It's easy to learn how to use.	5.00 (E)	4.90 (E)	4.95 (E)
3. It's easy to operate and control.	5.00 (E)	4.90 (E)	4.95 (E)
Grand Weighted Mean	**5.00 (E)**	**4.93 (E)**	**4.97 (E)**

Efficiency. As to the System Quality Attribute- efficiency, it is presented in Table 4 the indicators and scores provided by the two groups of users.

Table 6

System Quality Attributes as to Efficiency

Quality Attribute' Indicators	Faculty (Mean Score)	Deans (Mean Score)	Combined (Mean Score)
1. The system response time is appropriate.	4.80 (E)	4.80 (E)	4.80 (E)
2. The system execution time is appropriate.	4.80 (E)	5.00 (E)	4.90 (E)
3. The resources used are appropriate.	4.80 (E)	4.90 (E)	4.85 (E)
Grand Weighted Mean	**4.80 (E)**	**4.90 (E)**	**4.85 (E)**

From the table, the mean rating of the two groups pegged at 4.51 – 5.00 in which according to ISO/IEC standards, the efficiency of the developed

system is excellent. This is supported by the combined means of both users, the developed system's speed/time of manipulating data is excellently efficient.

Maintainability. When it comes to system quality attribute maintainability, it is display in Table 7 that the mean rating of the two groups pegged at 4.51 – 5.00 in which according to ISO/IEC standards, the maintainability of the developed system is excellent. The result provide impetus that the potential users can manipulate or modify changes when it comes to the utilization of the developed system.

Table 7

System Quality Attributes as to Maintainability

Quality Attribute' Indicators	Faculty (Mean Score)	Deans (Mean Score)	Combined (Mean Score)
1. It's easy to find failure when it occurs.	5.00 (E)	4.90 (E)	4.95 (E)
2. It's easy to modify and adopt.	4.90 (E)	4.90 (E)	4.90 (E)
3. Changes are easy to test.	4.90 (E)	4.90 (E)	4.90 (E)
Grand Weighted Mean	**4.93 (E)**	**4.90 (E)**	**4.92 (E)**

Portability. There are four indicators for the System Quality Attribute - Portability, as shown in Table 8, all the combined mean of each indicator range from 4.51 – 5.00, the standard quality portability attribute of the Educational Data Ming-Based Decision Support System is excellent. It is supported by the

grand weighted mean of 4.90 in which it also falls on the said range and standards.

Table 8

System Quality Attributes as to Portability

Quality Attribute' Indicators	Faculty (Mean Score)	Deans (Mean Score)	Combined (Mean Score)
1. It's easy to adopt with other environment.	5.00 (E)	4.90 (E)	4.95 (E)
2. It's easy to install in other environment.	4.80 (E)	4.80 (E)	4.80 (E)
3. It is in agreement with portability standard	4.90 (E)	5.00 (E)	4.95 (E)
4. It's easy to use to replace another program	4.80 (E)	5.00 (E)	4.90 (E)
Grand Weighted Mean	**4.88 (E)**	**4.92 (E)**	**4.90 (E)**

In summary, the developed system has been rated by users as excellently developed as to its functionality, reliability, usability, efficiency, maintainability, and portability. It conforms further with International Standards Organization (ISO)/International Electrotechnical Commission (IEC) 2510:2011. Thus, preliminary used of it on the intended takers must be implemented.

Chapter 5

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of the study, the conclusion derived aligned to the objectives of the study, and the recommendation made based from the results.

Summary of Findings

This dissertation developed Educational Data-Mining Based Decision Support System focusing on the design, algorithm, and accuracy of the results. In relation to this and in reference to the results discussed in the previous chapter, the following is the summary of results:

1. The educational data requirements for the developed decision-support system as to curriculum programs are the students' list per course or subject, students' grade, top 10 class standing, class program, teacher's program and schedules. For the subjects offered in the curriculum, the data required are the units, teachers, and number of students. As to faculty handling the subjects, it's still on the teacher's program and class schedule same and for the grades, it could compute the general weighted average for each student enrolled in the course under a certain program and teacher or faculty.

2. The analyses that were applied for the students' academic performance per department are: (1) the analysis of instructor's rating for students towards student grade classifications; (2) analysis of students in program/course standing (student program elimination); (3) analysis of Program's Subjects per Student Remarks (Passing, Failing and Blank); (4) analysis of student average and general weighted average; (5) analysis of student's performance evaluation-based on class standing, and (6) analysis on top performing.

3. Educational data mining-based decision support system was developed for administrators to trace students' academic performance which general features include the different ways in which student performance data can be analyzed and presented for academic decision-making like, such as students rating classification can be: Excellent, Very Good, Good, Average, Bad. General analysis also shows faculty handled subjects and student classification distribution, total number of failing students per subject, display of students general weighted average (GWA) and the top 10 good performing students per program and per subject. Displaying the number of students versus academic term and terms spent at the university/college on a departmental basis.

4. The automatic computation of a student's average for every semester and the overall GWA served as bases for decision support system for students' academic performance. The system can display the result of the academic

standing of the student specifically by filtering the list of honor rolls of students per program. It also displays the standing of student performance retention in the program, this is where decision make takes place for the teacher or instructor and the administrators themselves to help improve student's performance through appropriate actions.

5. Based on the beta testing conducted both the faculty and deans have an overall rating for the Educational Data Mining-Based Decision Support System, this means that the system excellently works or functions as to functionality, reliability, usability, efficiency, maintainability and portability.

Conclusions

The data available in Higher Education Institutions helped in a decision making especially if these data are utilized. The developed Educational Data Mining-Based Decision Support System are capable of providing decisions to teachers and administrators especially on the students' performance. The said system is excellently functional, reliable, usable, efficient, maintainable and portable which is easier to manipulate and produce outcomes. These processing engines interact with each other in sending and accepting requests to complete a computing task. Database is the essential component to this system and its completeness of data which greatly affects the computational process and its result. Building additional model can be added to further expand the system capabilities.

Recommendations

This study recommends to validate the system to other schools. The data input is one of the contributory elements that affects the quality attribute of the Educational Data Mining-Based Decision Making Support System, thus it is a necessary requirement that should be complied in the future.

Chapter 6: Educational Data Mining Decision Support System

Welcome to Analyzing Big Data!

