Enhancing Learner Support and Motivation with Mind Map Generation

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Project Proposal Report

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DECLARATION

We declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The supervisor/s should certify the proposal report with the following declaration.

The above candidates are out research for the undergraduate Dissertation under my supervision.

Signature of the Supervisor   Date

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Signature of the Co-Supervisor: **Date:**

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Ms. Thilini Jayalath

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ABSTRACT

As educational methods continue to evolve, there is a growing emphasis on visual learning tools that align with how our brains process and retain information. Mind maps have emerged as a powerful tool in this context, enabling students to visualize complex concepts and their interrelationships, which enhances comprehension and memory retention. This research focuses on integrating personalized mind maps within a Learning Management System (LMS) to leverage these visual learning benefits effectively.

The proposed system tailors mind map generation based on initial assessments, customizing the maps to reflect individual learning progress and needs. This personalization allows students to interact with the mind maps by expanding or collapsing nodes, which helps them focus on specific areas of their learning journey. The mind maps are further enhanced with links to relevant articles, videos, and external resources, providing a comprehensive learning experience.

In addition to mind maps, the research introduces a digital notecard system for managing key concepts and a note-taking tool integrated with lecture content. A forum feature will also be implemented to facilitate communication between student groups and lecturers, organized by subject for targeted discussions. These interactive tools are designed to improve cognitive processing, support collaborative learning, and ensure students have the resources necessary to succeed in their educational endeavors.

Keywords: *Adaptive Learning, Learning Management System (LMS), Large Language Models (LLM), Return on Investment (ROI), personalized learning,visualization*

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1.0 INTRODUCTION

A mind map is a dynamic and versatile diagram that visually organizes information around a central concept. Developed by Tony Buzan in the 1960s, mind maps use a non-linear approach to representation, which contrasts with traditional linear note-taking methods. The central idea or theme is placed at the center of the map, and related subtopics radiate outward in a branching structure. Each branch represents a different aspect or category related to the main idea, creating a web-like structure that highlights the relationships between various pieces of information. Mind maps incorporate a combination of words, images, and colors to enhance the visual appeal and cognitive engagement of the user. The use of colors and images not only makes the information more engaging but also helps in distinguishing between different categories and themes, facilitating easier recall and understanding.

The necessity for mind maps in modern education stems from their alignment with how the human brain processes and retains information. Traditional educational methods, such as lectures and problem-solving with chalk and board, often follow a linear approach. This method may not fully leverage the brain's capacity for visual and associative learning, which can limit comprehension and retention.

Mind maps offer several key benefits that address these limitations:

1. **Enhanced Comprehension and Retention**: Mind maps help learners visualize complex relationships and hierarchies within a subject, which aids in understanding and remembering the material. By presenting information in a non-linear format, mind maps enable students to see connections between concepts, improving their ability to grasp and retain information.
2. **Increased Engagement**: Traditional teaching methods can sometimes be monotonous, leading to disengagement. Mind maps, with their visually appealing and interactive nature, can capture students' attention and make learning more enjoyable. This increased engagement is crucial for maintaining motivation and interest in the subject matter.
3. **Improved Organization**: Mind maps provide a structured overview of a topic, helping students organize their thoughts and information systematically. This organization is beneficial for planning study sessions, writing assignments, and tackling complex projects, as it allows students to see the big picture and manage details effectively.
4. **Facilitation of Critical Thinking**: The non-linear structure of mind maps encourages learners to explore and make connections between different ideas. This approach fosters critical thinking and problem-solving skills, as students are prompted to analyze relationships and integrate information from various sources.

Traditional teaching methods, such as problem-solving in small groups and lectures using chalk and boards, have been foundational in education for centuries. These methods are effective for direct instruction and interactive discussions, but they often lack the dynamic and visual elements that modern educational technologies can offer. As educational theories and practices evolve, there is a growing recognition of the benefits of incorporating visual and interactive tools into teaching. Mind maps represent a significant advancement in this regard. By aligning with contemporary educational theories that advocate for multi-modal learning engaging multiple senses and cognitive processes mind maps provide a more comprehensive and flexible approach to education. They support a range of learning styles, from visual to kinesthetic, and can be adapted to various educational contexts, from classroom settings to online learning environments.

