

Higher Education Dashboard Implementation Using Data Mining and Data Warehouse: A Review Paper

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ABSTRACT: Most of the activities including lecturer recruiting, advertising, pupil admittance, scholar registration, educational procedures, and alumni system, most higher education institutions now use integrated information systems. The higher education information system produces a lot of transactional information, and the quantity of data is growing every day, nonetheless the best way to utilize it is yet unknown. Each piece of data saved on a data storage medium is used for a certain purpose. A higher education institution, on the other hand, requires a comprehensive understanding of all data. In light of these circumstances, an analytical tool is required to excerpt statistics and uncover useful knowledge from large amounts of data. Such procedures necessitate a longer processing time and a more complicated procedure. The goal of this study was to create a data warehouse model and dashboard for an analytical tool, as well as to apply data mining techniques to higher education institutions. The study approach started with the creation of knowledge requirements, followed by the creation of an evolutionary archetype to a data warehouse, the application of data mining methods, and the creation of a console for an investigative utilities. The end consequence was basically a prototype of data mining, data warehouse, and systematic utility for higher education institutions that would help them enhance their analytical and decision-making processes and therefore improve their performance.

KEYWORDS: Analytic Tools, Dashboard, Data Mining, Data Warehouse, Higher Education.

I. INTRODUCTION

In Indonesia nowadays, there are about 3200 higher education institutions, with 320 of them in Jakarta, the capital city [1]. Higher education institutions are under extreme compression to enhance the superiority of their educational processes and administration. Higher education is being encouraged to spend more money on technologies that enable them to gather and handle data directly. The

quality of education provided by higher education would be of importance to stakeholders such as parents, students, funding agencies, and the government. This level of quality may be found in a variety of higher education data sources. Higher education institutions want technology that may help them manage and support decision-making processes, as well as aid them in developing plans. By delivering fresh information derived from historical and operational data, the eminence of higher teaching processes and management systems may be improved. Every business, including colleges, relies heavily on reliable and timely data. In reality, owing to a lack of use of information technology, the data held by institutions far exceeds their expectations. Higher education institutions should conduct regular evaluations in order to enhance their quality. Internal and external data are required for the evaluation process. As a result, database technology, data warehouses, and data mining are required in the assessment process to assist in data optimization [2]. Many higher education institutions that have utilized information systems have been unable to examine their data in order to aid decision-making. Many businesses have utilized data warehouses, but many higher education institutions have not. Information that can be accessible at any time is essential for businesses. Furthermore, businesses need precise and reliable data to aid in decision-making. One of the most significant issues surrounding Higher Education institutions is competition. Higher education institutions from across the world compete for potential students. One of the strategies for winning the competition is to use information technology. Information technology (IT) and the related analytical tools primarily are two instruments that aid decision-making in Higher Education institutions. As a result, a decision-making system in Higher Education may be able to assist institutions in making ad-hoc decisions, allowing them to quickly adapt to numerous changes. This system must gather data from a variety of internal and external sources.

A. Data Warehouse

A data warehouse is a collection of subject-oriented and interconnected databases intended to assist decision-

making, with each unit of data pertinent to the incidents occurring at a particular moment [3]