EDM

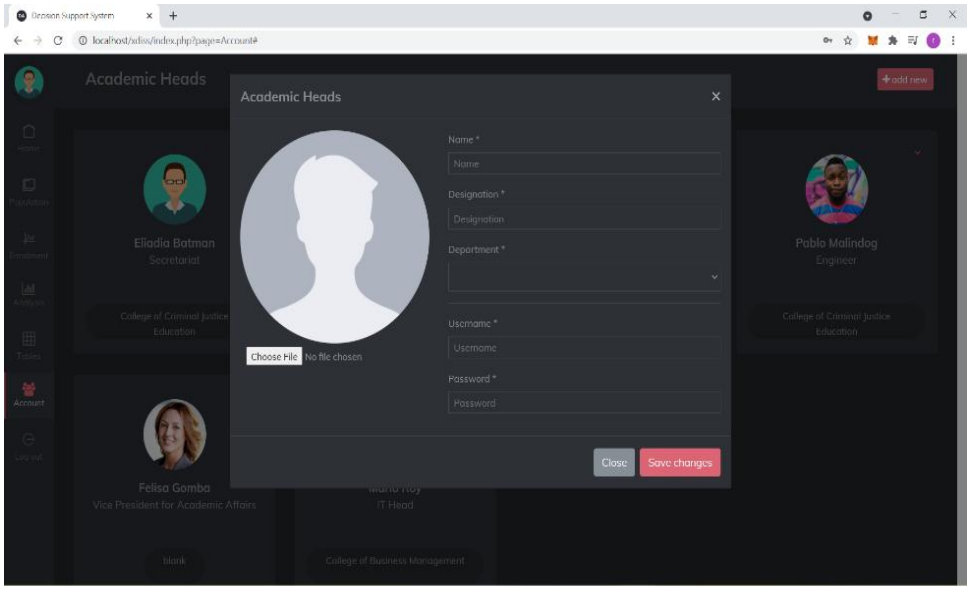
User's Manual

First run

Step-by-step Set up

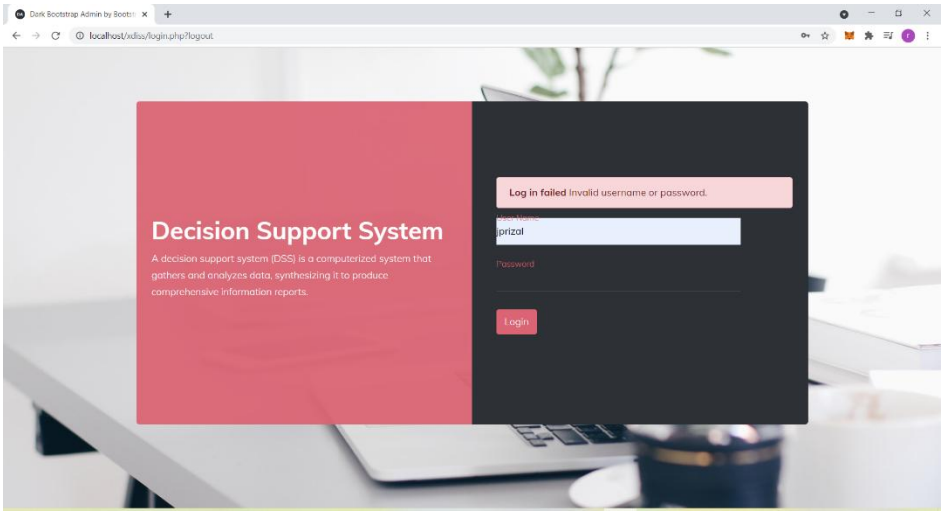
1. First is the installation of the system. Click

2. Set up your user's account



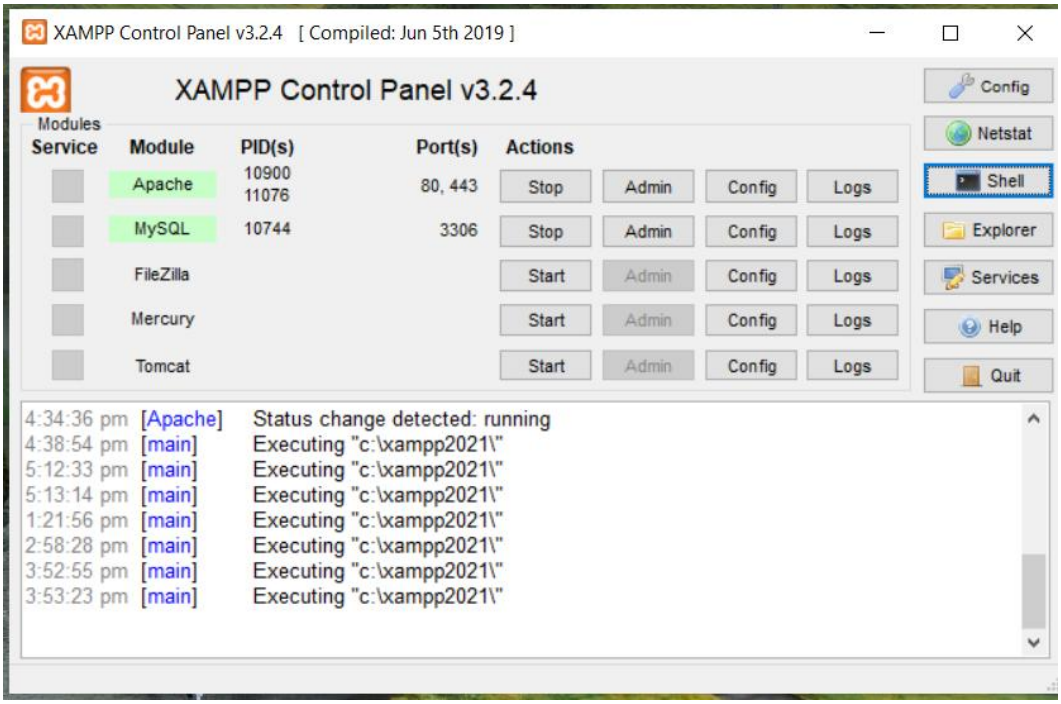
Note: After filling out all fields, click save change.

3. Log in

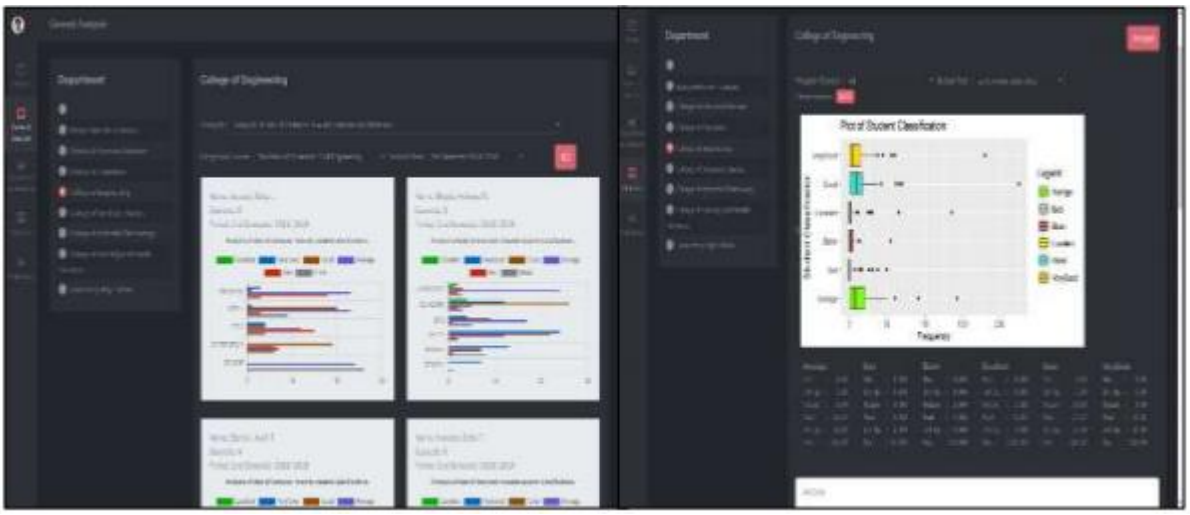

Dark Bootstrap Admin by Bootst
localhost/xdlss/login.php?logout
Decision Support System
A decision support system (DSS) is a computerized system that gathers and analyzes data, synthesizing it to produce comprehensive information reports.
Log in failed Invalid username or password.
jprizol
Password
Login

