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Decision Support System to Enhance Students' Employability using Data Mining Techniques for Higher Education Institutions

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Abstract: The paper aimed to establish a decision support system for higher education institutions to predict student employability. The data mining techniques used can assess students' preparedness for employment before finishing their studies. The study used descriptive and developmental methods, including scrum methods and the Hypertext Preprocessor (PHP) to create the website. The Weka software was also used to create a prediction model to measure student employability. Information technology experts evaluated the developed system via an online questionnaire that assessed the system's quality according to ISO/IEC 25010 standards. The dataset was validated using 10-fold cross-validation. The results suggest that academic standing, internship mark/grade, and credit hours are the most significant predictors of students' employability. They also indicate that J48 had the highest accuracy (96.6135%), followed by REPTree (96.2151%) and Random Tree (91.6335%). These models are therefore considered the most appropriate data mining techniques for predicting student employability. Moreover, the paper revealed that the developed decision support system has an overall mean of 4.43, described as a "very great extent," and complies with the ISO 25010 Software Quality Standards.

Keywords: Data Mining, Decision Support System, ISO 25010 Software Quality Standards, J48, Student Employability

1. INTRODUCTION

Student employability is a top priority for Oman's higher education institutions (HEIs) because it represents the main evidence that the HEIs have provided a quality education. It is one of the most important indicators of educational achievement and a way to measure the performance of each HEI. It further indicates the needs of industries for students with specific qualities of knowledge, skills, and values gained from HEIs.

This has been proven by research that shows the importance of academic qualifications for graduate employment [1]. Therefore, students should gain the employability skills required by the job market prior to graduation. According to Santiago et al. [2], one of the functions of HEIs is to provide students with the necessary knowledge and skills to fulfill these employment demands. Employability skills are critical for graduates to be more competitive in the job market [3].

According to Andrews and Higson [4], the gap between what graduates must be able to do and what industries need is causing worry. Globally, industries are concerned that HEIs are not fulfilling their function of providing graduates with the necessary skills [5]. Many studies have demonstrated that graduates develop job skills before entering the workforce [6–8]. This has made it more important for HEIs to make their graduates more employable by making sure that the knowledge, skills, and abilities they have learned are marketable [9].

Furthermore, as illustrated in Figure 1, Oman's unemployment rate grew to 0.2% last year. In 2021, the rate of unemployment was 3.12% [10].

Unemployment is the primary challenge confronted by the country. Approximately 15,000 graduates were seeking jobs in 2012, but approximately 22,000 are still jobless. These were the graduates who had not found a job since the beginning of 2012 [11]. Moreover, Jose [12] reported that the unemployment rate was between 7% and 19% in 2011. Continuous feedback to the HEIs regarding graduate employability results will allow them to enhance their

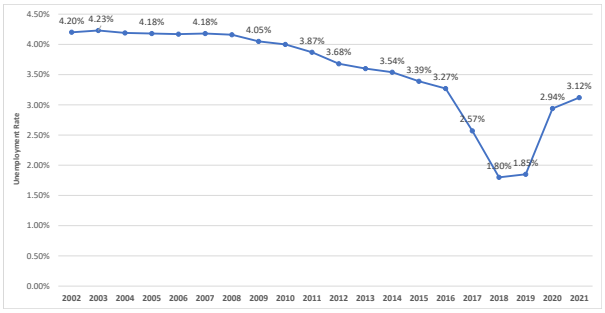

Figure 1. Oman Unemployment Rate from 2002 to 2021

program offerings and curricula. Oman's Ministry of Higher Education, Research and Innovation (MoHERI) conducted another survey of graduates in 2019 to gather accurate information about their jobs, knowledge, skills, and abilities to compare them with those needed for jobs in the Sultanate [13]. The objective of the survey was to determine how long graduates stay in jobs, how much they make, and how they acquire their positions.

As previously mentioned, employability is one of the top priorities of HEIs in Oman and around the globe. Al Abduwani [14] emphasized that HEIs must meet the needs of companies by ensuring that students know what is expected of them. Employers now want graduates to exhibit technical competencies and broader skills such as leadership, communication, teamwork, managerial abilities, and critical thinking. Furthermore, Harvey [15] stated that employability goes beyond continual improvement and development of attributes of learning experience to get jobs. Instead, employability is about learning; it is less about "employment" and more about ability.