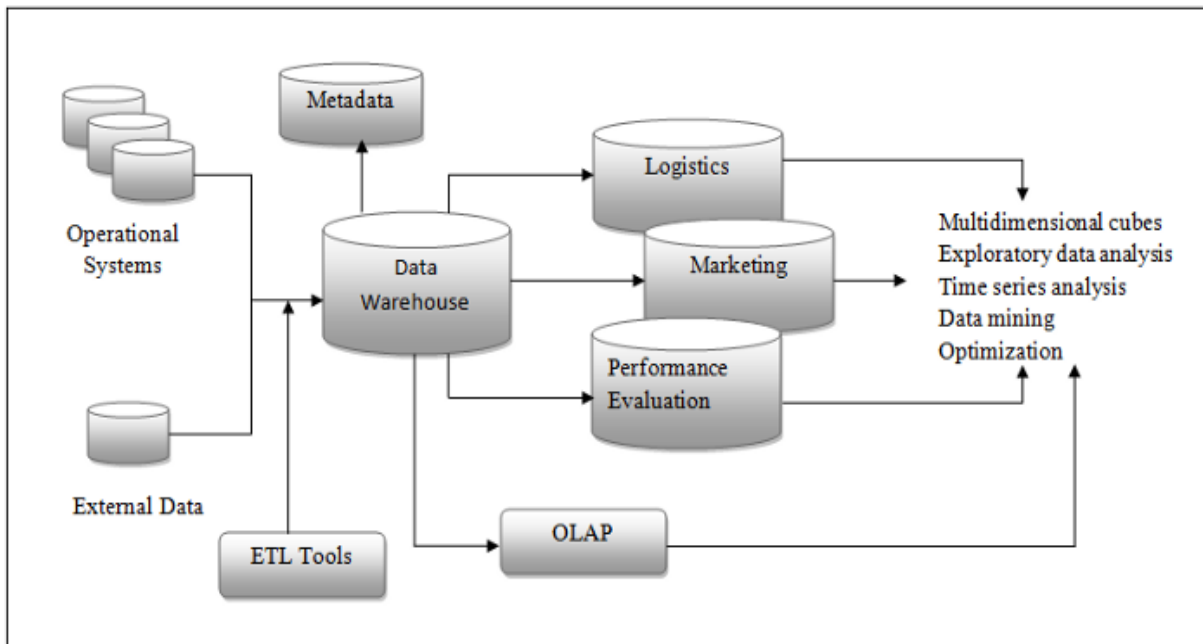


Figure 1: Illustrates the Architype and Functionalities of a Data Warehouse [4]

B. Data Mining (DM)

Extraction of interesting (non-trivial, implicit, previously unknown, and possibly valuable) patterns or information from large amounts of data is known as data mining (knowledge discovery from data) [5,6]. Data mining may be described in a variety of ways, each of which focuses on a distinct element of DM. DM is the process of using machine learning (ML) and artificial intelligence (AI) algorithms to uncover subtle arrangements of connection between data components in huge, noisy, and chaotic data sets, which may bring about activities that enhance utility in one or the other way.

C. Dashboard

Most performance management systems, performance measurement systems, BPM suites, and BI platforms provide scorecards and dashboards. Both dashboards and scorecards offer visual representations of essential information that are aggregated and organized on a single screen, allowing information to be absorbed and examined in a single look.

D. Objectives

The overall goals of the current study are basically to create a DW model, a data mining tool, and an investigative tool to aid in the analysis and decision-making process. This approach has the potential to provide useful information to aid decision-making and strategic planning. This study is divided into three (three) stages, each with its own set of goals:

1. Using techniques used in mining data as per the information model to build the data warehouse model (previous research result)
2. Creating dashboards for analytic software
3. Assessing the model

E. Methods

This study used exploratory descriptive research without drawing any comparisons or connecting it to other studies. Several methods were used in this study:

1. Case studies, analysis, assessment, and research of organization papers' literature, as well as other information resources on the deployment of an analytical system in a Higher Education institution.
2. As a source of information, interview top-level management to learn regarding the officialdom's approach, decision-making plans, analytical activities, and key policymaking process.

The following were the objectives of this research:

- a) Examine the information model in light of prior study findings.
- b) Analyze the results of the literature investigation, as well as internal and external data, and identify the finding.
- c) Using SQL Server to create a data warehouse model. The fact table model and connection between tables were the outcomes of this study.
- d) Use the interview method to evaluate the model.