1 Launching the Educational Data Mining Decision Support System (EDM)

To launch the program, just open XAMPP application then, open a web browser then type : localhost//EMD

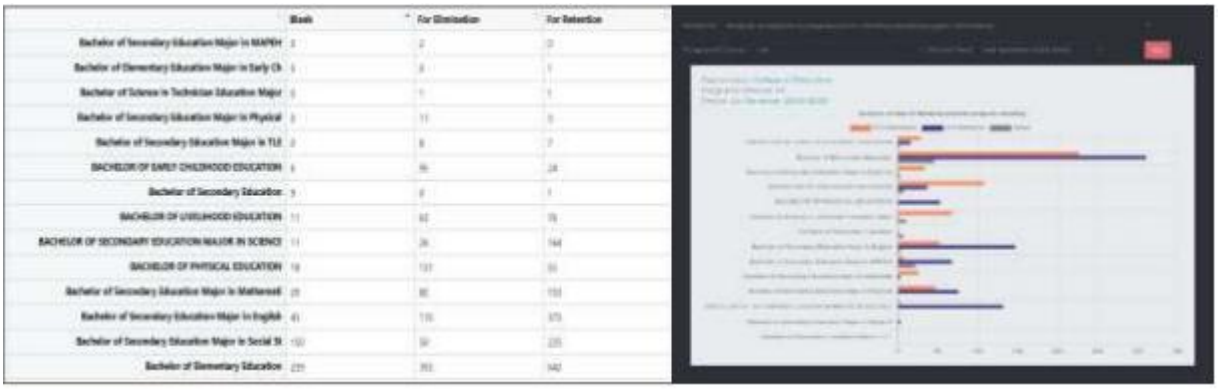


Analyses of Student Grades Classifications



Students in program/course standing (student program 18 elimination

Analysis of Student Standing in a Program



Program subjects per student remarks (passing, failing, and 20 blank)

Analysis of Students' Remarks

SOURCE CODE

INDEX.PHP

```
<?php
session_start();
header("Cache-Control: no-store, no-cache, must-revalidate, max-age=0");
header("Cache-Control: post-check=0, pre-check=0", false);
header("Pragma: no-cache");
if( !isset( $_SESSION['dss'] ) ){
		header("location: login.php");
		exit();
}
require_once('php\functions.php');
			/*
			<li class="active"><a href="index.html"> <i class="icon-home"></i>Home
</a></li>
	<li><a href="tables.html"> <i class="icon-grid"></i>Tables </a></li>
	<li><a href="charts.html"> <i class="fa fa-bar-chart"></i>Charts </a></li>
	<li><a href="forms.html"> <i class="icon-padnote"></i>Forms </a></li>
	<li><a href="#exampledropdownDropdown" aria-expanded="false" data-
toggle="collapse"> <i class="icon-windows"></i>Example dropdown </a>
	 <ul id="exampledropdownDropdown" class="collapse list-unstyled ">
	  <li><a href="#">Page</a></li>
	  <li><a href="#">Page</a></li>
	  <li><a href="#">Page</a></li>
	 </ul>
	</li>
	<li><a href="login.html"> <i class="icon-logout"></i>Login page </a></li>*/
	   $active = "Home";
	   if( isset($_GET['page'])){
			$active = $_GET['page'];
	   }
	   $menus = array(
                                        new MenuLink($active, $href="", $icon="icon-
home",$text="Home"),
                                        new MenuLink($active, $href="", $icon="icon-
windows",$text="Population"),
                                        new MenuLink($active, $href="", $icon="icon-
chart",$text="Enrollment"),
new MenuLink($active, $href="", $icon="fa fa-bar-chart",$text="Analysis"),
                                        new MenuLink($active, $href="", $icon="icon-
grid",$text="Tables"),
                                        new MenuLink($active, $href="", $icon="fa fa-
users",$text="Account"),
                                        new MenuLink($active, $href="login.php?logout",
$icon="icon-logout",$text="Log out"),
```

```
                                        );

?>
<!DOCTYPE html>
<html>
 <head>
  <meta charset="utf-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <title>Decision Support System</title>
  <meta name="description" content="">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <meta name="robots" content="all,follow">
  <!-- Bootstrap CSS-->
  <link rel="stylesheet" href="vendor/bootstrap/css/bootstrap.min.css">
  <!-- Font Awesome CSS-->
  <link rel="stylesheet" href="vendor/font-awesome/css/font-awesome.min.css">
  <!-- Custom Font Icons CSS-->
  <link rel="stylesheet" href="css/font.css">
  <!-- Google fonts - Muli-->
  <link rel="stylesheet" href="https://fonts.googleapis.com/css?family=Muli:300,400,700">
  <!-- theme stylesheet-->
  <link rel="stylesheet" href="css/style.default.css" id="theme-stylesheet">
  <!-- Custom stylesheet - for your changes-->
  <link rel="stylesheet" href="css/custom.css">
  <!-- Favicon-->
  <link rel="shortcut icon" href="img/favicon.ico">
  <!-- Tweaks for older IEs--><!--[if lt IE 9]>
    <script src="https://oss.maxcdn.com/html5shiv/3.7.3/html5shiv.min.js"></script>
    <script src="https://oss.maxcdn.com/respond/1.4.2/respond.min.js"></script><![endif]-->

                <script src="vendor/jquery/jquery.min.js"></script>
                        <script src="vendor/popper.js/umd/popper.min.js"> </script>
                        <script src="vendor/bootstrap/js/bootstrap.min.js"></script>
                        <script src="vendor/jquery.cookie/jquery.cookie.js"> </script>
                        <script src="vendor/chart.js/Chart.min.js"></script>
                        <script src="vendor/jquery-validation/jquery.validate.min.js"></script>
                        <!-- <script src="js/charts-home.js"></script>-->
                         <script src="js/jquery.form.min.js"></script>
                        <script>

                                var url_local           = "http://localhost/diss/php/exe.php";
                                var script_server       =
"http://localhost/diss/php/script_exe.php";
```

```
                function exeQuery( dataWithexe , callback){
                        $.ajax({
                                type: "POST",
                                url: url_local,
                                data:  dataWithexe ,
                                success: function
(response) {

        callback( response );
                                }
                                });
                }



                function exeScript( dataWithexe , callback){
                        $.ajax({
                                type: "POST",
                                url: script_server,
                                data:  dataWithexe ,
                                success: function
(response) {

        callback( response );
                                }
                                });
                }



                function getStatus( alert_type, title, text  ){
                        return '<div class="alert '+ alert_type +'">'+
                                '<strong>'+ title +'</strong> '+ text +
                                '</div>';
                }

        </script>


 </head>
 <body>

        <!-- -->
```

```
        <?php
                //include("frag\header.php");

        ?>
        <!-- -->



   <div class="d-flex align-items-stretch">
    <!-- Sidebar Navigation-->
    <nav id="sidebar"  >
     <!-- Sidebar Header-->
                    <a id="img">
     <div class="sidebar-header d-flex align-items-center">

      <div class="avatar">

                            <img src="php\getimg.php?id=<?php echo
$_SESSION['dss']['photo_id']; ?>" alt="..." class="img-fluid rounded-circle">

                            </div>

       <div class="title">
        <h1 class="h5"><?php echo $_SESSION['dss']['name']; ?></h1>
        <p><?php echo $_SESSION['dss']['deptname']; ?></p>

       </div>

      </div>

                    </a>
     <ul class="list-unstyled">
      <?php
                            foreach( $menus as $menu)
                                    echo $menu->getMenu();
                     ?>
     </ul>


     </nav>


     <!-- Sidebar Navigation end-->
```

```
    <div class="page-content">

                                    <?php
                                            switch( $active ){
                                                    //case $menus[0]->text :
include('php\tempdashboard.php'); break;
                                                    case 'Account' : include('php\users.php'); break;
                                                    case 'Home' : include('php\dashboard.php');
break;
                                                    case 'Enrollment' :
include('php\enrollment.php'); break;
                                                    case 'Population' :
include('php\population.php'); break;
                                            }
                                    ?>

                    <footer class="footer" style="height:20px">

        <div class="footer__block block no-margin-bottom" >
          <div class="container-fluid text-center">
            <!-- Please do not remove the backlink to us unless you support us at
https://bootstrapious.com/donate. It is part of the license conditions. Thank you for
understanding :)-- >
            <p class="no-margin-bottom">2019 &copy; Your company. Design by <a
href="https://bootstrapious.com/p/bootstrap-4-dark-admin">Bootstrapious</a>.</p>
                                    -->
          </div>
        </div>
      </footer>

    </div>
  </div>
  <!-- JavaScript files-->

  <script>
                    $(function (){
                            $('#sidebar').toggleClass('shrinked');
                            $('.page-content').toggleClass('active');
                            $(document).trigger('sidebarChanged');
                            $("#img").click(function(){
                                    $('#sidebar').toggleClass('shrinked');
                            $('.page-content').toggleClass('active');
                            $(document).trigger('sidebarChanged');
                            } )
```

```
                    })
            </script>

    </body>
</html>
```