HEIs must constantly monitor employability and ensure that their students are fully equipped with the knowledge and skills needed to perform jobs before completing their studies, thus preparing them for employment. In addition, HEIs must collaborate with industries to better understand their needs and consider professional career prospects when revising academic programs. Goodwin [16] established a list of important HEI offerings that can help students become more employable. These include helping students write their curriculum vitae (CV), having mock interviews, determining what skills they need to improve, spending time in a business or organization on placement, and shadowing a professional as they perform their job.

Advances in information technology have changed how educational institutions and academe provide information to enhance academic productivity. In this new frontier of education, information technology has become a common resource for HEIs to improve the services they offer to different stakeholders. Technology has played a vital role in providing opportunities for networking and connecting people. Furthermore, supporting students is a primordial concern as they are considered one of the most important assets of every HEI.

The use of an advanced and sophisticated system for determining employability in higher education will help to efficiently and actively meet the needs and requirements of the job market. HEIs in Oman have striven to build good and open relationships with industry and provide high-quality resources to graduates, which highlights the great emphasis that the Sultanate has placed on the employability of its graduates.

Today's decision support systems (DSSs) rely on technology to compile, store, and present data. The primary purpose of integrating DSSs into the education system is to help middle and top management make more efficient decisions and develop their decision-making skills. Thus, DSSs were integrated into this study.

As data, information, and knowledge have grown in value, academe has recognized that the importance of these resources may accumulate over time, thus increasing their value. This has led many institutions to generate, collect, and utilize data for growing HEI activities. Consequently, the concept of educational data mining has emerged. Data mining is defined as an analytical method for extracting knowledge from massive amounts of data to make more effective decisions [17]. Some authors have defined educational data mining as sorting and filtering relevant or evident information for educational institutions [18], [19]. Data mining is an emerging discipline in the educational setting and is used to understand and analyze educational data to enhance the educational system's processes. Hence, the data mining technique with the highest accuracy was used in the study.

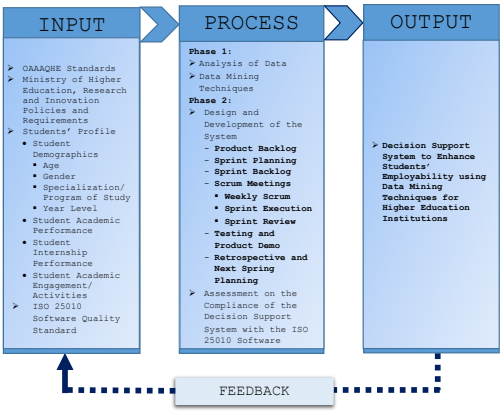

Figure 2. The Paradigm of the Study

Figure 2 shows the input-process model that provided the study's complete structure and paradigm. It gave a detailed outline of how the research paper was conducted. Its direction was based on three stages, which showed the most efficient way of analyzing the different aspects of the transformation process.

The INPUT box is composed of the variables from the external environment used in developing the Decision Support System to Enhance Students' Employability Using Data Mining Techniques.

The input variables are composed of the following: 1) Oman Authority for Academic Accreditation and Quality Assurance of Education (OAAAQA) Standards; 2) Ministry of Higher Education Research, and Innovation (MoHERI) Policies and Requirements; 3) the data sets of the students' profile in terms of demographics (age, gender, specialization/program of study and year level); student academic performance; student academic engagement/activities; 4) student internship experience; and 5) ISO 25010 Software Quality Standard.

These variables were analyzed, processed, and evaluated using the different system development phases listed in the PROCESS box.

The system development phases are the following: Phase 1: Analysis of Data and Data Mining Techniques; Phase 2: Design and Development of the System (Product Backlog, Sprint Planning, Sprint Backlog, Scrum Meetings (Weekly Scrum, Sprint Execution and Sprint Review), Testing and Product Demo, Retrospective and Next Sprint Planning and the Assessment on the Compliance of the Student Employability Decision Support System with the ISO 25010 Software.