- e) Choosing the technology to be utilized and designing a dashboard as the analytical system's user interface model.
- f) Making use of data mining techniques

II. DISCUSSION

A. Higher Education Information System Model

Many institutions are now using information systems to run their academic activities. As illustrated in Fig 2, the information system of national higher education was developed by the higher education directorate in 1990 [7]. There are ten (ten) subsystems in this system:

1. Academic
2. Community Service
3. Cooperation
4. Financial
5. Infrastructure
6. Library
7. Management subsystem
8. Personell
9. Research
10. Student and Alumni subsystem

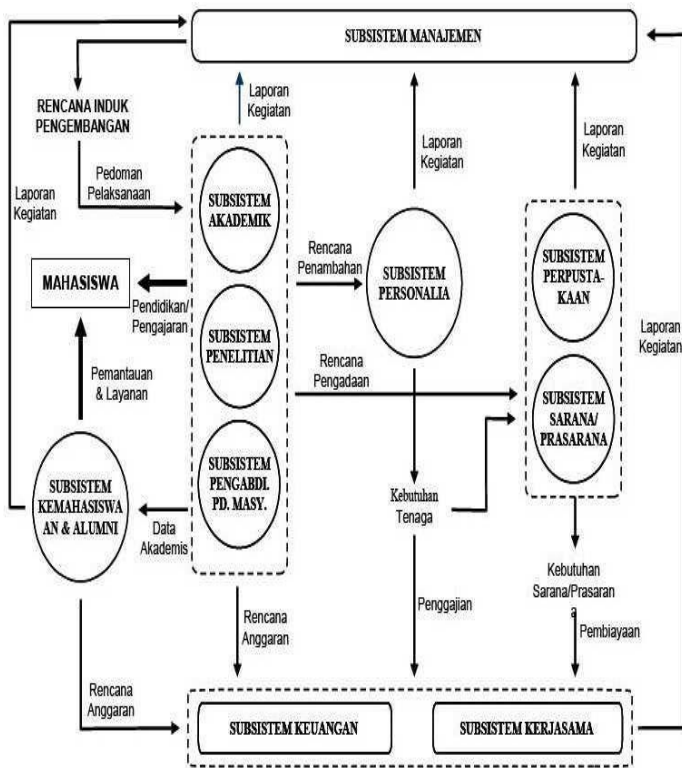


Figure 2: Illustrates the Information System of National Higher Education [8]

B. Higher Education Star Schemes

The authors recognize all fact tables and design star structure for creating the methodical utility in compliance with the Higher Education Information System (HEIS), regular endorsement for HE, and marks statement. The fact tables, dimension tables, and star system utilized to create the analytical tool are as follows [9]:

a. Scholar Admissions Scheme with a Star

The main points of the system are: develop advertising accomplishments intended for the activities (program and objective outcomes), evaluate and score or grade prospective students to regulate which can proceed to the subsequent stage, and re-recordkeeping for students who pass the test with a specific grade to complete admin and financial obligations.

b. Syllabus Development with Star Scheme

The primary goals of the system are mainly to define the variety of syllabus for every faculty and study programme by year, i.e., the time it took to create the curriculum.

c. Scheme for Professor

The primary goal of the system is to determine the count of lecturers taken in every semester/year based on the following factors: Foremost, professor rank (full-time or part-time), Qualification level, Lecturer academic field, status of various certificates obtained, and academic almanac year.

d. Star Scheme for Teaching Learning process

The information regarding appearance for every student and also the professor by semester, study program, and course are the primary perspectives of this system.

e. Payment and Registration Scheme

The primary goal of this system is to gather data on the total of actively participating learners enrolled by semester, major, registration status, and time.

f. Scheme for Evaluation Procedure

Total number of students who pass the assessment is the primary focus of this system, which may be broken out by course taught in the institute, department available in the institute, grading system adopted by the institute, and exam type conducted by education organizations.

g. Scheme for Student Coaching Activity

Total number of students who are helped by a professor is the primary focus of this program. This diagram depicts student coaching activity by study program, coaching method, and instructor.