LOGIN.PHP

```
<?php
session_start();

        if( isset($_GET['logout']) ){
                session_destroy();
                //header('location: login.php');
                //exit();
        }

                if( isset($_SESSION['dss'])){
                                        header('location: index.php');
                                        exit();
                                }

?>
<!DOCTYPE html>
<html>
 <head>
  <meta charset="utf-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <title>Dark Bootstrap Admin by Bootstrapious.com</title>
  <meta name="description" content="">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <meta name="robots" content="all,follow">
  <!-- Bootstrap CSS-->
  <link rel="stylesheet" href="vendor/bootstrap/css/bootstrap.min.css">
  <!-- Font Awesome CSS-->
  <link rel="stylesheet" href="vendor/font-awesome/css/font-awesome.min.css">
  <!-- Custom Font Icons CSS-->
  <link rel="stylesheet" href="css/font.css">
  <!-- Google fonts - Muli-->
  <link rel="stylesheet" href="https://fonts.googleapis.com/css?family=Muli:300,400,700">
  <!-- theme stylesheet-->
  <link rel="stylesheet" href="css/style.default.css" id="theme-stylesheet">
  <!-- Custom stylesheet - for your changes-->
  <link rel="stylesheet" href="css/custom.css">
  <!-- Favicon-->
  <link rel="shortcut icon" href="img/favicon.ico">
  <!-- Tweaks for older IEs--><!--[if lt IE 9]>
     <script src="https://oss.maxcdn.com/html5shiv/3.7.3/html5shiv.min.js"></script>
     <script src="https://oss.maxcdn.com/respond/1.4.2/respond.min.js"></script><![endif]-->
 </head>
 <body>
```

```
  <div class="login-page">
    <div class="container d-flex align-items-center">
      <div class="form-holder has-shadow">
        <div class="row">
          <!-- Logo & Information Panel-->
          <div class="col-lg-6">
            <div class="info d-flex align-items-center">
              <div class="content">
                <div class="logo">
                  <h1>Decision Support System</h1>
                </div>
                <p>A decision support system (DSS) is a computerized system that gathers and
analyzes data, synthesizing it to produce comprehensive information reports.</p>
              </div>
            </div>
          </div>
          <!-- Form Panel    -->
          <div class="col-lg-6">
            <div class="form d-flex align-items-center">
              <div class="content">
                                                <div id="alerter"></div>
                <form method="post" id="log-form"    class="form-validate mb-4">
                                                <input type="hidden" name="exe" value="log"/>
                  <div class="form-group">
                    <input id="login-username" type="text" name="username" required data-
msg="Please enter your username" class="input-material">
                    <label for="login-username" class="label-material">User Name</label>
                  </div>
                  <div class="form-group">
                    <input id="login-password" type="password" name="password" required data-
msg="Please enter your password" class="input-material">
                    <label for="login-password" class="label-material">Password</label>
                  </div>
                  <button type="submit" class="btn btn-primary">Login</button>
                </form>
              </div>
            </div>
          </div>
        </div>
      </div>
    </div>
    <div class="copyrights text-center">
```

```
      <!-- Please do not remove the backlink to us unless you support further theme's development at https://bootstrapious.com/donate. It is part of the license conditions. Thank you for understanding :)-->
    </div>
  </div>
  <!-- JavaScript files-->
  <script src="vendor/jquery/jquery.min.js"></script>
  <script src="vendor/popper.js/umd/popper.min.js"> </script>
  <script src="vendor/bootstrap/js/bootstrap.min.js"></script>
  <script src="vendor/jquery.cookie/jquery.cookie.js"> </script>
  <script src="vendor/chart.js/Chart.min.js"></script>
  <script src="vendor/jquery-validation/jquery.validate.min.js"></script>
  <script src="js/front.js"></script>
        <script>
                                var url_local = "http://localhost/diss/php/exe.php";

                                function exeQuery( dataWithexe , callback){
                                        $.ajax({
                                                                type: "POST",
                                                                url: url_local,
                                                                data:  dataWithexe ,
                                                                success: function (response) {

        callback( response );
                                                                        }
                                                                });
                                }
                                function getStatus( alert_type, title, text  ){
                                        return '<div class="alert '+ alert_type +'">'+
                                                        '<strong>'+ title +'</strong> '+ text +
                                                        '</div>';
                                }


                                $(function(){
                                        $("#log-form").submit(function(){
                                                //alert("xxx")

                                                var data = $(this).serialize();

                                                $("#log-form input").prop("disabled", true);
                                                $("#log-form button").prop("disabled", true);
                                                //alert( data )
```

```
        $("#alerter").html( getStatus("alert-info"," <i class='fa fa-spin fa-spinner'></i>
Authenticating...","Please wait.") );
                                                exeQuery( data,(response)=>{
                                                        alert( response )
                                                    if( response.trim() == "ok"){

        $("#alerter").html( getStatus("alert-success"," Success!"," You will be redirected in a
moment.") );

        setTimeout(()=>{location.reload();}, 2000 )
                                                    }
                                                    else{
                                                        $("#log-form
input").prop("disabled",false);
                                                        $("#log-form
button").prop("disabled",false);
                                                        $("#log-form
input[type=password]").val("");

        $("#alerter").html( getStatus("alert-danger", "Log in failed"," Invalid username or
password.") );
                                                    }

                                                } );


                                                return false;

                                            } )
                                        } )
                                </script>
 </body>
</html>
```

