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RESEARCH ARTICLE

STRATEGIC DECISION SUPPORT: DEVELOPING A DASHBOARD FOR MANAGERIAL INSIGHTS IN HIGH-LEVEL TVET STUDENTS' ENROLMENT AT UNIVERSITI MALAYSIA PAHANG AL-SULTAN ABDULLAH

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ABSTRACT - The purpose of this study was to create a dashboard with information visualisation to assist Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA) in managerial decision-making and to critically and hierarchically present data regarding the enrolment of Malaysian Diploma Vocational (MDV) students into high-level Technical Vocational Education and Training (TVET) programs at UMPSA. The Cross Industry Standard Process for Data Mining (CRISP-DM) model was applied in this research followed by dashboard development using Microsoft Power BI. The CRISP-DM model consists of six continuous and connected phases, namely business understanding, data understanding, data preparation, data modelling, data visualisation, and data synchronise and update. The data was obtained from the Undergraduate Records Management Unit, Centre for Academic Management, UMPSA. The database was used in the development of the dashboard to store information in the form of reports and for data visualisation purposes. The findings hope to assist the management of UMPSA in making better decisions and planning the enrolment process of prospective students. The dashboard outlines several initiatives and best practices that should be implemented by the Malaysian Government, the Ministry of Higher Education, and UMPSA through the UMPSA 2021–2025 Strategic Plan to empower the high-level TVET agenda.

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1.0 INTRODUCTION

Technical Vocational Education and Training (TVET) stands not only as a channel for processing and producing local skilled labour but also as an engine of national development. In the 21st century, highly skilled and knowledgeable workers in the technical field are necessary to ensure the positive growth of a nation's economy (Bakar, 2019). According to the Shared Prosperity Vision 2030, TVET is an enabler that can succeed in the formation of a prosperous developing country and achieve global attention (MOEA, 2019). In Malaysia, the Opening Ceremony of the National Technical Education and Vocational Training Week 2022 and the declaration of June 2nd as the National TVET Day by the Prime Minister illustrates the government's determination to increase the prestige of TVET as students' primary choice in furthering their education. The government also allocated RM 6.6 billion in the 2022 Budget to empower the TVET sector (MOF, 2021).

Increasing student enrolment into TVET programs is a challenge that must be overcome to reduce the nation's dependency on highly skilled foreign labour. To empower the field of TVET in Malaysia, it is crucial for the perceptions of parents, students, and the younger generation to be positive and aligned with the physical cyber revolution. According to Mohd Hussin et al. (2017), some students prefer to just follow the recommended courses and institutions of higher learning made by their parents. As outlined in the Industrial Revolution 4.0 (IR 4.0), TVET focuses on producing graduates to accommodate a highly skilled workforce. TVET graduates are also competent entrepreneurs (Mohd Ishar et al., 2020) who can be independent and create their own job opportunities upon undergoing various training, skills, and exposure to technology throughout their duration of study.

Higher Education Institutions (HEIs) are the major platform for creating a skilled workforce, whether through full-time or part-time courses, as a result of changes in the national education system (MOHE, 2015). However, several factors can affect the public's awareness of the opportunity to continue their education at higher education facilities. Additionally, HEIs require strategic planning. A study by Almadhoun et al. (2011) denoted that to accomplish marketing objectives, digital marketing has emerged as a trend that combines innovation and mechanisation. Teenagers rely mostly on this medium to determine the most recent news in the digital age. The internet and related applications make information about the academic programs offered by universities easily accessible.

Furthermore, students who pursue TVET do not end their education after achieving a diploma. Van Rooij et al. (2018) found that students' interest is also encouraged by their studies before enrolling into HEIs. The availability of numerous high-level TVET programs provided by the Malaysian Technical University Network (MTUN) allows students to further

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their education into a higher level. Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA) is one of the MTUN institutions created to achieve the goals and aspirations of educational transformation. Previously known as Kolej Universiti Kejuruteraan & Teknologi Malaysia (KUKTEM), a distinctive engineering and technology institution with a focus on engineering and technology, UMPSA is dedicated to expand the number of students enrolled in high-level TVET programs as per the 2021-2025 Strategic Planning (UMP, 2021).

The majority of students enrolled in high-level TVET programs at UMPSA hold a Malaysian Certificate of Higher Education, a Matriculation Certificate, or a Diploma. This research aims to analyse the profile characteristics and segmentation of Malaysian Diploma Vocational (MDV) students from Vocational Colleges that choose high-level TVET programs in UMPSA. The College of Engineering Technology, UMPSA offers MDV students with an array of technology programs majoring in civil, chemical, mechanical, manufacturing, and electrical. Unfortunately, the College is having trouble to recruit enough students and the feeder from MDV holders remains insufficient.

The purpose of this study is to identify suitable dashboard design standards and apply them to the dashboard. It also aims to gather accurate profiling and segmentation data to boost the enrolment into high-level TVET programs at UMPSA. The research objectives are: (i) to create a dashboard with information visualisation to assist UMPSA in managerial decision-making; (ii) to present data critically and hierarchically regarding the enrolment of Malaysian Diploma Vocational (MDV) students into high-level TVET programs at UMPSA.

To date, no previous research has been conducted concerning the topic in UMPSA. Therefore, this study is crucial to broaden the current knowledge and understanding of how to track students' enrolment into the Bachelor of Technology programs using data analytics dashboards. This will provide universities with real-time insights, customisable dashboards, and data visualisation to make the necessary improvements. The outcomes of tracking student enrolment in universities via a data analytics dashboard can be advantageous to university administration, faculty, staff, students, regulatory authorities, and business partners. UMPSA can lead to better results for all stakeholders and contribute to the expansion and success of the institution by utilising data-driven insights to make informed decisions.