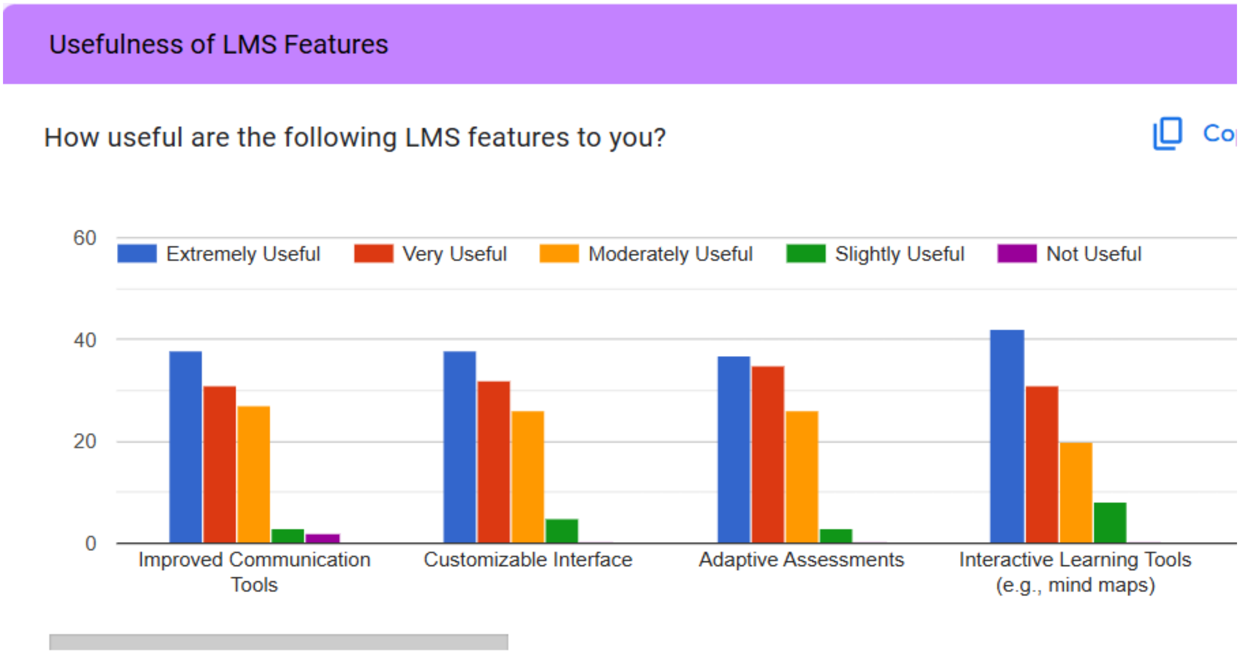

Figure 1:Survey results

Recent survey results from 101 students across campus government and private institutions reveal a compelling interest in mind maps. The data indicates that a significant number of students find mind maps extremely useful, highlighting their effectiveness in enhancing learning experiences. [Figure 1] This feedback underscores the growing need for innovative educational tools that align with students' learning preferences and needs.

The following essential stages will be included in the proposed research:

- **Integration of Additional Resources**: By incorporating links to supplementary materials such as articles, videos, and external websites within the mind maps, students gain access to a wealth of additional information. This not only broadens their understanding of the subject but also provides varied learning materials that cater to different preferences and needs.
- **Personalization**: The system will tailor mind maps based on individual assessments, customizing the content to reflect each student's learning progress and needs. This personalization ensures that the mind maps are relevant and aligned with each student's unique learning journey.
- **Enhanced Learning Experience**: The combination of interactive mind maps with additional resources and personalized content creates a more engaging and effective learning environment. Students can interact with the content, explore supplementary materials, and receive tailored information, all of which contribute to a more comprehensive and personalized educational experience.

1.1 Background and Literature

The landscape of education has undergone significant transformation with the introduction of innovative tools that enhance the way knowledge is conveyed and absorbed. Traditional educational methods, such as lectures and textbook-based instruction, often rely on linear approaches that may not fully engage the brain's natural ability to process and retain information. Mind maps, introduced by Tony Buzan in the 1960s, offer a departure from these linear methods by employing a non-linear, visual representation of information. This method places a central idea at the heart of the map, with related subtopics branching outward, creating a web-like structure that reflects the associative nature of human cognition. This non-linear format not only makes information more visually appealing but also aligns with cognitive processes, improving memory retention and comprehension [1].

Extensive research supports the effectiveness of mind maps in educational settings. Studies highlight that mind maps enhance cognitive benefits by helping learners visualize and integrate complex information, thus improving comprehension and retention. They also increase student engagement, making learning more interactive and enjoyable compared to traditional, often monotonous, methods. The ability of mind maps to organize information systematically provides students with a clear overview of topics, facilitating better planning and management of their studies. Additionally, mind maps foster critical thinking by encouraging learners to explore and analyze relationships between ideas, which enhances problem-solving skills [4].

The advent of digital mind mapping tools has further amplified these benefits. Technology integrates interactive elements, multimedia, and real-time collaboration features that adapt to various learning styles and contexts. This integration allows mind maps to be more personalized and adaptable, tailoring content to individual students' needs and preferences. As educational tools continue to evolve, mind maps represent a valuable innovation that aligns with contemporary theories of multi-modal and interactive learning. They support a more engaging and effective learning experience by providing a comprehensive approach that integrates visual, cognitive, and technological advancements.

1.2 Research Gap

Research Gap

	Interactive Elements	Personalized	Used in LMS	Online Environment
[1]	x	x	✓	✓
[2]	x	x	x	✓
[3]	x	x	x	x
[4]	x	x	x	x
Our system	✓	✓	✓	✓

Research 01-Mind maps to guide student questioning effectively supported students in progressing[1]
Research 02-Mind mapping as an online learning and group assessment tool in two medical physics courses during the COVID-19 pandemic.[2]
Research 03-Mind Map Learning Technique (MMLT) significantly improved nursing students' learning outcomes[3]
Research 04-Mind maps markedly increased student motivation and facilitated better integration of theoretical and empirical knowledge[4]

Figure 2:Research Gap

Limited Efficiency of Existing Mind Mapping Tools in Educational Settings -- Addressing Integration, Personalization, and Interactivity Challenges

Recent research underscores the effectiveness of mind maps in enriching student learning and engagement by providing a visual and organized representation of information. However, many existing mind mapping tools fall short of fully integrating with Learning Management Systems (LMS), limiting their applicability in comprehensive educational contexts. These tools often cover only a subset of the curriculum, missing the opportunity to offer a holistic view of the subject matter. Additionally, the lack of personalization means that students do not receive tailored content that could better address their individual learning needs.

Moreover, many mind mapping systems are not designed with optimal user experience in mind. They frequently lack interactive features that could significantly enhance their utility, such as embedded resource links within each node. These links would offer students immediate access to supplementary materials, thereby deepening their understanding and engagement. To truly harness the potential of mind maps in education, there is a pressing need to develop tools that integrate seamlessly with LMS platforms, provide comprehensive and personalized content, and incorporate interactive elements that support a more dynamic and engaging learning experience.

1.3 Research Problem

How do the personalization of mind maps based on initial assessments, integration of references and further reading materials, and interactive features impact student engagement, comprehension, and retention of complex information?

This research aims to explore how these elements impact student learning outcomes and cognitive processing. By investigating the effects of personalized mind maps, integrated references, and interactive features, the study seeks to understand their roles in improving educational experiences and outcomes.

Sub-Problems:

1. **Justification of the Proposed System:** The goal of this sub-problem is to provide a comprehensive rationale for the proposed mind mapping system. It addresses the limitations of current mind mapping tools, such as their lack of integration with Learning Management Systems (LMS), limited coverage, and insufficient personalization. The need for a more integrated, comprehensive, and personalized mind mapping solution that enhances student engagement and learning outcomes is established.
2. **Personalization of Mind Maps:** This sub-problem focuses on how to effectively personalize mind maps based on initial assessments of student knowledge and learning styles. It involves defining methods for customizing content to fit individual learning needs and evaluating how such personalization influences student engagement and understanding. The goal is to develop strategies for tailoring mind maps to improve educational impact.
3. **Integration of References and Further Reading Materials:** The objective here is to explore how embedding references and additional reading materials within mind maps can support student comprehension and further learning. This includes identifying effective ways to integrate resources into mind maps and assessing their impact on students' ability to connect concepts and explore topics in greater depth.
4. **Development of Interactive Features:** This sub-problem examines the design and implementation of interactive elements within mind maps, such as clickable nodes and embedded multimedia. It aims to determine how these interactive features affect cognitive processing, information retention, and overall engagement. The focus is on creating interactive mind maps that enhance the learning experience.
5. **Evaluating Impact on Student Learning Outcomes:** The goal of this sub-problem is to assess the overall impact of personalized, integrated, and interactive mind maps on student learning outcomes. This includes measuring changes in student engagement, comprehension, and retention of complex information. The objective is to evaluate the effectiveness of the proposed system in improving educational results and informing future enhancements.

These sub-problems provide a structured approach to addressing the main research problem, focusing on justification, personalization, integration, interactivity, and evaluation of the proposed mind mapping system.

2.0 OBJECTIVES

2.1 Main Objective

Create an adaptive and interactive mind map generation in the LMS that customizes visualizations based on initial assessments and individual learning progress, enhancing the personalization of the learning journey by providing tailored content, allowing access to additional resources, and engaging learners with customized visualizations.

2.2 Specific Objective

The following are the sub-objectives of this research.

- Identify the most effective tool for creating and managing mind maps.
- Use grading and assessment data to tailor the mind map generation, reflecting individual learning needs and progress.
- Provide tools for users to search and navigate through different nodes and branches of the mind map easily.
- Embed links to supplementary resources such as articles, videos, and external websites relevant to the content of each mind map node.
- Use user performance data to continuously adapt and improve the mind map generation process.

3.0 METHODOLOGY

3.1 Requirement Gathering

The requirement gathering phase is a pivotal step in the development of our advanced mind map generation system, designed to thoroughly capture and document the specific needs and expectations of all relevant stakeholders. This phase is essential for ensuring that the system effectively addresses the limitations of current educational tools while seamlessly integrating with existing Learning Management Systems (LMS).To achieve this, we will adopt a systematic approach, engaging in comprehensive discussions and consultations with key stakeholders, including educators, students, and LMS administrators. These engagements are crucial for identifying the challenges faced in educational environments, particularly the lack of personalized content, limited curriculum coverage, and the absence of interactive features in existing mind mapping tools. The insights gained from these consultations will directly inform the design and functionality of the proposed system, ensuring it meets the diverse needs of its users and significantly enhances both student engagement and learning outcomes.

In parallel, an extensive review of relevant literature and existing educational technologies will be conducted. This review will focus on identifying best practices, emerging trends, and technological gaps that the new system can address, particularly in the context of mind map generation within LMS environments. The findings will guide the development of a system that not only integrates seamlessly with LMS platforms but also provides a comprehensive, personalized, and interactive learning experience. Collaboration with technical experts will be central to defining both the functional and non-functional requirements of the system. Functional requirements will include key features such as personalized learning paths based on initial assessments, real-time data integration with LMS, and the incorporation of interactive elements like embedded resource links within mind map nodes. Non-functional requirements will emphasize scalability, security, and user-friendliness, ensuring the system's adaptability to a wide range of educational settings. Throughout this phase, all identified requirements will be meticulously documented to serve as a foundational blueprint for subsequent stages of system design, development, and evaluation. This documentation will ensure that the final system aligns with the needs and expectations of its stakeholders, ultimately delivering a tool that significantly enhances the educational experience.

Ethical considerations will be integrated into the requirement-gathering process, ensuring that the system's development adheres to stringent privacy and data protection standards. This will include securing informed consent from participants, safeguarding sensitive information, and ensuring compliance with relevant data protection regulations. A significant focus will also be placed on the system's technical integration with existing LMS platforms. The development team will collaborate closely with LMS providers to ensure seamless integration, addressing potential compatibility issues and ensuring the system's easy adoption across various educational institutions. This collaboration will involve detailed technical assessments to understand the specific requirements of different LMS platforms, such as data formats, APIs, and security protocols. Scalability and future-proofing will be key considerations during this phase. As educational technology evolves, it is essential that the proposed system is designed with flexibility in mind, allowing it to adapt to future advancements and changing educational needs. This foresight will involve identifying potential areas for future development, such as the integration of artificial intelligence for more sophisticated personalization or the inclusion of new educational content formats.

In conclusion, the requirement gathering phase is a critical foundation for the successful development of the mind map generation system. By thoroughly understanding and documenting stakeholder needs, validating these requirements through prototyping and usability testing, and ensuring seamless integration with existing LMS platforms, this phase will lay the groundwork for a system that enhances educational outcomes and sets a new standard for personalized, interactive, and comprehensive learning in the digital age.

3.1.1 Past Research Analysis

To establish a strong foundation for the proposed research on mind map generation within Learning Management Systems (LMS), it is essential to conduct a thorough analysis of past research in this domain. This analysis aims to understand the methodologies, tools, and approaches previously employed in the creation and utilization of mind maps in educational contexts, as well as to assess their strengths, limitations, and areas where further innovation is required. The past research analysis will involve a comprehensive literature review, examining relevant databases, academic journals, and other credible sources to identify significant studies related to mind mapping, LMS integration, and personalized learning.

The analysis will focus on several key aspects:

Techniques and Approaches: In reviewing past research, the focus will be on the techniques and approaches previously used to generate and apply mind maps in educational settings. Historically, these studies have not utilized advanced tools such as Large Language Models (LLMs) or libraries like Mermaid.js for dynamic mind map generation. Instead, earlier research often relied on more traditional methods, resulting in static and less interactive representations of information. The proposed research, however, aims to bridge this gap by leveraging LLMs to accurately identify and extract key points from module PDFs and using Mermaid.js to create interactive and visually engaging mind maps. This shift represents a significant advancement in how mind maps can be generated and applied within educational contexts, potentially offering a more personalized and effective learning experience. By critically analyzing the limitations of past techniques, this research will demonstrate the added value of integrating these modern tools into the process.

Datasets and Evaluation Metrics: The review will also consider the datasets used in prior studies on mind map generation. This includes the types of educational content used to generate mind maps, the diversity and complexity of the data, and how these factors influence the effectiveness of the mind maps produced. Additionally, the evaluation metrics applied in previous research will be scrutinized to understand how the success of mind mapping tools was measured. Metrics such as user engagement, learning outcomes, and cognitive load will be analyzed to determine their relevance and applicability to the current study. This examination will help ensure that the proposed system is evaluated against rigorous and meaningful criteria, thereby enhancing its credibility and impact.

Limitations and Gaps: A critical component of the past research analysis is the identification of limitations and gaps in existing studies. Many mind mapping tools have been found to lack full integration with LMS platforms, which limits their utility in comprehensive educational environments. Additionally, past research often fails to address the need for personalized content delivery, resulting in a one-size-fits-all approach that does not cater to the diverse needs of individual learners. Another significant gap is the limited focus on user interaction and the incorporation of dynamic elements, such as embedded resource links, which can enhance the learning experience. By identifying these shortcomings, the proposed research aims to address them by developing a more integrated, personalized, and interactive mind map generation system.

Lack of Adaptive Learning Features: Past studies have generally overlooked the importance of incorporating adaptive learning features within mind mapping tools. Many existing systems provide static mind maps that do not adjust to the user's learning progress or preferences, limiting their effectiveness as educational tools. This research will emphasize the development of adaptive mind maps that can evolve based on student performance, offering a more tailored and responsive learning experience. By leveraging LLM technologies, the proposed system will aim to create mind maps that dynamically adjust to individual learning paths, thereby filling a significant gap in the current literature.