EXE.PHP

```
<?php
                session_start();
                // sleep( 2 );
                        require_once('database.php');

                                        if( isset($_POST['exe']) and
$_POST['exe']=='log'){



                                                $u          =
db_input( $_POST['username'] );
                                                $p          =
db_input( $_POST['password'] );

                                                $sql    = "SELECT *,

                ( SELECT `deptname_acronym` FROM `department` WHERE id=department_id)
as deptname_acronym,

                ( SELECT `deptname` FROM `department` WHERE id=department_id) as
deptname

                FROM `users` WHERE `username`='$u';";
                                                $r          =
db_query($sql);
                                                $arr    = array();
                                                $arr['info'] ="";
                                                $success = "xxxxxx";



                                                if
( db_num_rows($r)>0){
                                                        $row =
db_fetch_array($r);



        //print_r( $row );
                                                        $hash =
password_hash($p, PASSWORD_DEFAULT, ['cost' => 12]);
```

```
                                                                    if
(password_verify( $p, $row['password'] )) {

        if( $row['IsActive'] == '1' ){

        $success                    ='ok';

        $arr['info']                        = $row;

        $_SESSION['dss']                    = $row;

                                                                        }else{

        $success                                = 'Account suspended.';
                                                                        }
                                                                    }else{

        $success                                = 'Invalid password.x jege';
                                                                    }
                                                        }else{

        $success                                = 'Invalid username.y bj';

                                                        }
                                                        echo $success;
                                                        //echo
json_encode( $arr );
                                                    }



                                    if( isset($_POST['exe']) and $_POST['exe']=='loaduser-
json'){
                                        $id                     =
db_input( $_POST['id']);
                                        $rw                             = "SELECT *
FROM users WHERE id=$id;";
                                        echo  json_encode( db_query_one_row( $rw ) );

                                    }
```

```
if( isset($_POST['exe']) and $_POST['exe']=='schedules'){
	$sy 		= db_input( $_POST['sy']);
	$rw 		= "SELECT count(*), deptcode FROM `schedules` WHERE `SchoolYear` LIKE '$sy' GROUP BY deptcode;";
	$db 		= db_query($rw);
	$arrCount 	= array();
	$arrLabel 	= array();
	$arrBGColor 	= array();
	$arrBDColor 	= array();
	$total 		= 0;
	while( $row = mysqli_fetch_array($db)){
		$arrCount[] 	= $row[0];
		$arrLabel[] 	= $row[1];
		$arrBDColor[] 	= '#EF8C99';
		$arrBGColor[] 	= '#EF8C99';
		$total 		+=$row[0];
	}

	echo  json_encode(
			array(
	"count"=>$arrCount,
	"BG" => $arrBGColor,
	"Border" => $arrBDColor,
	"label" => $arrLabel,
	"total"=>$total
	)
		);
}


if( isset($_POST['exe']) and $_POST['exe']=='save-user'){
// 	$data 		= $data->table;
```

```
                                        //      $tb                             = $data->table;
                                                $name                   = $_POST['name'];
                                                $department_id          = $_POST['department'];
                                                $username               = $_POST['username'];
                                                $password               = $_POST['password'];
                                                $hash                    =
password_hash($password, PASSWORD_DEFAULT, ['cost' => 12]);
                                                $IsActive               = 1;
                                                $designation     = $_POST['designation'];
                                                $photo_id               = $_POST['photo_id'];
                                                //exe=save-
user&name=asd&designation=asd&department=1&username=asd&password=ad
                                                if( isset($_POST['action']) and
$_POST['action']=='user-info'){
                                                        $sql =" UPDATE `users` SET `name` =
'$name', `department_id` = '$department_id',`designation` = '$designation' WHERE `users`.`id` =
".db_input( $_POST['update_id'] );
                                                }else

                                                if( isset($_POST['action']) and
$_POST['action']=='user-account'){
                                                        $sql = "UPDATE `users` SET `username`
= '$username', `password` = '$hash' WHERE `users`.`id` = ".db_input( $_POST['update_id']);
                                                }

                                                else{
                                                        $sql                    = "INSERT INTO
`users` (

                                    `id`,`photo_id`, `name`, `department_id`, `username`,
`password`, `IsActive`, `designation`)

                                VALUES (NULL, '$photo_id', '$name', '$department_id', '$username',
'$hash', '$IsActive', '$designation');";

                                                }

                                                db_query( $sql );
                                                // echo $sql;
                                        }
```

```
                                        if( isset($_POST['exe']) and $_POST['exe']=='upload-
img'){
                                                if(isset($_POST['but_upload'])){

                                                        $name = $_FILES['file']['name'];
                                                        $target_dir = "upload/";
                                                        $target_file = $target_dir .
basename($_FILES["file"]["name"]);

                                                        // Select file type
                                                        $imageFileType =
strtolower(pathinfo($target_file,PATHINFO_EXTENSION));

                                                        // Valid file extensions
                                                        $extensions_arr =
array("jpg","jpeg","png","gif");

                                                        // Check extension

if( in_array($imageFileType,$extensions_arr) ){

                                                                // Insert record
                                                                $query = "insert into
images(name) values('".$name."')";
                                                                mysqli_query($con,$query);

                                                                // Upload file

move_uploaded_file($_FILES['file']['tmp_name'],$target_dir.$name);

                                                         }

                                                        }
                                                        echo "xxxxxxxxxxxxxxxxxxx";
                                        }
```

```
                                        if( isset($_POST['exe']) and
$_POST['exe']=='population_data'){

                                                $sy             = db_input( $_POST['sy'] );
                                                $dept           = db_input( $_POST['dept'] );
                                                $sem            = db_input( $_POST['sem'] );
                                                //$sql          = "SELECT `Department`,Course,
YearLevel,count(*) as t FROM `gradesheet`,`students` WHERE `SchoolYear` LIKE '$sy' and
`Semester` =$sem and `gradesheet`.`StudentID` = `students`.`StudentID` and
Department='$dept' GROUP BY `YearLevel`,`Course`,`Department`  ORDER BY
`students`.`YearLevel` deSC";
                                                $sql            = "SELECT

        `Course`,

        `YearLevel`,

        `Department`,

        count( DISTINCT  gradesheet. `StudentID`) as enrolled
                                                                                FROM

        `gradesheet`,students
                                                                                WHERE

        `gradesheet`.`StudentID`=students.StudentID

        and `Semester`='$sem'

        AND `SchoolYear` LIKE '$sy'

        and Department='$dept'
                                                                                GROUP
by course, yearlevel, department ";
                                                //die( $sql );
                                                $db                     = db_query($sql );
                                                $colors =
array("#b5e7a0","#c94c4c","#FAFAD2","#f18973","#DA70D6","#c2d4dd","#ffef96","#F5DEB3","
#90EE90","#deddfa","#ffe196","#b0eacd","#d5c455","#bbe1fa");
                                                $data           = array();
                                                $i                      = 0;
                                                $arr            = array();
```

```
                                        $yrlvls    = array('1st year' , '2nd year', '3rd year',
'4th year');


                                        while($row       = mysqli_fetch_array( $db )){
                                                //$arr[ $row['Course'] ]['data'][]
          = $row['t'];
                                                $arr[ $row['Course'] ]['label']     =
$row['Course'];
                                        /*
                                                if( !isset($arr[ $row['Course'] ]
[ $row['YearLevel'] ]) )
                                                        $arr [ $row['Course'] ]
[ $row['YearLevel'] ] =0;
                                                $arr [ $row['Course'] ] [ 'yearlvl' ] []  =
$row['enrolled'];


                                                */
                                        //      print_r( $row );
                                                $arr [ $row['Course'] ]
[ $row['YearLevel'] ] = $row['enrolled'];

                                        }

                                  //    print_r( $arr );
                                        //die("x");

                                        foreach( $arr as $ar => $values){

                                                $d                                      =
array();
                                                $d['label']         = $ar;
                                                $d['color']         = array( $colors[$i],
$colors[$i],  $colors[$i],  $colors[$i]  );
                                                /* */

                                                foreach($yrlvls as $yrlvl){
                                                        //$d['data'][] = $value;
                                                        if( !isset( $values[ $yrlvl ] ) ){
                                                //              echo $yrlvl ."=". "0";
                                                                $d['data'][] = "0";
                                                        } else{
                                                //              echo $yrlvl ."=".
$values[ $yrlvl ]. " | ";
```

```
                                                    $d['data'][] =
$values[ $yrlvl ];
                                                }

                                            }
                                            //echo "----$ar----";
                                            //print_r( $d );
                                            //        = array( $value['1st year'] ,
$value['2nd year'], $value['3rd year'], $value['4th year'] );
                                            $data[]         = $d;
                                            /* */

                                            $i++;
                                        }

                                        //        die("");
                                        //print_r( $data );
                                        echo json_encode( $data );
                                    }



                                    if( isset($_POST['exe']) and
$_POST['exe']=='enrollment_data'){

                                        $from           = db_input( $_POST['from'] );
                                        $dept           = db_input( $_POST['dept'] );
                                        $to             = db_input( $_POST['to'] );
                                        //$sql          = "SELECT `Department`,Course,
YearLevel,count(*) as t FROM `gradesheet`,`students` WHERE `SchoolYear` LIKE '$sy' and
`Semester` =$sem and `gradesheet`.`StudentID` = `students`.`StudentID` and
```

```
Department='$dept' GROUP BY `YearLevel`,`Course`,`Department`  ORDER BY
`students`.`YearLevel` deSC";
                                        $sql            = "SELECT schoolyear,Semester,
`Course`,  `Department`, count( DISTINCT gradesheet. `StudentID`) as enrolled FROM
`gradesheet`,students WHERE `gradesheet`.`StudentID`=students.StudentID and department
='$dept'  and ( SchoolYear BETWEEN '$from' and '$to')  GROUP by course, SchoolYear";
                                        //die( $sql );
                                        $db                     = db_query($sql );
                                        $colors =
array("#b5e7a0","#c94c4c","#FAFAD2","#f18973","#DA70D6","#c2d4dd","#ffef96","#F5DEB3","
#90EE90","#deddfa","#ffe196","#b0eacd","#d5c455","#bbe1fa","#161616","#C94D65","#E7C04
9","#92B35A","#1F6764","#26251C","#EB0A44","#F2643D","#F2A73D","#A0E8B7");
                                        $data           = array();
                                        $i                      = 0;
                                        $arr            = array();


                                        $y                      = array();

                                        $max            = 0;

                                        while($row      = mysqli_fetch_array( $db )){
                                                //if( !isset($arr[ $row['Course'] ]
[ $row['YearLevel'] ]) )
                                                //      $arr [ $row['Course'] ]
[ $row['YearLevel'] ] =0;
                                                $arr[  $row['Course'] ]
[ $row['schoolyear'] ] = $row['enrolled'];

                                                if( $row['enrolled'] > $max )
                                                        $max = $row['enrolled'];

                                                if(! in_array( $row['schoolyear'],$y ) ){
                                                        $y[]    = $row['schoolyear'];
                                                }
                                        }

                                //      print_r( $y );
                                //      die( $sql );
                                //      die("*****************");
                                        /* */

                                        foreach( $arr as $ar => $values){
```

```
                                        $d                              =
array();
                                        $d['label']     = $ar;

                                        $d['color']     =   $colors[$i];
                                        $c                              =
array();
                                        foreach($y as $y1){
                                                //echo $values[ $y1 ];
                                                if( !isset( $values[ $y1 ] ) ){
                                                        $c[]            = "0";
                                                }else{
                                                        $c[]            =
$values[ $y1 ];
                                                }

                                        }
                                        $d['data']              = $c;
                                        $data[]         = $d;
                                        $i++;
                                }
                                /* */
                                //      die("");
                                //print_r( $data );
                                $a              = array("SchoolYear" => $y,
"data" => $data, "max"=>((round($max / 50) * 50) + (($max % 50)>0?50:0))) ;
                                echo json_encode( $a );
                        }
```

```
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?>
```

