CHAPTER I
INTRODUCTION

I.1 Background

Information technology development in the 4.0 industrial revolution era has significantly transformed various sectors, including higher education. Artificial intelligence (AI) has become a primary focus, increasingly adopted in education ecosystems for personalized learning, administrative process automation, and institutional performance monitoring.

AI adoption growth in education is supported by market projections showing positive global trends. Market data indicates significant growth in recent years with projections for continued future increases, as shown in Figure I-1.

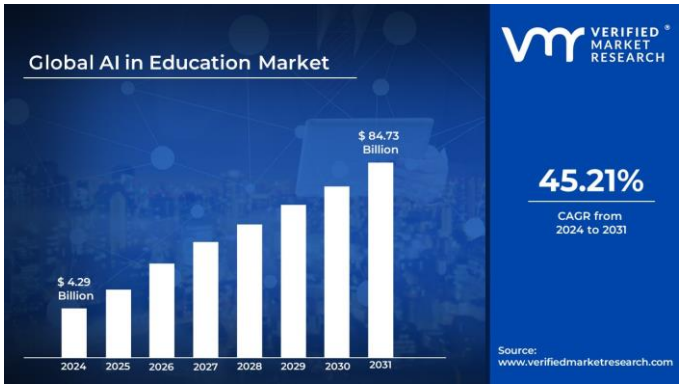

Figure I-1. Global AI in education market
Source (Verified Market Research, 2024)

Based on Figure I-1, the AI market in the education sector is continuing to grow rapidly. According to a report from Verified Market Research (2024), the market value of AI-based educational technology is projected to reach USD 84.73 billion by 2031, with a Compounded Annual Growth Rate (CAGR) of 45.21% from 2024 to 2031. This growth reflects the increasing adoption of AI technology in educational institutions for data analysis and decision support systems. The integration of AI technology enables educational institutions to analyze complex datasets and provide strategic insights for institutional management.

The development of effective dashboards requires careful consideration of information presentation and user interaction. Few (2013) defines a dashboard as a

visual display of important information designed to help users achieve goals, presented on a single screen for quick monitoring. Yigitbasioglu and Velcu (2012) emphasize that dashboards serve as data-driven decision support systems that provide information in formats suitable for decision-makers. This concept aligns with the need for educational institutions to monitor student performance efficiently.

Recent advances in Natural Language Processing have opened new possibilities for database interaction. Gao et al. (2024) demonstrate that Large Language Models can achieve significant accuracy in converting natural language queries to SQL, making complex data analysis accessible to non-technical users. Such capabilities are particularly valuable in educational contexts where stakeholders may lack technical expertise but require access to analytical insights.

At Telkom University's Faculty of Industrial Engineering (FRI), student activities are crucial for developing academic and non-academic potential. However, managing student achievements in independent competitions remains suboptimal due to limitations in the current dashboard system, which hinders effective management and strategic decision-making, as illustrated in Figure I-2.

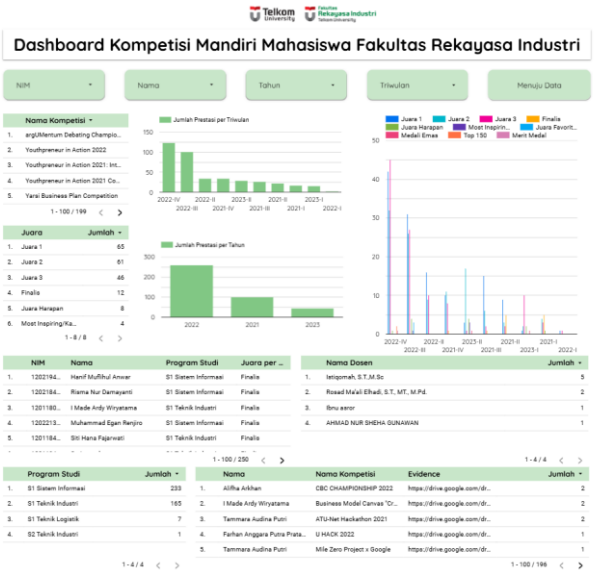

Figure I-2. Current FRI student independent competition dashboard

Based on Figure I-2, the current system uses a simple dashboard with data displayed in the form of regular tables and some basic graphs that only meet very basic data

presentation needs. The dashboard interface only provides basic functionality for data search, without any in-depth analysis features or adequate visualization. The current dashboard system can only present data in basic visualization formats without deep analytical capabilities or natural language-based interaction.

The system lacks integrated information and strategic insights, hindering data-driven decision-making. Without AI technology integration, it cannot provide interactive recommendations, comprehensive trend analysis for strategic planning, deeper insights, or strategic recommendations, thus impeding effective decision-making and targeted student guidance.

Existing dashboard limitations reveal a research gap in AI integration for student performance monitoring in higher education. While traditional dashboards excel at data presentation, they lack analytical intelligence to transform raw data into actionable strategic insights—particularly evident in student competition monitoring, where stakeholders need both data visualization and intelligent interpretation/recommendation capabilities for evidence-based decision-making.