The OUTPUT box contains the Decision Support System to Enhance Students' Employability Using Data Mining Techniques for Higher Education Institutions; the result of the processed data. The system was evaluated and validated through a feedback mechanism. Comments and suggestions were gathered from IT experts to further refine the system.

This paper aimed to develop a DSS to enhance students' employability and assess their preparedness for employment before finishing their studies. The system generates data that can be used to identify students who require intervention early in their studies. HEIs may use the results to develop strategies to improve student performance and prepare them for employment. More specifically, this paper sought to answer the following questions: 1) What are the significant predictors of student employability?; 2) What data mining techniques are most appropriate for determining student employability?; 3) What DSS can be developed to enhance student employability in compliance with the ISO-20510 software quality standards of functionality suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, portability? and; 4) What enhancements can improve the developed student employability management system?

2. LITERATURE REVIEW

A. Student Employability Definition

There is currently no clear and standardized definition of student employability, as different organizations and industries use different definitions and indicators. In this study, the various definitions were gathered to provide a clear understanding of what students need to become employed. Many definitions have been suggested to date, which has resulted in uncertainty and misunderstanding regarding what employability refers to in an educational system.

Employability is defined in many ways and settings. Hillage and Pollard [20] defined the term as the ability to obtain and sustain employment. Knight and Yorke [21] described it as a set of skills and knowledge. For Yorke and Knight [22], it is a set of competencies that improve graduates' prospects of getting jobs and excelling in their chosen careers, therefore benefiting themselves, their communities, and the economy. Employability, as defined by Yorke [23], relates to a graduate's accomplishments and potential for obtaining a "graduate job" and should not be confused with actual employment. Moreover, he underlined that "employability" is not a characteristic exclusive to recent graduates; rather, it must be continually renewed throughout an individual's working life and understanding as well as personal attributes, which improve their chances of obtaining jobs.

Several authors have used Yorke's definition of employability as a lens through which to view employability in their research [24],[25]. From the literature review, employability is a term with a comparable definition and structure. It refers to the ability of students to learn and develop the necessary knowledge, skills, and values to find work in the labor market after completing their studies. In the study, this phrase will be used to refer to the same concept.

B. Datasets and Data Mining Methods to Predict Students' Employability

Cruz and Encarnacion's study [26] was adopted for this paper to identify datasets and data mining techniques and algorithms that could help predict students' employability. Cumulative grade point average (CGPA) was determined to be the most relevant data for predicting students' performance and employability during their studies. Because CGPA and grades have real value in predicting student employability and career performance as well as defining the level of academic performance, many researchers have used them as measures. Moreover, gender, technical skills, communication, critical thinking, problem-solving, analytical and decision-making skills, extracurricular activities, and training/internship placement were identified as additional key data points. Classification techniques were beneficial in determining students' employability by predicting their success in examinations, developing emotional skills, and receiving promising job offers and employment. There are

significant benefits to using classification techniques to assess students' academic performance, forecasting the high risks for failure, identifying weak students, developing a system for predicting academic performance, predicting successful academic performance, and enhancing the educational system.

C. Data Mining Algorithms for Predicting Student Employability

Verecio [27] projected employability skills using the J48 model with 10-fold cross-validation, revealing that 85.50% of students with expert (82.8%), advanced (95%), and intermediate (57.10%) on-the-job-training performance were accurately categorized. Moreover, the "model has a high acceptance for predicting employability" from on-the-job training. Other studies have assessed the accuracy of various other classification algorithms. For example, Sapaat et al. [28] developed an employability model using data mining classification techniques. The authors conducted a classification experiment to ascertain graduates' employability. Bayes algorithms were compared with two tree-based algorithms, and J48 was shown to have the highest accuracy.

The study of Cruz and Encarnacion [26] showed that classification techniques have been the most frequently used in the extant research on predicting students' employability and students' academic performance. The study tested and compared the J48 and Naïve Bayes algorithms, among others, to predict student employability.