FUNCTIONS.PHP

```
<?php

	require_once("php\database.php");

	function getMenu($active, $href, $icon,$text){

		return '<li class="'.$active.'">
					<a href="'.$href.'">
						<i class="'.$icon.'"></i>'.$text.' </a>
						</li>';
	}


	 class MenuLink {
				// constructor
				public function __construct($active, $href, $icon,$text) {
					$this->active	= "";
					if($active==$text)
						$this->active	= "active";

					$this->href	= "?page=". $text;
					if( $href !="")
						$this->href	= $href;
					$this->icon	= $icon;
					$this->text	= $text;
				}

				public function getMenu() {
					echo getMenu($this->active, $this->href, $this->icon,$this->text);
				}

			}


	function getDepartmentDropDown(){
		$sql	= "SELECT * FROM `department` ORDER BY `department`.`deptname_acronym`  ASC";
		$db		= db_query($sql);
		$li	= "";
		while($row  = mysqli_fetch_assoc($db)){
			$li.= '<option value="'.$row['id'].'">'.$row['deptname_acronym'].'</option>';
```

```
		}
		return $li;
	}


	function sem($num){
		if($num == 1) return "First Semester";
		if($num == 2) return "Second Semester";
		if($num == 2) return "Summer";
	}



	function getDepartment(){
		$sql	= "SELECT COUNT(*) AS `Rows`, `Department` FROM `students` GROUP
BY `Department` ORDER BY `Department`";
		$db		= db_query($sql);
		$li	= "";
		while($row  = mysqli_fetch_assoc($db)){
			$li.= '<option
value="'.$row['Department'].'">'.$row['Department'].'</option>';
		}
		return $li;
	}



	function getSchoolYear($asc = "desc"){

		$sql	= "SELECT COUNT(*) AS `Rows`, `SchoolYear` FROM `gradesheet`
GROUP BY `SchoolYear` ORDER BY `SchoolYear` $asc";
		$db		= db_query($sql);
		$li	= "";
		while($row  = mysqli_fetch_assoc($db)){
			$li.= '<option
value="'.$row['SchoolYear'].'">'.$row['SchoolYear'].'</option>';
		}
		return $li;
	}

?>
```