For this purpose, UMPSA must investigate the criteria used to choose students for admission to universities as it will help to preserve the institution's reputation for excellence. An important source of revenue for the university is student enrolment. UMPSA must understand students' needs through a variety of approaches, including by asking them about their opinions and perspectives on the university. Deciding where to pursue tertiary education is a crucial decision for students that can have a lasting impact. Students will also commit a significant amount of time into their studies, adjusting into the UMPSA environment, and the predetermined cost of their education. One of the main obstacles for continuing education at a university is the cost of living (Alida et al., 2007). This area of research can offer significant recommendations for enhancing the strategy and quality of student enrolment from MDV to choose UMPSA as a first choice in the UPU Online System.

The remainder of this paper is organised as follows: Section 2 briefly presents a summary of literature review pertaining to the topic; Section 3 explains the research methodology; Section 4 presents the results and discusses the main findings; and Section 5 concludes the paper.

2.0 METHODS AND MATERIAL

2.1 High–Level TVET in Malaysia

TVET is a significant route for Malaysia to develop skilled labour and become a high-income nation (Rajadurai et al., 2018). By 2020, the nation is anticipated to have 1.3 million more occupations that require skills related to TVET (MOHE, 2017). According to the Eleventh Malaysia Plan, high-quality TVET programs are offered by public HEIs, including Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA). As a technical university founded in 2002 and classified by the Malaysian Technical University Network (MTUN), UMPSA is dedicated towards increasing student enrollment in high-level TVET programs based on the 2021-2025 Strategic Planning (UMP, 2021). High-level TVET is an advanced and in-depth level of technical and vocational education and training that prepares students for a highly skilled, specialised, and demanding profession in their areas of specialisation. High-level TVET programs must be flexible and adaptive, and they ought to give students a mix of theoretical knowledge and practical skills. According to Ruhizan and Norazah (2014), the 10th Malaysia Plan showed that the number of highly skilled workers in Malaysia was lower than in other nations like Singapore, Chinese Taipei, and Korea where it constituted to a substantially higher percentage of the workforce. Among the significance of TVET includes improving productivity, encouraging the development of complementary capital skills, exploring technological transition, enhancing work organisation, and facilitating access to trade, competition, and foreign direct investment (Ab. Rahim, 2011).

2.2 Cross-Industry Standard Process for Data Mining (CRISP-DM)

Several methodologies can be used for data mining, such as Cross-Industry Standard Process for Data Mining (CRISP-DM), Sample, Explore, Modify, Model and Assess (SEMMA), Knowledge Discovery in Databases (KDD), Team Data Science Process (TDSP), and Agile Data Science. CRISP-DM is a widely used data mining method that offers a structured means of controlling the data mining process (Ayele, 2020). Complex data mining projects can be more easily managed

since CRISP-DM provides a structured approach to data mining. The methodology divides the data mining process into several stages, each with its own set of tasks and deliverables (Abdelhadi et al., 2022).

Several industries, including Daimler Chrysler, SPSS, and NCR, contributed to the development of CRISP-DM in 1996. According to Schröer et al. (2021), CRISP-DM provides a standard data mining process as a generic approach to problem-solving from a company or research organisation. The life cycle of a data mining project is organised into six phases in CRISP-DM where the results of the preceding step determine the following steps in the sequence. Figure 1 shows the list of phases in CRISP-DM that can be used to analyse the need for a dataset.

Figure 1. CRISP-DM method for data mining (Schröer et al., 2021)

2.3 Data Analytics

Organisations can use data analytics to gain insightful information and make better decisions, which will ultimately enhance performance, increase efficiency, and produce better results (Albright & Winston, 2017). Since the advancement of modern technology has made it possible to handle large amounts of data from various sources, data analytics has expanded in importance in recent years. Artificial intelligence and machine learning allow the quick processing of large amounts of data to generate interesting insights (Mutanov et al., 2020). Descriptive and diagnostic analytics are the main focus of this study's adaptation and analysis for enrolments in the Bachelor of Technology programs at UMPSA. Data analytics is a wide phrase with various meanings depending on the data analytics maturity curve; however, data without analytics is not very useful (Susnjak et al., 2022). The term "analytics" is used to refer to all four pillars of the modern analytics model.

2.4 Data Visualisations

Visual data presentation makes it simple to see patterns, trends, and connections between variables, which simplifies the process of drawing conclusions and making informed decisions (Saggi & Jain, 2018). Data is a collection of information via the observation of an item and can take the shape of numbers, symbols, or text. Finding data is not that difficult in the modern digital era, particularly as the internet has an accessible dataset, which is massive, complicated, and challenging to evaluate using data processing software like a spreadsheet. Abstraction into visual information is a useful technique for making complex information understandable (Dipace et al., 2019). Similarly, the effectiveness of data visualisation depends on how well the speaker delivers the information to the audience. Data visualisation techniques refer to the translation of data or information into a visual object, such as points, lines, or figures in graphics. The method has been utilised to visualise data storage using analogies between the past and present. Additionally, visualisation enables the transformation of data into understandable information.

2.5 Dashboard Development Using Microsoft Power BI

The dashboard visualisation's design plays a crucial role in presenting insights and capturing the interest of the audience. There are numerous tools available for creating dashboards and displaying informative data. One example is Tableau, which provides sophisticated analytics tools including predictive modelling, statistical analysis, and data blending. Meanwhile, QlikView supports a range of data sources and uses an in-memory data format for quicker performance. Another useful tool is Google Data Studio, which provides a straightforward drag-and-drop interface for building visualisations and may be shared with others for teamwork.

According to Ramalingam (2018), Microsoft Power BI is a business intelligence software program that allows for data visualisation, query creation, data connection, and report generation. Power BI is simple to utilise due to the user interface being similar to Microsoft Office programs and the familiar, user-friendly interface stands as its main advantage (Bhargava et al., 2018). The software can thoroughly process data and present it in an interactive format. Three different platforms can be used to access Power BI, namely (1) Desktop Platform, which can be installed on a PC or laptop; (2) Web Platform, which can be accessed through a web browser; and (3) Mobile Platform, which can be used on

smartphones. Power BI enables users to take and utilise usable data to solve problems by analysing data and assisting with normal daily decisions in the organisation.

3.0 METHODOLOGY

This study aims to standardise the analysis of massive amounts of data to produce analytical insights by using the Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology. Since it is not necessary to follow each step continually, the order of all phases in CRISP-DM is generally not rigid. In this research project, the CRISP-DM methodology was used and improved using a number of procedures and commitments.

3.1 Research Design

This study attempts to improve the way data is reported to UMPSA's management and incorporate data analytics into the creation of dashboards that are thought to improve decision-making. Figure 2 illustrates the flow of this research, which describes the first three phases in CRIPS-DM and the expected objective to be achieved.

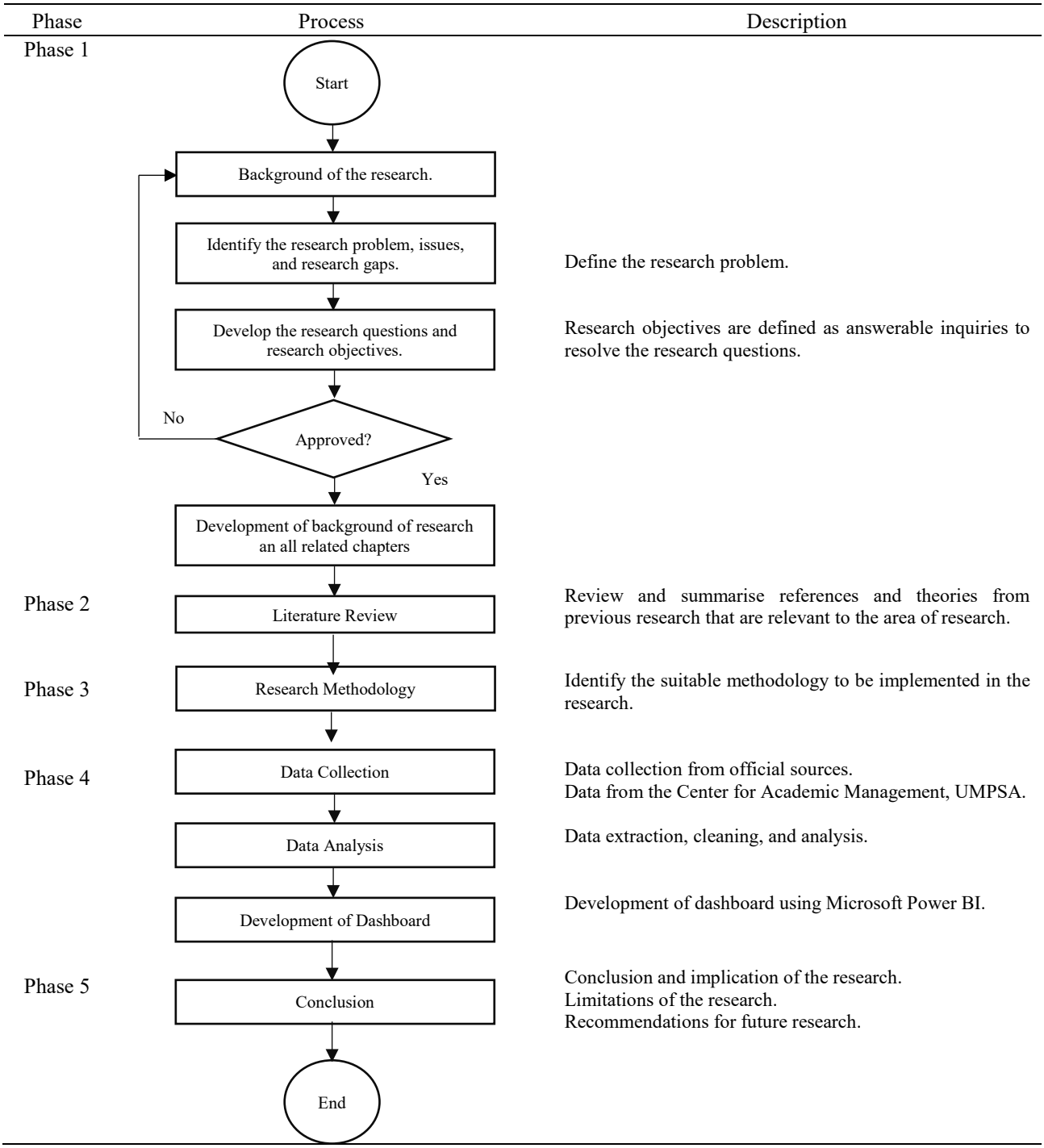

Figure 2. Flow of research

3.2 Developing a Dashboard Using Microsoft Power BI

Microsoft Power BI is a business intelligence application used to help visualise information. Such an application is useful since it can show data visualisation through graphics, assisting individuals in need and making information easier to manage in terms of decision-makers concerning speed and high quality (Raje et al., 2021). Power BI is a less complicated and user-friendly business intelligence tool that gathers thorough data from various data sources, logically arranges and visualises the data, and makes it simple for users to share insights.

The results were utilised to develop a dashboard implementation planning visualisation regarding the enrolment of Malaysian Diploma Vocational (MDV) students into a high-level TVET program at UMPSA. The dashboard system can be used to process and portray accessible data to help the system prepare interesting information. The visual development of information in the form of a costume or adjustment from desire, character, or specific functions until information can be supported by a dashboard. Furthermore, a dashboard is a visual representation of data that is thought to be crucial and is required to help the user with performance analysis and decision-making during the student recruitment process (Susnjak et al., 2022). The Microsoft Power BI Desktop program comprises six (6) primary steps to present data in the form of a dashboard.

Step 1: Business Understanding

Understanding the goals of the organisation and identifying the conditions or elements that may have an impact on the results. It is followed by the development of a dashboard implementation planning visualisation of MDV students' enrolment in a high-level TVET program at UMPSA.

Step 2: Data Understanding

Concentrating on data collection and ensuring its accuracy to prevent errors or missing numbers while acquiring a basic understanding of the data (Evans, 2020). In this stage, data was formally collected in the Microsoft Excel format from the Centre for Academic Management, UMPSA. The data obtained was raw and required further processing to generate the actual research data.

Step 3: Data Preparation

Concentrating on all tasks necessary to prepare, build, and include the relevant data that was chosen or found to be useful for analysis. To prepare the data for future processing, the CRISP-DM specification states that the data preparation phase includes all operations to create the final dataset from the initial raw data (Cazacu & Titan, 2020). This procedure is important in the early stages of dashboard creation. Among the benefits of data preparation include its usefulness in identifying issues or errors before the processing starts, contributing to the creation of higher quality data, producing better insights by processing higher quality data, and facilitating organisations in making better decisions as a result of having better insights.

Step 4: Data Modelling

Concentrating on choosing the best modelling technique to be implemented or adopted to develop a model and evaluate the model appropriately. In this phase, the clean data processed in Step 3 in the Microsoft Excel format was uploaded into the Microsoft Power BI format. A prototype dashboard was created and thoroughly examined to evaluate the possible visuals that could be shown in response to the processed data (Dipace et al., 2019).

Step 5: Data Visualisation

Bhargava et al. (2018) stated that data visualisation contains a collection of reports from a variety of datasets and has an integrated view. Dashboards can gather, organise, and present data from various sources so that users can see the performance of an organisation in real time. Dashboards can enhance decision-making by empowering understanding and utilising human perception.

Step 6: Data Synchronise and Update

Before undertaking any decision, it is important to have an up-to-date dashboard and report. This step involved the development of an interactive dashboard to compile all important performance indicators of the undergraduate data concerning MDV students' enrolment in a high-level TVET program at UMPSA.

4.0 RESULTS AND DISCUSSION

4.1 Business Understanding

Phase one of developing a dashboard using Microsoft Power BI was gaining a thorough understanding of the organisation's business objectives, goals, and processes. Such a process is referred to as business understanding in data analytics. This includes recognising the most important business concerns, figuring out the relevant information sources, and realising how data analysis can help with decision-making and boost productivity in the workplace. Business understanding in data analytics also involves assessing the feasibility and potential impact of data analysis projects.

This understanding helps organisations to make informed decisions about investing in data analytics initiatives and prioritising projects based on their potential return on investment. Clarifying issues, objectives, and resources during the first phases can help to gain as much understanding of the organisation's aim as possible. Business understanding in data analytics also involves identifying the specific business problems that need to be solved or the opportunities that can be leveraged using data analysis. It requires collaboration with stakeholders, such as business managers and subject matter experts, to define the scope of analysis and prioritise objectives based on their potential impact on the business.

The main business understanding of this study was focused on data analytics and decision-making related to students' enrolment in the Bachelor of Technology programs. During this stage, the tasks which needed to be done were setting a clear business objective, situation assessment, setting project goals, and creating a project plan. It involved gaining a clear understanding of the business objectives and requirements before proceeding with data analysis. The business understanding was based on the unprocessed data containing details of 437 students who enrolled in the Bachelor of Technology programs.

4.2 Data Understanding

The second phase of CRISP-DM accessed and explored the available data to obtain a better understanding of the necessary data. The subsequent stage of CRISP-DM further investigated the required data by obtaining and analysing the accessible data. This was accomplished by conducting the tasks in this phase, such as obtaining preliminary data, characterising the data, researching the data, and determining the data's accuracy. In this stage, data was formally collected in Microsoft Excel format from the Undergraduate Records Management Unit, Centre for Academic Management, UMPSA. The unit is in charge of organising, supervising, and conducting all aspects of undergraduate academic affairs.

4.3 Data Preparation

Data preparation is the third stage of the CRISP-DM methodology and it aims to create the dataset that will be used in this study. This step is the most crucial and time-consuming because six activities must be completed which are data gathering, data discovery, data cleaning, data transformation, data enrichment, and data storage. In Microsoft Power BI, the process of transforming and shaping raw data into a format appropriate for analysis and visualisation is known as data preparation. It involves identifying and handling missing values, outliers, and inconsistencies in the data. The data from the original set of 437 students was screened and cleaned before the study focused on the enrolment information of 395 students.

4.4 Data Modelling

In the CRISP-DM, the process of structuring the data to assist analysis and prediction is referred to as data modelling. The creation of the dashboard prototype is the focus of this phase. During the data preparation stage, the data was organised and detailed before being uploaded from the Microsoft Excel format to Microsoft Power BI for dashboard creation. Figure 3 illustrates the first stage of data uploading into Microsoft Power BI where the data for this study was uploaded in the Microsoft Excel format.

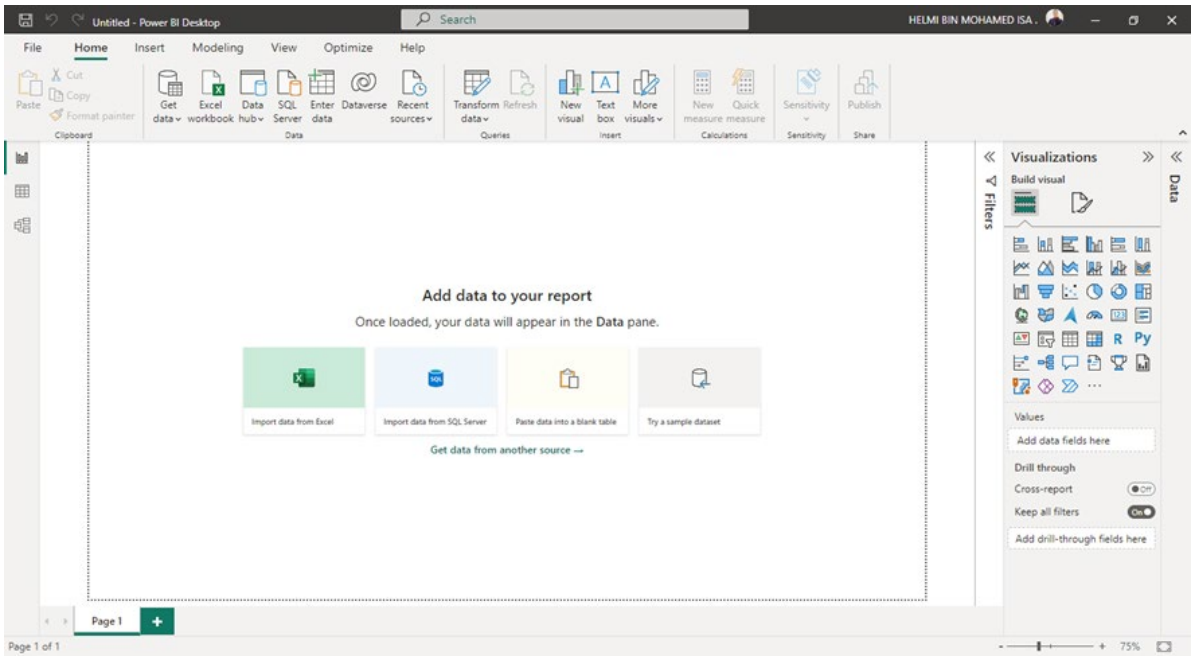

Figure 3. Visualisation of data upload

Figure 4. Visualization of dashboard design section 1: Front

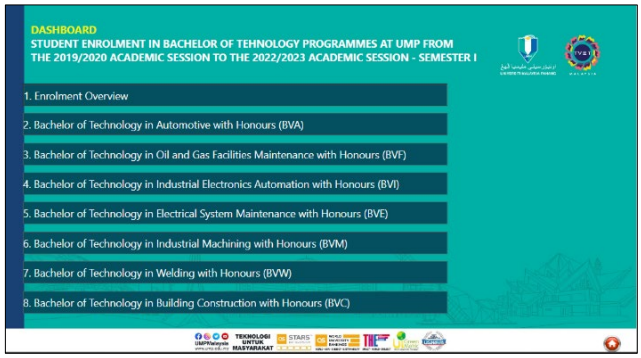

Figure 5. Visualization of dashboard design section 2: Home

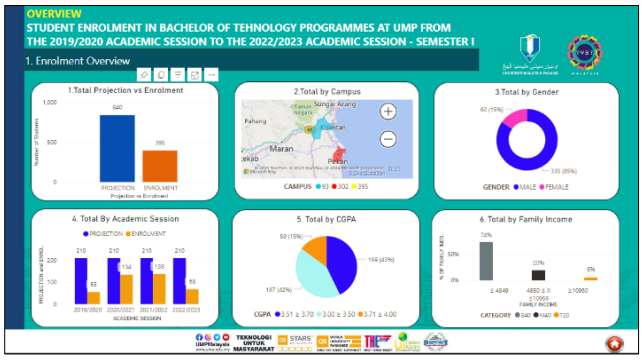

Figure 6. Visualisation of dashboard design section 3: Overview

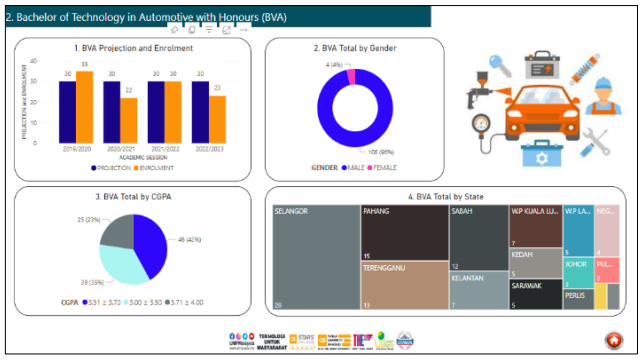

Figure 7. Visualisation of dashboard design section 4: Bachelor of Technology in Automotive with Honours (BVA)

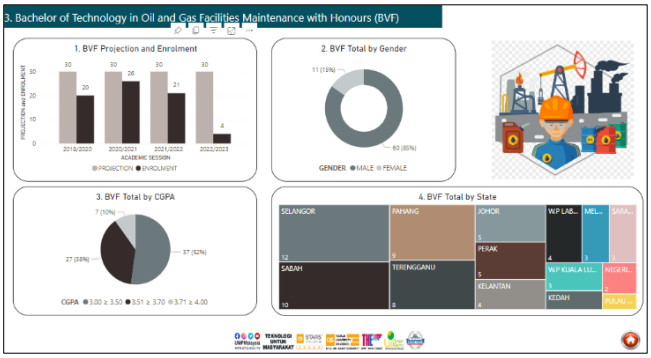

Figure 8. Visualisation of dashboard design section 5: Bachelor of Technology in Oil & Gas Facilities Maintenance with Honours (BVF)

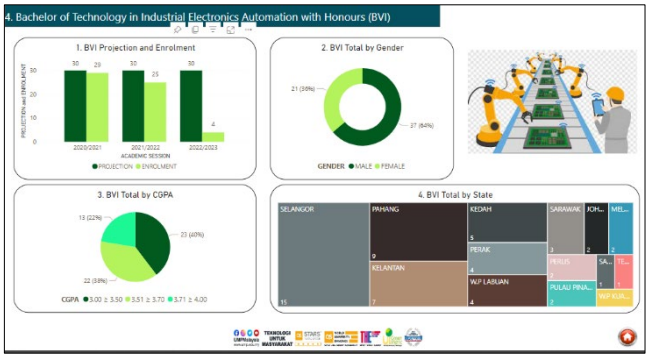

Figure 9. Visualisation of dashboard design section 6: Bachelor of Technology in Industrial Electronics Automation with Honours (BVI)

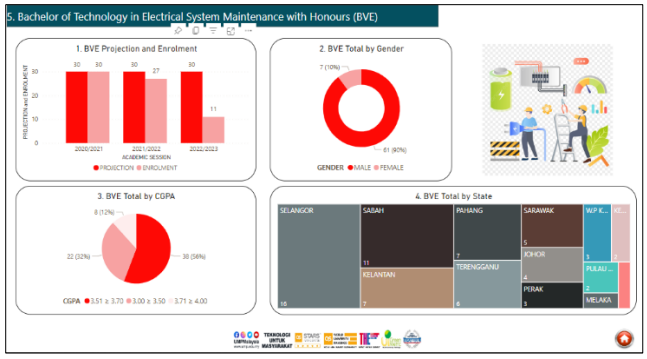

Figure 10. Visualisation of dashboard design section 7: Bachelor of Technology in Electrical Systems Maintenance with Honours (BVE)

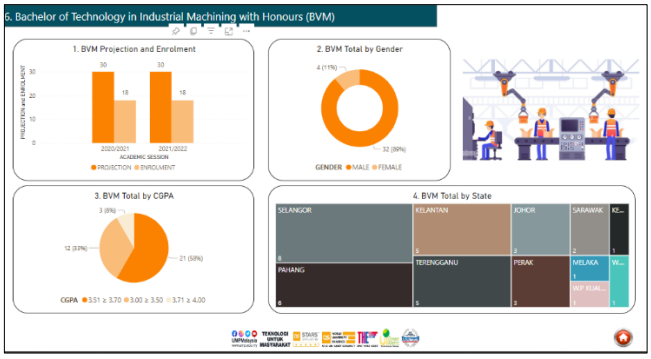

Figure 11. Visualisation of dashboard design section 8: Bachelor of Technology in Industrial Machining with Honours (BVM)

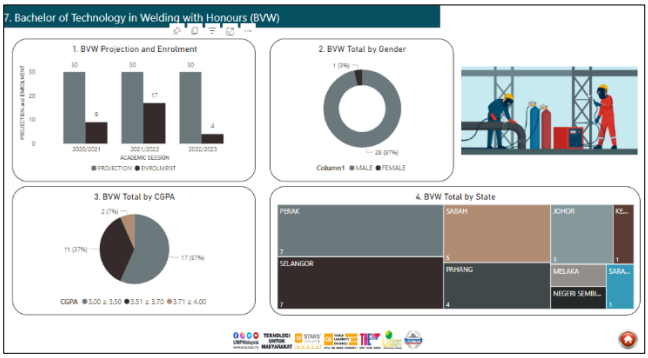

Figure 12. Visualisation of dashboard design section 9: Bachelor of Technology in Welding with Honours (BVW)

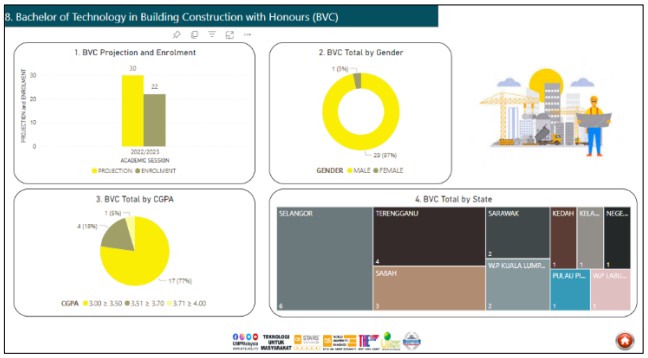

Figure 13. Visualisation of dashboard design section 10: Bachelor of Technology in Building Construction with Honours (BVC)

4.5 Data Visualisation

The CRISP-DM methodology uses data visualisation to display data graphically to effectively communicate patterns, trends, and insights. Various visualisation methods, such as scatter plots, bar charts, heat maps, or network graphs, were examined for their suitability in presenting different types of information. There are ten main sections in the dashboard created for this study using Microsoft Power BI.

4.6 Data Synchronise and Update

Data synchronising and updating refers to the process of adding new data to an existing dataset to maintain its current and analytical usefulness. The importance of data governance, documentation, and handling of information is to preserve data quality and allow the data mining process to be replicated. It is important to create a frequent data refresh plan to ensure that the dashboard displays up-to-date information. Refresh settings can be configured to update the dashboard data at intervals that are appropriate for the university's needs depending on the data source. Power BI provides several choices for data refresh, including on-demand refresh and automatic updates based on a set schedule. The data for each new academic session was synchronised and updated in this study.

4.7 Discussion

The dashboard that was created includes data reports on student enrolment in the Bachelor of Technology programs at UMPSA from the 2019/2020 to 2022/2023 Academic Sessions. It assists stakeholders in understanding the specifics of each program, tracking the growth of the enrolment rate, and serving as a foundation for decision-making. The creation of a business intelligence system for processing data based on a dashboard system by utilising Microsoft Power BI has resulted in the production of useful information in the form of graphic visualisation.

To make the data more useful and valuable for a particular function or objective, individuals or machines must reorder or transform the data. The third stage of the CRISP-DM technique was data preparation, which was crucial to provide the dataset used in this investigation. The three fundamental processes of typical data processing are input, processing, and output. Data cleanup is the process of locating, erasing, and/or replacing inaccurate or false information from the database. The original dataset of 437 students was screened and cleaned before focusing on the enrolment information of 395 students. It is highly recommended to prepare data in Microsoft Excel format so that it will be clean and in the desired format when it is finally uploaded into Microsoft Power BI. This method minimises the possibility of extracting inaccurate findings from processed data and ensures the quality of the data. Long-term savings of time and resources can be achieved by data cleaning. Organisations can prevent possible obstacles and difficulties during later phases of the data mining process by proactively detecting and fixing data issues.