D. Datasets and Data Mining Methods to Predict Students' Employability

Arnott et al. [29] defined DSSs in their study as information systems that intended to help managers make decisions, including personal, group, and executive information systems that perform online analytical processing, data warehousing, and business intelligence. According to Hosack et al. [30], DSSs were created to help make complicated structured, semi-structured, and unstructured decisions. The authors added that the prominence of DSSs as a research focus has grown them into a mature research field that addresses significant research challenges. They therefore emphasized the contemporary relevance of DSS research, which is aimed at continually enhancing decision-making processes.

A DSS was used in this study to analyze information in several ways and develop an accurate prediction model to identify a suitable solution for improving student employability. This model is a depiction of the current scenario in terms of employability and provides strategies for determining students' employability levels.

E. Student Employability and Data Mining

Many HEIs have begun to explore the potential of data mining to identify the needs of students and their graduates as well as the factors influencing employability [28], [31], [32]. Sapaat et al. [28] used data from a tracer study to classify a graduate profile as employed, unemployed, or undetermined. The Waikato Environment for Knowledge Analysis (Weka) was used to build the classifiers. Weka is a data mining application developed by the University of Waikato in New Zealand and is available as open-source software. The dataset was converted to AFFF file with the .afff extension.

AbdulRahman et al. [31] used data mining techniques to predict the employment status of fresh graduates from public institutions six months after graduation. Several learning algorithms, including $k-$nearest neighbors, naïve bayes, decision trees, logistic regression, and support vector machines, were employed, covering both supervised and unsupervised learning. The accuracy of the algorithms was compared to determine which was the most accurate. The training dataset was derived from the tracer study.

The study conducted by Elcullada-Encarnacion [33] intended to develop an online student academic advising system for Oman Tourism College. The system facilitated academic advising activities and kept track of students' academic performance. The author utilized data mining methods such that the system was capable of generating a dataset for data analysis and modeling to discover useful dasta types, such as students' profiles, academic concerns, skills assessments, priorities, and module marks. The present study is similar to those of Elcullada-Encarnacion [33] and Verecio [34] in terms of processes, except that the latter study focused on the predicting employability skills. The former used three techniques, namely decision tree classification, clustering with the k-means algorithm, and cross-validation, whereas the latter used the J48 algorithm. In the present study, the data mining techniques were identified and compared with those with the highest accuracy. Weka was used to create a prediction model of student employability.

3. RESEARCH METHODOLOGY

This research used both descriptive and developmental methods. Quantitative and qualitative data and information were collected using an online questionnaire.

The study started with data collection from the University of Nizwa database. The dataset was created using student records from the Spring and Fall Semesters of 2020–2021, containing 502 instances and 10 attributes. The processes concluded with the identification of the most accurate prediction model. The raw data were entered into Weka in .csv format. The Weka workbench provides graphical user interfaces for data analysis and predictive modeling [35]. Weka was built on Java, which is commonly used for data classification, clustering, association rules, and evaluation [36].

The web-based DDS was developed using agile project management. Agile is a project management methodology

that emphasizes continual improvement in system development. Recently, the agile software development process has become one of the most widely used software development approaches [37]. The agile technique was established to speed up and optimize the software development process and to identify and modify faults and flaws quickly. Using this process, developers and teams can deliver products better and faster via brief interactive sessions or sprints [38].

The design involving the development of the automated system were visualized with the use of the Unified Modeling Language (UML). According to Koc et al. [39], the UML is used to develop a system in software engineering; a visual language to define and document a system. The type of UML used in the study was the Use Case Diagram which describes the systems functional requirements in terms of use cases. Moreover, this research employed Scrum by Rubin [40], a sophisticated framework for agile procedures, to organize and manage the work needed to build the system. PHP was used to create the website. The back-end system is MySQL responsible for adding, accessing, processing, manipulating and controlling databases. The LAMP Stack (Linux OS, Apache web server, MySQL database and PHP) technology was used for production server.

The research went through an ethics review process to ensure that the research processes strictly adhered to the University's ethics standards and Data Privacy Law regulations. In addition, the researcher maintained the anonymity of the participants by not disclosing names or student IDs; a proper protocol was followed, and formal communications were observed. As the study was carried out in Oman, an Arab country, ethical sensitivity was taken into account.