SCRIPT.EXE

```
<?php

	$path			= 'C:\\"Program Files"\\R\\R-3.6.1\\bin\\Rscript.exe ';
	$xampp_path		= " C:\\xampp\\htdocs\\diss\\script\\";
	if( !isset($_POST['exe']) ) die("not set");

	if( isset($_POST['exe']) and $_POST['exe'] =="rscript" ){
			$number = $_POST['number'];
			$command = $path .$xampp_path."script.R " .$number;
			exec( $command );
			echo "<img src='php\\".$number."png.png' />";
		}
?>
```

DATABASE.PHP

```
<?php

    function db_connect($server = 'localhost', $username = 'root', $password = '', $database =
'diss2', $link = 'db_link') {
      global $$link;



                  if( isset( $_SESSION['terminal_db']))  $database = $_SESSION['terminal_db'];



      $$link = mysqli_connect($server, $username, $password);

      if ($$link) mysqli_select_db($$link,$database);

      return $$link;
    }

    db_connect();


  //Function to handle database errors.
    function db_error($query, $errno, $error) {
      $myfile = fopen("db-error.txt", "w") or die("Unable to open file!");

      fwrite($myfile, $error ."\n"."\n"."\n".$query);

      fclose($myfile);

      //die('<font color="red><b>Error Please contact the administrator!</b></font>');
      die($query.'<font color="red><b>'.$error.'</b></font>');
    }


  //Function to query the database.
    function db_query($query, $link = 'db_link') {
      global $$link;

      $result = mysqli_query($$link,$query) or db_error($query, mysqli_errno($$link),
mysqli_error($$link));
```

```
    return $result;
   }


  //Function to query the database.
   function db_insert_query($query, $link = 'db_link') {
    global $$link;

    $result = mysqli_query($$link,$query) or db_error($query, mysqli_errno($$link),
mysqli_error($$link));

    return mysqli_insert_id($$link);
   }

  //Get a row from the database query
   function db_fetch_array($db_query) {
    return mysqli_fetch_array($db_query, MYSQLI_ASSOC);
   }
  //The the number of rows returned from the query.
   function db_num_rows($db_query) {
    return mysqli_num_rows($db_query);
   }
  //Add HTML character incoding to strings
   function db_output($string) {
    return htmlspecialchars($string);
   }
  //Add slashes to incoming data
   function db_input($string, $link = 'db_link') {
    global $$link;

    if (function_exists('mysql_real_escape_string')) {
     return mysqli_real_escape_string( $$link,  htmlspecialchars( $string , ENT_QUOTES, 'UTF-
8') );
    } elseif (function_exists('mysql_escape_string')) {
     return  htmlspecialchars(  mysqli_escape_string($string) , ENT_QUOTES, 'UTF-8');
    }

    return addslashes(  htmlspecialchars($string, ENT_QUOTES, 'UTF-8') );
   }

   function db_query_one_row($query){
    $result =db_query($query);
    return mysqli_fetch_array($result,MYSQLI_BOTH);
   }
```

```
//db_connect() or die('Unable to connect to database server!');

 ?>
```

ENROLLMENT.PHP

```
<script src="js/statdata.js"></script>


    <section class="margin-bottom-sm">
      <div class="container-fluid">

       <?php include('php/titlebar.php'); ?>

                        <div class="row d-flex align-items-stretch">
                                <div class="col-lg-12">
                                        <div class="line-chart block chart">
                                                <div class="title">
                                                                        <div class="row ">
                                                                                <div
class="col-lg-12">

          <h3>Enrollment trend</h3>
                                                                                </div>
                                                                        </div>
                                                                        <div class="row ">

          <div class="col-lg-4 form-group">

                                <label for="selecter_department">Department</label>

                                <select id="selecter_department" class=" selecter form-control mb-3
mb-3"><?php echo getDepartment(); ?></select>



          </div>

          <div class="col-lg-4 form-group">



                                        <label for="selecter_From">From</label>

                                        <select id="selecter_From"  class=" selecter form-control mb-3
mb-3"><?php echo getSchoolYear("asc"); ?></select>
```

```
                </div>

        <div class="col-lg-4 form-group">

                        <label for="selecter_To">To</label>

                        <select id="selecter_To"  class=" selecter form-control mb-3
mb-3"><?php echo getSchoolYear("asc"); ?></select>

                </div>


                                                                        </div>
                                                                </div>
                                                        <canvas id="lineChartCustom3"></canvas>
                                                        </div>
                                                        </div>

                        </div>




    </div>
  </section>


                <script>
                        $(function(){
                                $(".selecter").change(function(){
                                        var dept        = $("#selecter_department").val();
                                        var from        = $("#selecter_From").val();
                                        var to    = $("#selecter_To").val();

                                                        data =
$.param({ exe:"enrollment_data",from: from, dept:dept, to:to });
                                                        exeQuery( data , ( rdata )=>{

                                                                console.log( rdata );
```

```
                                                    var json  = JSON.parse( rdata );

                                                    //alert( json.SchoolYear );
                                                    var ds  = [];
                                                    var lbl =    json.SchoolYear  ;//
["2013-2020", "2013-2020", "March", "April", "May", "June", "July"];
                                                    $.each( json.data, function(i,o){
                                                            //alert( o.label);
                                                            //alert( o.color);
                                                            //alert( o.data);


                                                            ds.push( {

        label:   o.label ,

        fill: false,

        lineTension: 0,

        backgroundColor: o.color,

        borderColor: o.color,

        borderCapStyle: 'butt',

        borderDash: [],

        borderDashOffset: 0.0,

        borderJoinStyle: 'miter',

        borderWidth: 2,

        pointBorderColor: o.color,

        pointBackgroundColor: "#fff",

        pointBorderWidth: 1,

        pointHoverRadius: 5,

        pointHoverBackgroundColor: o.color,
```

```
        pointHoverBorderColor: o.color,
        pointHoverBorderWidth: 2,
        pointRadius: 5,
        pointHitRadius: 10,
        data:   o.data   ,
        spanGaps: false
        } )
                                                                    } )
                                                                    //ddddddddd

        createLineGraph( ds, lbl, parseInt( json.max ) );

                                                                    /*
                                                                            var data_label =  ["1st
Year", "2nd Year", "3rd Year", "4th Year"];
                                                                            var json  =
JSON.parse( rdata );
                                                                            var dataset = [];
                                                                            $.each(json,
function(o,i){
                                                                                    var dset =  {
                                label: i.label,
```

```
                backgroundColor:i.color,

                hoverBackgroundColor:i.color,

                borderColor:i.color,

                borderWidth: 0.5,

                data: i.data

            };

        dataset.push(  dset  );
                                                                    } )
                                                                    console.log( dataset )


        createBarChart3( $('#barChartCustom3'), data_label, dataset);
                                                                        */
                                                                });
                                    } )


                                } )
                    </script>
```