This research develops an independent competition dashboard for FRI Telkom University to provide accurate, integrated, accessible student performance data visualization. The AI-integrated advanced dashboard enables faculty management to monitor achievements comprehensively in real-time, facilitating more accurate decision-making for student performance support. The research employs Waterfall methodology—a sequential, systematic software development model progressing through background/needs analysis, system architecture/interface design, gradual implementation from data to presentation layers, validation testing, and maintenance/documentation (Pressman & Maxim, 2019).

I.2 Problem Statement

Based on the background that has been outlined, the formulation of the research problem is as follows:

1. How to develop a dashboard integrated with AI technology to monitor and analyze student independent competition data within the Faculty of Industrial Engineering (FRI) at Telkom University?

2. How to utilize AI technology (through the Flowise AI platform and OpenAI API) to provide conversational interface capabilities that enable natural language queries and generate analytical insights supporting strategic decision-making for student development?
3. How to integrate multiple technologies (dashboard visualization, AI chatbot, and database management) into a unified platform that enhances accessibility and usability for non-technical stakeholders?

I.3 Research Objectives

Based on the problem statement, the objectives of this study are as follows:

1. To develop an AI-integrated dashboard system for monitoring and analyzing student independent competition data within the Faculty of Industrial Engineering (FRI) at Telkom University.
2. To implement AI technology (through the Flowise AI platform and OpenAI API) that provides conversational interface capabilities, enabling users to perform natural language queries and receive analytical insights for strategic decision-making.
3. To create a unified platform that integrates dashboard visualization, AI chatbot functionality, and database management to enhance data accessibility and usability for stakeholders with varying technical backgrounds.

I.4 Research Scopes

To ensure that this research is focused and aligns with the available time and resources, several research limitations are established as follows:

1. The development of the dashboard is focused on the independent competition participated in by FRI students at Telkom University, not including Belmawa competitions or competitions outside the focus of independent competitions.
2. The AI technology used is limited to the ability to provide insights (such as analysis, identification, and actionable insights) as well as answering

interactive questions based on data, using the Flowise AI platform integrated with the OpenAI API as a Large Language Model (LLM).

3. The data used is historical data and the latest competition data within the scope of FRI, sourced from the data warehouse that has been integrated into Aiven, with a maximum period of the last 5 years. The dashboard will be visualized using Looker Studio.

I.5 Research Benefit

Based on the problem statement and research objectives, this research is expected to provide the following benefits:

1. For the Faculty of Industrial Engineering (FRI) Telkom University: The dashboard facilitates comprehensive management monitoring and analysis of student performance in independent competitions. AI integration enables structured evaluations, pattern/trend identification, and effective planning through descriptive insights and strategic recommendations for student achievement monitoring.
2. For Student Affairs: The AI-integrated dashboard enables easier monitoring of student achievements across competitions. AI-generated information, including in-depth analysis and strategic recommendations, helps better understand achievement development, identify improvement opportunities, and formulate targeted support and coaching strategies.
3. For Other Researchers: This research serves as reference and foundation for developing similar information systems in universities or institutions, particularly for creating data-based performance monitoring systems that integrate AI technology for in-depth analysis and real-time or near-real-time decision-making.

I.6 Systematization of Writing

This research is described with the following systematic writing:

Chapter I. Introduction

This chapter contains problem context, research background, problem formulation, research objectives, research limitations, research benefits, and writing systematics.

Chapter II. Literature Review

This chapter contains relevant literature and previous study results. Includes multiple methodologies / methods / frameworks to solve problems or minimize gaps between existing conditions and targets. Concludes with methodology / method / framework selection analysis to determine the approach used in this research.

Chapter III. Methods

This chapter explains the Waterfall methodology for system development, including requirement analysis, system design, implementation, and validation phases. Covers data collection methods from stakeholders and DITMAWA, Python data processing pipeline, and systematic approach for developing layered architecture system integrating dashboard visualization with AI technology.

Chapter IV. Problem Resolution

This chapter presents system requirements analysis and integrated dashboard system design. Covers stakeholder analysis, functional/non-functional requirements, layered system architecture design, user interface design, and integration design between Laravel, Flowise AI, and Google Looker Studio components.

Chapter V. Result, Validation, and Implication

This chapter presents implementation process and testing of the integrated dashboard system. Covers systematic multi-layered architecture implementation and comprehensive testing through Automated Functionality Testing, User Acceptance Testing (UAT), and System Usability Scale (SUS) evaluation.

Chapter VI. Conclusion and Suggestion

This chapter is a closing chapter that contains conclusions from the overall results of the research and discussion that has been carried out. The conclusion will summarize the answer to the problem formulation that has been set in Chapter I. In addition, this chapter will also present suggestions that can be used as a reference for future system development or as ideas for further research.