A survey questionnaire was conducted in the study to assess the quality of the developed system considering the ISO/IEC 25010 System Quality Model Standards, specifically in terms of its functional stability, performance, efficiency, compatibility, usability, reliability, security, maintainability, and portability. Ratings were requested on a five-point Likert scale. The average responses of the participants were calculated as weighted arithmetic means.

TABLE I. WEIGHTED ARITHMETIC MEAN AND ITS INTERPRETATION

5	Very Great Extent
4	Great Extent
3	Moderate Extent
2	Low Extent
1	Very Low Extent

The research employed the weighted arithmetic mean to get the average responses of the participants.

The interpretation of the range of the weighted mean is shown below.

TABLE II. RANGE OF WEIGHTED MEAN AND ITS INTERPRETATION

Range of the Weighted Mean	Interpretation
4.20 – 5.00	Very Great Extent
3.40 – 4.19	Great Extent
2.60 – 3.39	Moderately Extent
1.80 – 2.59	Low Extent
1.00 – 1.79	Very Low Extent

4. RESULTS AND DISCUSSION

A. *Significant Predictors of Students' Employability*

TABLE III. STUDENTS' EMPLOYABILITY EVALUATION CRITERIA AFTER PRE-PROCESSING HAS BEEN PERFORMED

Attributes	Description	Values
CGPA	Cummulative Grade Point Average of Courses	3.75-4.0 3.30-3.74 2.75-3.29 2.30-2.74 2.00-2.29 1.99 and below
Academic Standing	CGPA Classification for bachelor's degree	Excellent with Honors, Excellent, Very Good, Good, Satisfactory and On Probation
College	Name of College where the student is registered	CEMIS (College of Economics, Management and Information Systems) CEA (College of Engineering and Architecture)
Department	Name of Department where the student is registered	Department of Accounting Department of Management Department of Economics Department of Architecture and Interior Design Department of Civil and Environmental Engineering Department of Electrical and Computer Engineering Department of Chemical and Petrochemical Engineering
Specialization	Major of the student	Accounting, Business Administration, Marketing, Economics and Finance Electrical Engineering, Computer Engineering, Architecture, Interior Design, Civil Engineering, Environmental Engineering and Chemical Engineering
Credit Hours	Credit hours completed by the student	9 – 160 hours
Gender	Gender of the student	(M, F)
Internship Grade	The final grade received by the student during internship	A (4.0); A- (3.7); B+ (3.3); B (3.0); B- (2.7); C+ (2.3); C (2.0); C- (1.7); D+ (1.3); D (1.0); F (0)
Internship Performance	Classification of internship rating based on the overall assessment of internship performance	(Excellent, Very Good, Good, Fair, Poor, Very Poor)
Age	Age of the student	20-38

Table III shows the complete training dataset for student employability derived from the University's database and summarizes their attributes, descriptions, and possible

values to identify the significant predictors of students' employability.

The study used feature selection, which is a critical component of successful data mining as it determines a dataset's most significant features. The following table presents a comparison of the following feature selection methods to determine the most appropriate method:

- InfoGainAttributeEval,
- CorrelationAttributeEval, and
- (CfsSubsetEval) correlation-based feature selection subset evaluation.

TABLE IV. COMPARISON OF FEATURE SELECTION METHODS USED IN THE STUDY

Attribute Evaluator	Search Method	Attributes
InfoGainAttributeEval	Ranker	CGPA, Internship Mark, Internship Performance
CorrelationAttributeEval	Ranker	Internship Mark, Credit Hours, CGPA
CfsSubsetEval	BestFirst	Credit Hours, Internship Mark, Academic Standing

Table IV shows the different attribute evaluators and search methods used and the corresponding attributes identified from the dataset in the study. The figures below show the results using Weka.

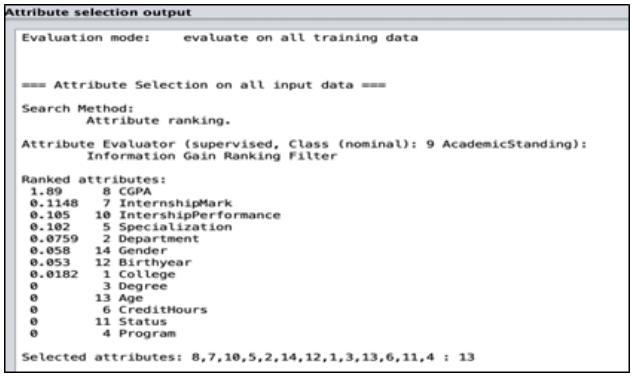

Figure 3. InfoGainAttributeEval Result

Figure 3 shows the identified predictors of student employability with the use of InfoGainAttributeEval. As a result of employing such an attribute evaluator, the ranked attributes are listed in the figure.

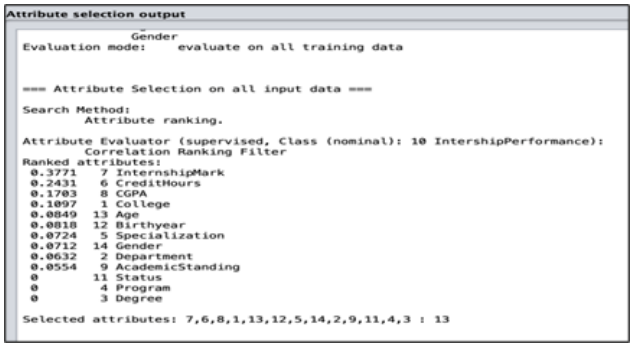

Figure 4. CorrelationAttributeEval Result

Figure 4 shows the identified predictors of student employability with the use of CorrelationAttributeEval. As a result of employing such an attribute evaluator, the ranked attributes are listed in the figure.

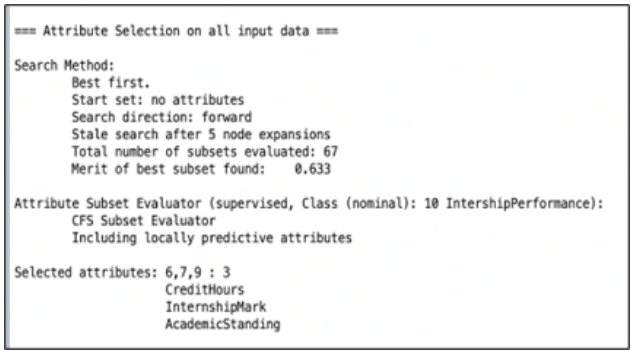

Figure 5. CfsSubsetEval Result

Figure 5 shows the identified predictors of student employability with the use of CfsSubsetEval. As a result of employing such an attribute evaluator, the selected attributes are listed in the figure.

Consequently, credit hours, internship mark/grade, and academic standing were identified as the most predictive factors. These predictors were available in the University of Nizwa database, which is why they were used in the present study.

Furthermore, these predictors were compared with previously identified predictors of students' employability in terms of their existence in the university database, including technical, communication, critical thinking, problem-solving, analytical, and decision-making skills, CGPA, gender, age, and training/internship placement. Moreover, internship grades incorporated measures of the following skills: technical, communication, critical thinking, problem-solving, analytical, and decision-making skills. These were incorporated into the assessment of students' internship performance. Academic standing, on the other hand, was based on the students' CGPAs; age and gender were not considered.

TABLE V. CLASSIFICATION ACCURACY USING VARIOUS ALGORITHMS IN WEKA

Attribute Evaluator	Search Method	Nominal Value	Tree Method	Correctly Classified	Incorrectly Classified
InfoGain AttributeEval	*Ranker*	*Internship Performance*	*Random Tree*	*86.4542%*	*13.5458%*
			REPTree	*89.243%*	*10.757%*
			J48	*90.6375%*	*9.3625%*
		Academic Standing	*Random Tree*	*83.4661%*	*16.5339%*
			REPTree	*96.0159%*	*3.9841%*
			J48	*96.6135%*	*3.3865%*
Correlation AttributeEval	*Ranker*	*Internship Performance*	*Random Tree*	*86.8526%*	*13.1474%*
			REPTree	*91.8327%*	*8.1673%*
			J48	*94.6215%*	*5.3785%*
		Academic Standing	*Random Tree*	*80.8765%*	*19.1235%*
			REPTree	*96.2153%*	*3.7849%*
			J48	*96.6135%*	*3.3865%*
CfsSubsetEval	*Best First*	*Internship Performance*	*Random Tree*	*92.4303%*	*7.5697%*
			REPTree	*93.2271%*	*6.7729%*
			J48	*95.0199%*	*4.9801%*
		Academic Standing	*Random Tree*	*91.6335%*	*8.3665%*
			REPTree	*96.2151%*	*3.7849%*
			J48	*96.6135%*	*3.3865%*