ANALYSIS.PHP

```
<?php

$atype = "Please select analysis  ";
if( isset( $_GET['id'] ) ){

        $a = db_query_one_row("SELECT * FROM `tblanalysis` WHERE
id=".db_input( $_GET['id'] ) );

        $atype ="<i class='fas fa-chart-bar'></i>". $a['analysis'];
}

 ?>


 <div class="page-header">
       <div class="container-fluid">
```

```
                    <div class="list-inline-item logout pull-right">

                        <div class="input-group-prepend float-left">
                         <button data-toggle="dropdown" type="button" class="btn
btn-outline-secondary dropdown-toggle">
                            Select Analysis
                            <span class="caret"></span>
                            </button>
                         <div class="dropdown-menu">

                            <?php
                                $db = db_query("SELECT * FROM `tblanalysis`
WHERE 1");
                                while( $row = mysqli_fetch_array( $db )){
                                    echo '<a
href="?page=Analysis&id='.$row['id'].'" value="'.$row['id'].'" class="dropdown-
item">'.$row['analysis'].'</a>';
                                }
                            ?>
                         </div>
                        </div>

                    </div>
      <h3>   <?php echo $atype; ?></h3>
     </div>
    </div>

        <div class="container-fluid">
                    <?php  if( $a['html']!="")
                            include("php/forms/".$a['html']);
                            else
                                echo "No forms yet!";
                        ?>
        </div>
```

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A P P E N D I C E S

Appendix A

LETTER TO THE RESPONDENTS (END-USERS)

Date: _____

Dear Ma'am/Sir,

Greetings!

The undersigned is doctorate student taking up Doctor of Philosophy major in Technology Management. He is currently working on his dissertation titled "**Educational Data Mining-Based Decision Support System".**

In connection to the said research undertaking, the undersigned would like to ask your available time as the end user of the developed system so he can facilitate the beta-testing as output of his study, there will be initial orientation of the said system at your most convenient time just let him know.

He also takes this opportunity to ask permission to accommodate her in your respective college on the months of February to March as her data collection period. Rest assured that all the data provided by you will be treated with utmost confidentiality, and after having used the data, it will be disposed properly.

Looking forward to grant this request. Thank you so much.

Respectfully yours,

(Sgd.) ROBERTO R. FLORA
Ph.D.-TM, Candidate Student

Noted:

(Sgd.) ESTEBAN A. MALINDOG, JR., Ph.D.
Dean, Graduate School

Appendix B

BETA-TESTING QUESTIONNAIRE

Name (Optional): _____ Date: _____

Direction: Please check (√) the column that corresponds to your rating on the developed system as to several quality system attribute indicators. Read each item carefully and check the most appropriate rating using the 5-point Likert scale as follow:

5	Excellent	(E)
4	Good	(G)
3	Fair	(F)
2	Poor	(P)
1	Very poor	(V)

	System Quality Attribute Indicators	**5 (E)**	**4 (G)**	**3 (F)**	**2 (P)**	**1 (V)**
FUNCTIONALITY						
1	The proposed system has available all function required for its execution.					
2	The proposed system is precise in its results.					
3	The proposed system interacts with specified modules					

4	The proposed system complies with standards, laws, etc.					
5	The proposed system has secured access through password					

System Quality Attribute Indicators		5 (E)	4 (G)	3 (F)	2 (P)	1 (V)
RELIABILITY						
1	The proposed system reacts appropriately when failure occurred					
2	The proposed system informs user concerning invalid data entry					
3	The proposed system is capable of recovering data in the event of failure					

System Quality Attribute Indicators		5 (E)	4 (G)	3 (F)	2 (P)	1 (V)
USABILITY						
1	It's easy to understand the concept and application					

2	It's easy to learn how to use					
3	It's easy to operate and control					

System Quality Attribute Indicators		5 (E)	4 (G)	3 (F)	2 (P)	1 (V)
EFFICIENCY						
1	The system response time is appropriate					
2	The system execution time is appropriate					
3	The resources used are appropriate					

System Quality Attribute Indicators		5 (E)	4 (G)	3 (F)	2 (P)	1 (V)
MAINTAINABILITY						
1	It's easy to find failure when it occur.					
2	It's easy to modify and adopt					
3	Changes are easy to test					

System Quality Attribute Indicators	5 (E)	4 (G)	3 (F)	2 (P)	1 (V)
PORTABILITY					

1	It's easy to adopt with other environment					
2	It's easy to install in other environment					
3	It is in agreement with portability standard					
4	It's easy to use to replace another program					

Comments and Suggestions (if there's any):

_____

_____

_____

_____

Thank you for your cooperation!

Appendix C

SAMAR STATE UNIVERSITY
Arteche Blvd., Catbalogan City, Philippines 6700
Office of the University President

We Innovate. We Build. We Serve.

JAS-ANZ
Certificate No. AJA18.1089
SSU-OPRES-EA-007
01-FEB-2020 REV. 001

CERTIFICATE OF ETHICS APPROVAL

This is to certify that the Samar State University Institutional Research Ethics Review Committee (IRERC) has reviewed and approved a study entitled:

Title : **Educational Data Mining Based Decision Support System**
Name of Researcher/s : **Robert R. Flora**
Reference No : **IRERC EA-0022**
Date of Application : 02/24/2020
Date Reviewed : 02/28/2020

It is hereby mandated that in the implementation of the aforementioned study, the subject researcher shall adhere to International ethical guidelines, national guidelines and all other pertinent requirements prescribed by the SSU-IRERC.

The Researcher can now commence to the data gathering process and the study shall be valid for two (2) years from the date of issuance hereof.

DATE OF ISSUANCE: May 21, 2020 VALID UNTIL: May 21, 2022

RHEAJANE A. ROSALES, D.M.
Director, IRERC

MARILYN D. CARDOSO, Ph.D.
University President

Telephone No. (055) 251 – 2139 | Fax: (055) 543 - 8394 | Website: www.ssu.edu.ph

ETHICAL APPROVAL CERTIFICATE

CURRICULUM VITAE

CURRICULUM VITAE

ROBERT R. FLORA

P2 Brgy. Bunu-anan Catabalogan City Samar

(+639277168467)

rflora214@gmail.com

Personal Vitae

Date of Birth	:	July 28, 1986
Place of Birth	:	Catbalogan City
Citizenship	:	Filipino
Marital Status	:	Married

Professional Qualifications

GRADUATE STUDIES

Doctorate's Degree:

University	:	Samar State University
Address	:	Catbalogan city
Degree	:	Doctor in Philosophy major in Technology Management
Inclusive year:		First 2016- 2020

Master's Degree:

University : Eastern Visayas State University
Address : Tacloban city
Degree : Master of Science in Technology Management
Year Graduated: May 2014

TERTIARY

University : Eastern Visayas State University
Address : Tacloban city
Degree : Bachelor of Science in Information Technology
Year Graduated: 2008

Professional Experience

June 2008 - Present: College Instructor
Samar Colleges, Inc.
Catbalogan City

Skills

Computer Literate

Languages

English, Filipino, and Waray-waray

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES