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Analysis Design of E-IM3 Information System with Object Oriented Design

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Abstract

*This research aims to analyse and design an information system based on the E-IM3 model using the Object-Oriented Design (OOD) approach to support the digital learning and decision-making process, especially for students with slow learning needs. The E-IM3 model, which consists of the stages of Identifying Problems, Building Ideas, Clarifying Ideas, and Assessing the Feasibility of Ideas, serves as a foundation to foster students' critical and reflective thinking. In Indonesian, E-IM3 is **e**lectronic based **I**dentifikasi masalah, **M**embangun ide, **M**engklarifikasi ide, dan **M**enilai kewajaran ide. Utilizing the System Development Life Cycle (SDLC), this research applies Object Oriented Analysis (OOA) and OOD to translate pedagogical needs into a technically robust system. The system design involves UML modelling elements starting from activity diagrams to user interfaces. Each component of the system was organized into boundary, control, and entity classes, reflecting a modular, maintainable, and user-cantered design. The user interface was developed to be intuitive and inclusive, facilitating gradual student engagement in decision-making tasks. The results show that the E-IM3 based system effectively supports personalized learning pathways and encourages high-level cognitive engagement through technology integration. This research contributes to the development of adaptive educational technologies aligned with technical and pedagogical standards in the digital age.*

Keyword: E-IM3, Object Oriented Design, Educational Information System

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INTRODUCTION

The rapid development of information technology has driven significant changes in the way people access, manage and deliver information. In the context of education, the utilization of digital-based information systems is increasingly important to support the effectiveness of learning, assessment and decision-making processes (Le et al., 2020). One innovative approach that is relevant in this regard is the development of an electronic model-based information system, namely E-IM3. E-IM3 includes the stages of Identifying Problems, Building Ideas, Clarifying Ideas, and Assessing the Reasonableness of Ideas in a structured manner through technological support. In Indonesian, E-IM3 is **e**lectronic based **I**dentifikasi masalah, **M**embangun ide, **M**engklarifikasi ide, dan **M**enilai kewajaran ide (Murtafiah, 2024; Murtafiah et al., 2021). This model is designed to strengthen students' critical thinking and decision-making skills in problem-based learning. Electronic implementation of E-IM3 is believed to increase cognitive efficiency and facilitate the adaptation of 21st century competency-based learning strategies (Putra et al., 2022).

In the process of designing E-IM3-based information systems, the use of the Object-Oriented Design (OOD) method is considered effective because it can describe the system in a modular, flexible, and continuously developable manner. OOD emphasizes an object-based approach that complies with modern software engineering principles, such as encapsulation, inheritance, and polymorphism (Pressman & Maxim, 2020). This methodology allows developers to design information systems that are easier to maintain, test, and extend according to user needs (Ibrahim & Nasution, 2020). In addition, OOD is also very relevant to be applied in educational projects because it can accommodate the needs of personalization and user interactivity, especially in the development of mobile or web-based educational modules (Anam & Widodo, 2023).

The study of the E-IM3 information system with the OOD approach requires a thorough analysis both in terms of software architecture and the needs of end users, namely educators and students. Proper needs analysis will produce a system that is not only technically appropriate, but also pedagogically effective (Nurhidayati et al., 2021). In addition, the integration of E-IM3 components into an OOD-based system can produce an intuitive interface and system workflow that reflects the decision-making thought process (Afandi & Supriyanto, 2021). Previous research shows that designing educational information systems with an object-based approach can increase user involvement and the effectiveness of system utilization in learning activities (Mulyana et al., 2022).

With this background, analyzing and designing the E-IM3 information system using the

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Object-Oriented Design approach is a strategic step in supporting the development of digital tools that can facilitate higher-level thinking processes. This research is expected to contribute to the development of educational information systems that are not only technically reliable, but also in accordance with pedagogical demands. The application of OOD principles in the context of E-IM3 also provides an opportunity to enrich digital-based instructional design approaches, especially in creating a learning environment that supports independent and contextualized learning (Santosa & Wijaya, 2021) (Lestari & Darmawan, 2023). Therefore, this research is important to evaluate the effectiveness and technical challenges in implementing E-IM3 through object-based design systematically and comprehensively.