In this study, CfsSubsetEval was used as the selection method. Table V displays the results of comparing the various features where CfsSubsetEval has generated three attributes, including credit hours, internship grade, and academic standing (see Figure 5), whereas CorrelationAttributeEval and InfoGainAttributeEval generated more attributes (see Figures 3 and 4). Therefore, CfsSubsetEval was chosen to determine the worth of a subset of attributes by considering each feature's predictive ability and the degree of redundancy between them [41]. The search algorithm employed was best-first search, which explores the most promising node in a graph.

B. *Data Mining Techniques Most Appropriate for Predicting Student Employability*

The study reviewed the summary of 30 related studies in Cruz and Encarnacion [26] on the datasets, data mining techniques, and algorithms and were also utilized in the study as well as the various authors' findings. In their study, the classification techniques were discovered to be primarily used for prediction- and analysis-related tasks. The review of the literature revealed that the J48, Naïve Bayes, and CHAID decision tree algorithms were the best data mining algorithms for predicting students' employability and determining students' academic performance. These findings were also tried out in this study.

However, the study identified a dataset tested using the classification technique under the tree method with the J48, Random Tree, and RepTree algorithms in Weka.

TABLE VI. CLASSIFICATION ACCURACY USING J48 ALGORITHM IN WEKA

Classification Algorithms	Correctly Classified	Incorrectly Classified
Random Tree	91.6335%	8.3665%
REPTree	96.2151%	3.7849%
J48	96.6135%	3.3865%

The prediction was performed through a series of classification experiments with the use of the tree methods algorithms to predict students' employability. During the training phase, the above-mentioned tree methods were tried out on the pre-formatted data to generate the binary tree model. Following the testing phase, the data was divided into k number of equal-sized folds using k-fold cross-validation. Hence, 10-fold cross-validation was used to validate the dataset. The results showed that J48 had the highest accuracy percentage at 96.6135% compared with REPTree at 96.2151% and Random Tree at 91.6335%. The generated J48 algorithm from Weka was integrated into the DSS to predict student employability.

C. *Developed Decision Support System (DSS) to Enhance Students' Employability and the Extent of Its Compliance to the ISO 25010 Software Quality Standards*

The developed system is a web-based application system intended to identify students who are at risk of not finding employment after completion of their studies. It also determines the students' potential based on the number of credit hours they have completed, their academic standing, and their internship performance.

Furthermore, it was developed as an application available through mobile devices for easy accessibility. Moreover, the web-based DSS may be used by faculty advisers, students, and other relevant stakeholders.

The figures below show sample screenshots of the web-based DSS:

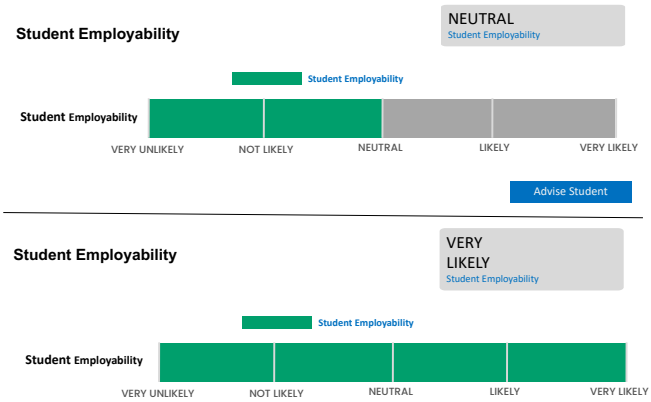

Figure 6. Student Employability Dashboard Screenshots

Figure 6 illustrates two examples of the student employability dashboard to show how the developed web-based DSS figures out a student's employability status by putting them into one of five categories: "very unlikely," "not likely," "neutral," "likely," or "very likely" to get a job. As assessed by the developed system, an adviser may request a meeting with students who are very unlikely, not likely, or neutral to obtain employment or who are at risk of

getting employment. In addition, the adviser may provide immediate counseling or refer students to other University units that offer teaching and learning services and tutorial sessions.