Innovative Contributions: The past research analysis will also highlight any novel contributions or breakthroughs in the field of mind map generation, particularly focusing on the evolution of tools and technologies rather than the use of traditional algorithms. Previous studies may have introduced new features or methods that enhanced the usability and functionality of mind maps, but they often did not fully exploit the potential of advanced technologies like Large Language Models (LLMs) or modern libraries. By integrating these cutting-edge tools into the proposed research, the study seeks to push the boundaries of educational technology, providing a next-generation mind map tool that not only improves learning outcomes but also offers a more interactive and personalized experience. The innovative elements identified in past research will serve as a foundation for further exploration, with the current study aiming to refine and expand upon these ideas to create a system that is both advanced and practical for contemporary educational settings.

This "Past Research Analysis" section will thoroughly explore the existing literature on mind map generation, focusing on the methodologies, datasets, and technologies employed in previous studies. By identifying and addressing the gaps and limitations of past research, this analysis will provide a solid foundation for the development of a more advanced, integrated, and personalized mind mapping system within LMS platforms. The proposed study will not only build upon the successes of previous research but also introduce innovative solutions to enhance the effectiveness and applicability of mind maps in education.

3.1.2 Refer Official Documentations

To ensure that the development of the mind map generation system adheres to established standards and guidelines, it is crucial to refer to relevant official documentation. This process will safeguard the integrity, usability, and effectiveness of the system by aligning it with best practices and regulatory requirements. The approach for consulting official documents is outlined as follows:

- ✓ **Identify Relevant Official Documents:** The first step involves identifying and sourcing official documents related to the development and implementation of educational technology, mind mapping tools, and integration with Learning Management Systems (LMS). These documents may include guidelines from educational technology organizations, standards from educational institutions, and best practice recommendations from academic and professional bodies. Examples could include standards from the International Society for Technology in Education (ISTE), guidelines from the Association for Educational Communications and Technology (AECT), and recommendations from the European Union's General Data Protection Regulation (GDPR) for data privacy.

- ✓ **Documentation Review:** Once identified, the relevant official documents will be reviewed in detail. This includes examining the guidelines, recommendations, and protocols provided by these sources. The focus will be on aspects related to the development of interactive and personalized mind maps, integration with LMS platforms, and data protection practices. Particular attention will be paid to any sections or chapters that discuss the use of technology in education, interactive learning tools, and data security measures to ensure that the system aligns with these established guidelines.
- ✓ **Compliance Standards and Ethical Issues:** Official documentation often outlines compliance standards and ethical considerations related to technology use in educational settings. The research team will scrutinize these aspects to ensure that the proposed system adheres to ethical guidelines and legal requirements. This includes obtaining necessary approvals from ethics committees, ensuring compliance with data protection laws such as GDPR, and addressing any privacy concerns related to user data.
- ✓ **Methodology Coherence:** Official documents may provide insights into recommended methodologies for developing educational tools and integrating them with LMS platforms. The research team will compare these recommendations with the proposed methodologies for the mind map generation system. Any discrepancies or areas requiring adjustment will be identified and addressed to ensure that the methodology aligns with established standards and best practices.
- ✓ **Industry Best Practices:** Official documentation frequently includes references to industry best practices and lessons learned from previous implementations. The research team will incorporate these best practices into the design, development, and evaluation phases of the mind map generation system. This will enhance the system's effectiveness, usability, and overall quality by leveraging proven strategies and avoiding common pitfalls.
- ✓ **Reporting and Documentation:** The findings from the review of official documents will be comprehensively reported and documented in the study proposal. This documentation will demonstrate the research team's commitment to adhering to established standards and guidelines, ensuring that the proposed system is well-founded and compliant with regulatory and best practice requirements.

3.1.3 Identify Existing Methodologies

Identifying existing methodologies is a pivotal step in developing an advanced mind map generation system. This phase focuses on understanding current techniques and practices, setting the stage for integrating novel tools such as Large Language Models (LLMs) and JS libraries (Mermaid Js) into the proposed system.