METHOD

This research uses the System Development Life Cycle (SDLC) approach with an emphasis on Object-Oriented Analysis (OOA) and Object Oriented Design (OOD) methods to produce an E-IM3 information system that is reliable and easy to develop (Lobov & Tran, 2020). In the initial stage, a needs analysis was conducted through data collection, observation, and interviews to map user needs and determine the scope of the system. Along with that, analysis artifacts such as activity diagrams, event tables, class diagrams, use case diagrams, use case descriptions are compiled to represent system functionality in detail (Clune et al., 2012). According to (Pressman & Maxim, 2020), Object Oriented Analysis is the foundation in defining the system conceptually by identifying actors, use cases, and business process flows. Meanwhile, Object Oriented Design consists of design class, simple sequence diagram, communication diagram state chart, deployment and software architecture, first cut design class program, update design class diagram, package diagram, persistent object and user interface. The last step is coding based on the steps that have been designed previously.

RESULTS AND DISCUSSION

The Object-Oriented Analysis (OOA) approach identifies the different types of objects involved in a system, and explains to users the requirements that must be met in order to effectively interact with the system to accomplish a specific task (Leong et al., 2022). This approach aims to evaluate existing objects to determine their possible reuse in the future, as well as identify the need for new objects or modified versions of existing objects. All of these objects will then be designed in such a way as to form a useful computing system in a business context.

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In general, objects are defined as entities that have attributes and behaviors. In a computer system, objects can be divided into several types, such as user interface objects (UI objects), system domain objects, and problem domain objects (Taneja et al., 2020). UI objects serve as a link between the user and the system, including elements such as buttons, menu items, text boxes, and labels. Attributes describe the characteristics of an object, such as the size, color, location, and name of UI elements or information such as name, address, and phone number in a customer context.

Meanwhile, methods describe actions or behaviors that can be performed by the object. Problem domain objects are objects that have a direct relationship with the business process being run, for example, such as customer, product, or order objects. Classes are used to group objects based on similar attributes and behavior. Objects created from a class are called instances. Communication between objects is done through sending messages, where an object can call methods owned by other objects.

Object-oriented design is the process of detailing the types of objects that have an important role in the interaction between the user and the system, as well as describing the communication patterns between objects in accomplishing specific system tasks. This approach also includes refining the structure and behavior of each object so that it can be implemented effectively in a particular software development platform. As explained by (Booch et al., 2007) that Object Oriented Design aims to translate conceptual models from object analysis into technical designs that can be directly implemented, by defining attributes, methods, and relationships between objects in a software system.

Activity Diagram

Activity diagrams describe the sequence of user and system activities in using the e-IM3 model-based application. This diagram helps in understanding the dynamic process of the system as a whole, including workflows, decision branching, and interactions between actors and the system. In the E-IM3 system, there are two main actors, namely Students (main users) and Admin. The core activities are divided into four main stages:

1. Problem Identification

   The user logs in, then selects the “Problem Identification” module. Here the user fills in a form to identify problems experienced in the context of learning or real life. The system then saves this data and displays a summary of the results.

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2. Idea Building
   After the identification stage, users are directed to the "Idea Building" module. Users are asked to propose various solutions or ideas to the problems they have identified. The system will accommodate these ideas and provide options to revise or save.
3. Clarifying Ideas
   At this stage, users are asked to provide further explanation for the ideas that have been submitted. The system provides logic or reasoning-based guiding questions and saves the clarification results.
4. Assessing the Reasonableness of the Idea
   The final stage is scoring. The user is given assessment criteria, then gives a score to the idea that has been developed. The system calculates the results and displays concise feedback as a recommendation.

Class Diagram

In the context of designing the E-IM3 Information System, a class diagram is a static representation of the system structure that describes the main classes, attributes, methods (operations), and relationships between classes (Chen et al., 2020). Class diagrams play an important role in the Object-Oriented Design (OOD) approach because they help in understanding how entities in the system interact and how data is processed and stored systematically.