Data synchronisation and updating are important stages to maintain the relevance, consistency, and accuracy of the data utilised for analysis and modelling in the CRISP-DM framework. Institutions can gain current insights, create a coherent data perspective, and enhance the overall quality and dependability of their data-driven decision-making processes by maintaining current data. Over the duration, data sources frequently change as new data is produced and old data is changed or eliminated. Institutions can guarantee that the data used in their analysis and models is the most recent by synchronising and updating data. As a result, the insights will become more precise and significant, thus enabling thoughtful decision-making. Data integration from many sources is necessary for data synchronisation and updating to create a coherent and unified view. Meanwhile, data discrepancies and inconsistencies are reduced by the integration process for establishing consistency and coherence across various datasets. Institutions have the chance to improve the quality of their data during the data synchronisation and update process. The risk of reaching incorrect conclusions or making poor decisions based on inaccurate or inadequate data is decreased by using high-quality and reliable data. To ensure that the dashboard created for this study can provide the most recent statistics and information, the data must be updated each time the new student enrolment procedure is finished.

Organisations can use data-driven decision-making to make decisions based on objective facts and evidence rather than biased or subjective decisions. They can also find patterns, anomalies, and correlations in massive amounts of data,

which can lead to the discovery of insightful information. The significant information can be presented on the dashboard that has been created and utilised for analysis and decision-making based on the data received. In comparison to the projected total of 840 places, 395 students (47%) were enrolled in the Bachelor of Technology programs at UMPSA from the 2019/2020 to 2022/2023 Academic Sessions. From the number, 302 students (76%) were located at the Pekan Campus while 93 students (24%) were in the Gambang Campus. The majority of these students were male (85%) as compared to females (15%). The 2021/2022 Academic Session had the highest number of student enrolments with 138 students as opposed to the anticipated 210 places. Further exploration of the students' academic performance revealed that those earning a CGPA between 3.51 and 3.70 was the highest (43%), followed by those with a CGPA of 3.00 and 3.50 (42%) and 3.71 and 4.00 (15%). Finally, 74% of the students belonged to the B40 category, 20% were categorised as the M40 category, and only 6% of them were in the T20 category.

5.0 CONCLUSIONS

This study aimed to create a dashboard with information visualisation to assist UMPSA in managerial decision-making and present critical and hierarchical data regarding the enrolment of Malaysian Diploma Vocational (MDV) students into high-level TVET programs at UMPSA.

Several limitations arose while creating a dashboard with Power BI. The first limitation was related to data transformation. While basic data transformation capabilities are provided by Power BI, it requires the use of Power Query Editor or outside tools for more complicated transformations. The second limitation was regarding data refresh. Scheduled data refreshes are possible with Power BI, but the frequency and methods available are limited. The refresh frequency may vary depending on the Power BI license level. Additionally, some data sources might not enable immediate refreshing, requiring manual or scheduled refreshes.

The following suggestions for additional research are made concerning the findings of the study on Universiti Malaysia Pahang Al-Sultan Abdullah High-Level TVET Programs Dashboard for Student Enrolment: (1) Implement a data source for student enrolment directly from the university's server so that the data can be viewed in real-time, particularly as student enrolment data changes every semester and year. Based on real-time data, the most important information is not just the number of enrolled students; in reality, the data can show how many students are still enrolled or quit courses. (2) To maintain focus on developing the dashboard and ensure that the data shown is relevant and meaningful. It is necessary to investigate the types of data and the information that will be displayed during the dashboard production process. For a dashboard to be constructed following the needs of the user, it is best to configure the components for any assessments that must be made during the testing phase. (3) Future versions of this study can concentrate on the variables influencing student decision-making concerning the high-level TVET programs at UMPSA. Students' selection of a high-level TVET program is commonly influenced by two primary factors: Push factors and Pull factors.

Examples of push factors include students' interests, which can be influenced by their studies before enrolling into HEIs. For instance, students who major in life sciences are more interested in the fields of engineering and medicine. Family influence is another element that falls under the push factors. Some students prefer to enrol into courses and HEIs that are recommended by their parents. Meanwhile, the pull factors comprise various elements, including marketing and promotion. Students will obtain correct information about educational programs and HEIs through marketing strategies. Other pull factors include the cost of living and career prospects. The latter is crucial as students must choose their academic programs and HEIs based on the market demands to ensure that they will not fall into unemployment after graduation. A final pull factor is accreditation. Students must ensure that their preferred academic programs and HEIs are accredited and recognised by the Malaysian Qualifications Agency (MQA) to ensure their marketability and future employability.

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7.0 CONFLICT OF INTEREST

The authors declare no conflicts of interest.

8.0 AUTHORS CONTRIBUTION

Each author involved and contributed evenly to this manuscript. All authors read and approved the final manuscript.

9.0 REFERENCES

Abdelhadi, A., Zainudin, S., & Sani, N. S. (2022). A Regression Model to Predict Key Performance Indicators in Higher Education Enrollments. International Journal of Advanced Computer Science and Applications, 13(1), 454–460.

Albright, S. C., & Winston, W. L. (2017). Business analytics: Data analysis and decision making. Cengage Learning, Inc.

Alida, S., Abdullah, J., Wati, F., & Ibrahim, B. (2007). Memenuhi Keperluan Pelajar di Universiti Awam Malaysia: Aspek Pendapatan dan Perbelanjaan Meeting the Needs of Students of Public Universities in Malaysia: Income and Expenditure Aspects. REKAYASA-Journal of Ethics, Legal and Governance, 3, 50–60.

Almadhoun, N. M., Dominic, P. D. D., & Woon, L. F. (2011, September). Social media as a promotional tool in higher education in Malaysia. In 2011 National Postgraduate Conference (pp. 1-7). IEEE.