h. Star Scheme for Thesis Guidance

Total number of meetings conducted with regards to thesis counseling activities by education program, semester, and professor is the primary focus of this system.

i. Star Scheme for Library Collection

The amount of library collections by kind of gathering, education course and program, and language is the primary focus of this system.

j. Star Scheme for Research

A total of research activities conducted in the incubation center of the institute by research category, academic position, and time is the primary focus of this system.

k. Star Scheme for Publication

The number of publications per education course, instructor, and kind of journal is the primary focus of this system.

l. Stars Scheme for Grant

This scheme's primary focus is on the number of grants awarded per grant type, major, academic position, and time.

m. Star Scheme for Infrastructures

The amount of organizational set-up and infrastructure by educational courses and time are the key points of this plan.

n. Star Scheme for Community Services

The amount of civic or communal service accomplishments by major, municipal service category, academic status, and time is the primary focus of this program.

o. Stars Schemes for Information and Communication Technology

The number of IT devices by research period, timeframe, and kind of device is the primary focus of this plan.

p. Star Scheme for Industry and Government relationship

The number of relationships by study program, time, kind of industry, and scope of industry are the key features of this system.

C. Higher Education Dashboard

The next step is to design a user interface in the form of a dashboard after establishing each star scheme for information requirements. The Higher Education administration uses this user interface. To make the monitoring process easier, the data is displayed in a graphical manner [10]. The following are some of the user interfaces that Higher Education management may employ.

a. Control Panel for Registration

The registration control panel displays data on the number of potential learners as well as their speculative standing.

b. Control Panel for Learner Payment and Intake

The learner intake control panel shows the total students who apply to universities (applicant) in each province, as well as the total learners who pass the admission test (applicant) in each department (faculty). The payments control panel shows the total students who have finished the process of registration as well as their tuition payments.

c. Dashboard for Lecturer

Academic dashboard for lecturers that shows the number of lecturers in each Major and Discipline area. This dashboard shows the number of lecturers for each Academic job, as well as their education degrees, status, and national certification status.

d. Control Panel for Alumni

The alumni control panel shows the total number of alumnae as well as the dissemination of different kinds of

grads. The control panel may associate the number of ex-student from one educational course to the other, as well as examine the position of old pupils by employed or jobless after completing their course. All of the information presented above may aid higher education in developing new programs that will be required in the future. The total of students who worked prior to or after graduation is shown on the job vacancy dashboard. The dashboard shows information for each job industry, role, and location in more depth.

e. Control Panel for Assessment Procedure

The assessment procedure control panel shows data on student learning results. The data is presented in the form of a comparison of the number of passed and failed pupils. A comparison of the distribution of courses and grades may then be used to examine the data in more depth.

f. Dashboard for Research

The research dashboard shows data from research projects involving professors and students. This dashboard shows the number of activities by department (faculty), research category, and lecturer grade in greater detail (academic position).

g. Dashboard for Community Services

The Community Services dashboard shows information on initiatives engaging professors and students in community service. This dashboard shows the number of activities by department (faculty), community service category, and lecturer grade in greater detail (academic position).

h. Dashboard for Grant

The grant dashboard shows the number of grants awarded by department (faculty), grant type, and professor grade (academic position).

III. CONCLUSION

To assist Higher Education management in obtaining useful information, data warehouse models are developed with the display of information in the form of graphs / dashboards. As a result, data warehouses and data mining are used to extract information and find useful knowledge from large amounts of data. Many Higher Education institutions are now unable to use and benefit from operational data produced by the existing information system, and this information and knowledge may be utilized for operational and strategic purposes. Many public and private universities in Indonesia may be involved in future research plans. Furthermore, different mining methods may be utilized for data analysis and assessment. Finally, a thorough assessment is required to ensure that the data warehouse, data mining, and dashboard implementations satisfy the requirements of Higher Education management.

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