TABLE VII. ASSESSMENT OF IT EXPERTS ON THE EXTENT OF COMPLIANCE OF THE DEVELOPED SYSTEM TO ISO 25010 SOFTWARE QUALITY STANDARDS

Criteria	Weighed Mean	Descriptive Interpretaion
Functional Suitability	4.47	Very Great Extent
Performance Efficiency	4.33	Very Great Extent
Compatibility	4.45	Very Great Extent
Usability	4.40	Very Great Extent
Reliability	4.30	Very Great Extent
Security	4.50	Very Great Extent
Maintainability	4.48	Very Great Extent
Portability	4.50	Very Great Extent
Overall Mean	**4.43**	**Very Great Extent**

Table VII summarizes this study's assessment of the developed system's compliance with the ISO 25010 Software Quality Standards. Based on its assessment by IT experts, the DSS evaluation determined that it complies with the ISO 25010 Software Quality Standards in terms of its functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability, with a computed mean of 4.43 and described to a great extent. This means that IT experts found the system usable and capable of performing its intended functions and meeting the requirements. Wulandari et al. [42] said that information systems are very important in the area of globalization and that they should be in line with the ISO 25010 standards to make sure that the quality of the software application meets the relevant standards and the user's needs. Franca and Soares [43] provided in their study a specific quality for service-oriented architecture based on the quality attributes defined by ISO 25010. The authors also reiterated that ISO 25010 is currently the most complete version of quality models of ISO standards.

D. Further Enhancements that can Help to Improve the Developed System

One important enhancement that was determined from the results of this study would be the inclusion of students' extracurricular activities to predict employability as extracurricular activities were identified as a critical factor in predicting employability. Because an extracurricular activities interface is already in the University's system, integrating it into the system developed in this study would be easy. In addition, course learning outcomes, program outcomes, and graduate attribute attainment should be integrated into the system as attributes that can be used to predict students' employability. Students are expected to meet the course's learning outcomes, and students' academic performance in their courses which is measured according to their knowledge, skills, and values. The students are expected to demonstrate proficiency in these program-specific competencies (knowledge, skills, and values) that align with the desired attributes of graduates of HEIs. Students are informed of the learning outcomes of both the degree programs and the individual courses and are guided through these outcomes in order to gain a thorough understanding of how they are assessed. Another valuable enhancement to the system would be the addition of a chatbot to facilitate communication between advisers and students and quickly address any concerns.

5. CONCLUSION AND FUTURE RESEARCH

With higher education's emphasis on student employability and providing a quality education that will produce graduates who qualify for employment opportunities, the developed system was deemed useful and necessary, given the University's commitment to student employment. The use of the developed system would simplify the identification of at-risk students by faculty advisers and allow them to provide fast and appropriate interventions to assist their student advisees in improving their academic performance.

The developed DSS intended to enhance student employability and may be implemented and utilized by all relevant stakeholders to improve student employability at the University of Nizwa. The system can be integrated with the University of Nizwa's existing Eduwave system to centralize the University's information database, automate routine tasks, simplify processes, and optimize operations. Other data mining techniques may be tested occasionally over time as the system and other University practices evolve.

Furthermore, the evaluation by IT experts demonstrated that the developed system complies with the ISO 25010 Software Quality Standards in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The analysis, design, development, and testing of the DSS to enhance student employability addressed the prevalent issues associated with monitoring students' academic performance and employability, as determined by the findings of this study. Therefore, the developed system will be vital for identifying students who require intervention during their studies so they may receive the necessary assistance and support to be able to obtain employment following graduation from the University.

Lastly, this will contribute to a more accurate prediction of student employability. Similar studies should be conducted to enhance the functionality of the developed system as well as the various identified components that are significant predictors of student employability.

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