Arnaboldi, M., Robbiani, A., & Carlucci, P. (2021). On the relevance of self-service business intelligence to university management. Journal of Accounting and Organizational Change, 17(1), 5–22.

Ayele, W. Y. (2020). Adapting CRISP-DM for idea mining a data mining process for generating ideas using a textual dataset. International Journal of Advanced Computer Science and Applications, 11(6), 20–32.

Azmi, T., & Salleh, D. (2021). A Review on TVET Curriculum Practices in Malaysia. International Journal of Education, Psychology and Counseling, 6(40), 35–48.

Bakar, A. (2019). Technical Vocational Education & Training (TVET) in Malaysia: (Issue January).

Bhargava, M. G., Kiran, K. T. P. S., & Rao, D. R. (2018). Analysis and design of visualization of educational institution database using power BI tool | global journal of computer science and Technology. Global Journal of Computer Science and Technology(C), 18(4).

Cazacu, M., & Titan, E. (2020). Adapting CRISP-DM for Social Sciences. BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 11(2sup1), 99–106.

Delen, D., & Ram, S. (2018). Research challenges and opportunities in business analytics. Journal of Business Analytics, 1(1), 2–12.

Dipace, A., Fazlagic, B., & Minerva, T. (2019). The design of a learning analytics dashboard: Eduopen MOOC platform redefinition procedures. Journal of E-Learning and Knowledge Society, 15(3), 29–47.

Evans, J. R. (2020). Business Analytics, Global Edition. Pearson

Finance, M. of. (2021). Malaysia Budget 2022 (M. of Finance (ed.); 1st ed. Percetakan Nasional Malaysia Berhad.

Kholiavko, N., Grosu, V., Safonov, Y., Zhavoronok, A., & Cosmulese, C. G. (2021). Quintuple Helix Model: Investment Aspects of Higher Education Impact on Sustainability. Management Theory and Studies for Rural Business and Infrastructure Development, 43(1), 111–128.

Lepenioti, K., Bousdekis, A., Apostolou, D., & Mentzas, G. (2020). Prescriptive analytics: Literature review and research challenges. International Journal of Information Management, 50, 57–70.

Ministry of Economic Affairs. (2019). Shared Prosperity Vision 2030. Attin Press Sdn.Bhd.

Mohd Ishar, M. I., Wan Derahman, W. M. F., & Kamin, Y. (2020). Practices and Planning of Ministries and Institutions of Technical and Vocational Educational Training (TVET) in Facing the Industrial Revolution 4.0 (IR4.0). Malaysian Journal of Social Sciences and Humanities, 5(3), 47–50.

MOHE. (2015). Malaysia Education Blueprint. 1(1), 40.

MQA. (2019). Pekeliling MQA Bil 9 2019 Pelaksanaan Sistem Jaminan Kualiti Tunggal TVET: Penambahbaikan Laluan Pendidikan TVET.

Munisamy, S., Mohd Jaafar, N. I., & Nagaraj, S. (2014). Does Reputation Matter? Case Study of Undergraduate Choice at a Premier University. Asia-Pacific Education Researcher, 23(3), 451–462.

Mutanov, G., Mamykova, Z., Kopnova, O., & Bolatkhan, M. (2020). Applied research of data management in the education system for decision-making on the example of Al-Farabi Kazakh National University. In E3S Web of Conferences, 159.

Nafiisah, N., Noor, N., Lufti, S. L., Darweena, S., Ahmad, S., & Feisal, A. (2021). Interactive Dashboard for Tracking System Dashboard Using. Inacix, 43–50.

Norhidayah Hussin, M. H., Mujahideen, H. & Najmuddin, W. S. (2017). Faktor-Faktor Pendorong Pemilihan Kursus Di Institusi Pengajian Tinggi - Satu Ulasan. Journal of Humanities, Language, Culture and Business, 1, 139–145.

Nur Fatin, M. S. (2015). Technical and Vocational Education Transformation in Malaysia: Shaping the Future Leaders. Journal of Education and Practice, 6(22), 85–90.

Rajadurai, J., Sapuan, N. M., Daud, S., & Abidin, N. (2018). The Marketability of Technical Graduates from Higher Educational Institutions (HEIs) Offering Technical and Vocational Education and Training (TVET): A Case from Malaysia. Asia-Pacific Education Researcher, 27(2), 137–144.

Raje, M., Jain, P., & Chole, V. (2021). Sales Analysis and Prediction Dashboard Using Power Bi. 06, 522–529.

Ramalingam, V. A., & Ramalingam, V. A. (2018). Introduction to Microsoft Flow. Introducing Microsoft Flow: Automating Workflows Between Apps and Services, 1-32.

Rehman, M. H., Yaqoob, I., Salah, K., Imran, M., Jayaraman, P. P., & Perera, C. (2019). The role of big data analytics in industrial Internet of Things. Future Generation Computer Systems, 99, 247–259.

Saggi, M. K., & Jain, S. (2018). A survey towards an integration of big data analytics to big insights for value-creation. Information Processing and Management, 54(5), 758–790.

Saputra, D., Soleh, O., & Dewi, M. A. (2013). Dashboard Marketing System for Student'S Enrollment Case Study: Unis Tangerang. In Information Systems International Conference, 294-299.

Schröer, C., Kruse, F., & Gómez, J. M. (2021). A systematic literature review on applying CRISP-DM process model. Procedia Computer Science, 181(2019), 526–534.

Susnjak, T., Ramaswami, G. S., & Mathrani, A. (2022). Learning analytics dashboard: a tool for providing actionable insights to learners. International Journal of Educational Technology in Higher Education, 19(1).

UMP. (2021). Pelan Strategik UMP 2021 - 2025 (P. UMP (ed.); 1st ed.). Penerbit UMP.

Van Rooij, E. C. M., Jansen, E. P. W. A., & van de Grift, W. J. C. M. (2018). First-year university students' academic success: the importance of academic adjustment. European Journal of Psychology of Education, 33(4), 749–767.