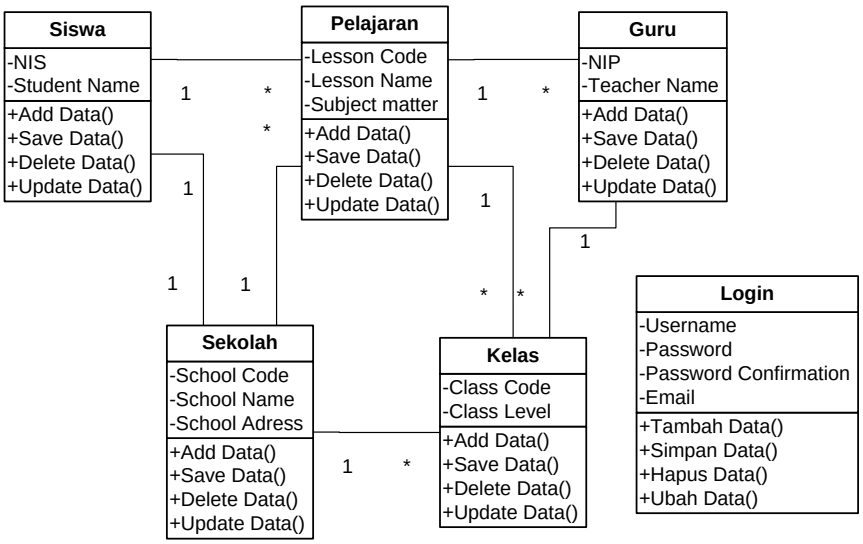


Figure 1. Class Diagram

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Use Case Diagram

Use case diagrams are an important part of the Unified Modeling Language (UML) used to describe system functionality from the user's perspective (Riesener et al., 2022). In the design of the E-IM3 Information System, use case diagrams help identify interactions between actors (users) and the system, which include all processes that can be carried out by users according to their roles.

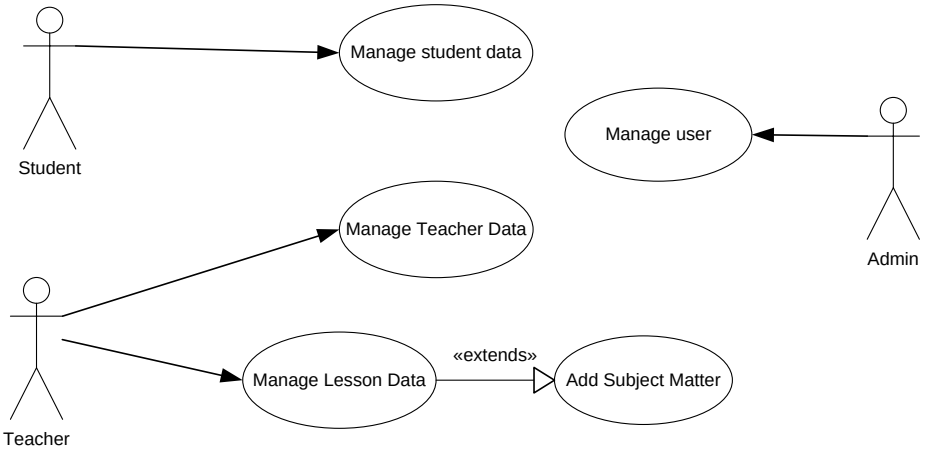


Figure 2. Use Case Diagram

Use Case Description

Use Case Description is a structured representation that describes the details of the interaction between actors and the system for each scenario in the use case diagram (Yang et al., 2022). In the context of the E-IM3 information system, this description is important to understand the logical flow of the processes that users carry out, so that the system can be developed according to functional needs. This use case description provides a detailed explanation of how the system handles one important process in the e-IM3 stages, namely “Building Ideas”. By providing preconditions, normal flow, and postconditions, the use case description clarifies the requirements, flow, and expected results of each user interaction (Maarif et al., 2023).

In the Object Oriented Design approach, the details of these use cases can be used to construct sequence diagrams, and design methods and attributes in class diagrams more precisely (Alexandrov et al., 2021). In addition, this process helps in user interface development and system testing as each step is well documented.

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State Chart

State Chart Diagram is one of the important components in object-oriented modelling that is used to describe changes in the state of an object in the system in response to events that occur (Breunig et al., 2020). In the context of the E-IM3 information system, this diagram is very useful for modelling the flow of the student process in undergoing the stages of the e-IM3 model which consists of:

Initial State: Student logs into the system.

1. State 1: Fill in Problem Identification
   After logging in, students are directed to fill in the problem data faced.
2. State 2: Submitting Solution Ideas
   After identification is complete, students develop and submit solution ideas to the problem.
3. State 3: Idea Clarification
   Ideas that have been submitted are then clarified, both by lecturers and peers.
4. State 4: Idea Assessment
   After going through clarification, the ideas will be assessed by the lecturer regarding their feasibility and validity.
5. Final State: E-IM3 Process Report
   After all stages are completed, the system will generate a process report that can be reviewed by students and lecturers.

In the Object Oriented Design approach, state chart modelling provides an in-depth understanding of the lifecycle of objects in the system.

Deployment and Software Architecture

The deployment model and software architecture of the E-IM3 system were designed with access efficiency, data security, and system scalability in mind (Huang & Wang, 2022). The Object Oriented Design approach supports modularity and separation of responsibilities between components, making the system easier to develop, test, and maintain (Berger et al., 2021).

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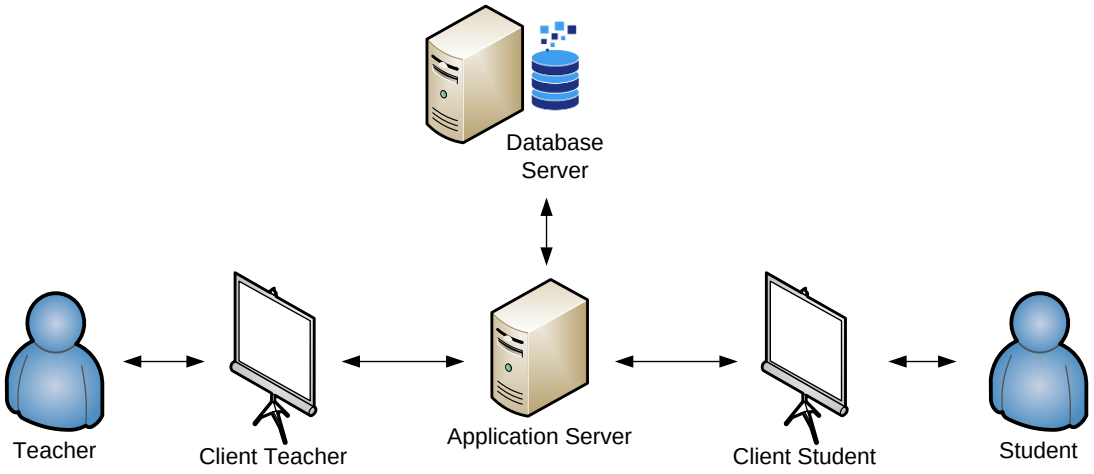


Figure 3. E-IM3 Architecture System

User Interface

User Interface (UI) is an important component in the design of OOD-based information systems because it is the link between users and system logic (Krosman et al., 2021). A good UI must be able to represent user needs intuitively, functionally and responsively. In the E-IM3 information system, the interface is designed to support the entire e-IM3 model process (Identifying problems, Building ideas, Clarifying ideas, Assessing the reasonableness of ideas), especially for slow learner students so that they can go through the decision-making stages in a gradual, structured, and easy-to-use manner (Biondi et al., 2021).

The UI design of the E-IM3 system follows the principle of user-centered design and adapts the Object Oriented Design approach through the implementation of boundary classes. Each interface is associated with a control class to separate the business logic from the display. With this design, the system becomes:

a. Easy to use by students with special needs.
b. Flexible and modular because each part of the UI has a clear function.
c. Consistent with the e-IM3 model, supporting systematic thinking and decision-making.

CONCLUSION

Based on the analysis of the E-IM3 Information System designer with the Object Oriented Design (OOD) approach, it can be concluded that this system is designed through communication of functional requirements and object-based modeling which includes use case diagrams, class diagrams, and architecture diagrams. Each system component is separated into three main layers, namely boundary, control, and entity that support modularity, reusability, and

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maintainability. The e-IM3 model consisting of the stages of Identifying Problems, Building Ideas, Clarifying Ideas, and Assessing the Fairness of Ideas was successfully implemented in the system through the design of a user interface (UI) that is friendly to slow learner students. With this OOD approach, the E-IM3 system has advantages in terms of ease of development, and support for learning based on critical and reflective thinking digitally. The implementation of E-IM3 has a weakness, namely the E-Im3 system has not been able to record the complete learning assistance process so that the learning development of slow learner students can monitor their progress, the current E-IM3 system can only manage subject and question data, so in the future it is necessary to develop a system that is able to monitor the learning activities of slow learner students so that it can detect their progress.

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