The process includes several key steps:

- **Literature Review:** A comprehensive literature review will be conducted to explore the methods and technologies used in past research related to mind map generation. This review will include academic papers, conference proceedings, and relevant publications, although specific tools and libraries used in previous studies may not always be detailed. The focus will be on understanding general methodologies, approaches for content visualization, and the application of mind maps in educational settings. Keywords such as "mind map generation," "educational visualization," "interactive diagrams," and "dynamic content adaptation" will guide the search.

- **Methodological Analysis:** Despite the lack of detailed information on specific tools used in past research, the analysis will still examine the broad methodologies and approaches employed. This includes reviewing general practices for generating and applying mind maps, including techniques for visualizing complex information and integrating mind maps within educational platforms. The analysis will provide insights into common practices and identify opportunities for leveraging advanced tools like LLMs for generating resource links and JS(Mermaid js) for creating interactive diagrams.
- **Strengths and Weaknesses:** The review will assess the strengths and weaknesses of the methodologies identified in the literature. This evaluation will consider factors such as the effectiveness of visualization techniques, ease of integration with Learning Management Systems (LMS), and the adaptability of mind maps to different educational contexts. Identifying these strengths and weaknesses will highlight areas where the proposed system, using LLMs and JS libraries, can provide improvements, such as offering more dynamic and personalized learning experiences or enhancing user interactivity.
- **Unique Approaches:** The analysis will also identify any unique or innovative approaches in the existing research, even if specific tools are not mentioned. This includes discovering creative methods for generating interactive mind maps, novel ways of integrating mind maps into educational platforms, and innovative techniques for content customization. The proposed research will build on these insights by incorporating LLMs to generate contextually relevant resource links and using Mermaid.js to create sophisticated and interactive mind maps.
- **Comparative Analysis:** A comparative analysis will be performed to evaluate the effectiveness and applicability of different methodologies identified in the literature. This analysis will compare the general approaches used in previous research with the capabilities of LLMs and Mermaid.js. By highlighting similarities and differences, the study will ensure that the proposed system leverages the strengths of existing methods while addressing any gaps or limitations. This approach will guide the selection and implementation of techniques that best align with the goals of the proposed mind map generation system.

3.2 Feasibility Study

3.2.1 Technical Feasibility

Assessing the technical feasibility of a project is crucial to determine whether the proposed system can be successfully developed and implemented using current technology. For the mind map generation system, the technical feasibility study involves evaluating the technical requirements, resources, and challenges associated with the project. This includes several key aspects:

- **Technology Assessment:** The first step is to evaluate the technological components that will be used in the project. This includes assessing the capabilities and limitations of the technologies chosen for generating and visualizing mind maps. Evaluating the compatibility of these technologies with the project's requirements ensures that they can be effectively used to achieve the desired outcomes.

- **Infrastructure Requirements:** The technical feasibility study must also consider the infrastructure required to support the implementation of the chosen technologies. This includes evaluating server capabilities, storage requirements, and network bandwidth to ensure that the system can handle the computational demands and provide a responsive user experience. Identifying the infrastructure needs will help in planning for adequate resources and scalability.
- **Integration and Interoperability:** The feasibility study will assess the ability to integrate the proposed system with existing platforms and systems. This includes evaluating how well the technologies can be incorporated into existing Learning Management Systems (LMS) or other educational platforms. Ensuring interoperability between the mind map generation system and other components of the educational technology ecosystem is crucial for a seamless user experience. The study will examine potential challenges related to data exchange, API integrations, and compatibility with other software tools and platforms.
- **Development and Maintenance:** The technical feasibility study will also address the development and maintenance aspects of the project. This includes evaluating the availability of skilled developers and the ongoing maintenance requirements for the technologies being used. Assessing the learning curve associated with these tools and the support available from their respective communities or documentation will help determine the ease of development and long-term sustainability of the system.
- **Security and Privacy:** Lastly, the feasibility study will consider the security and privacy implications of the proposed system. This includes ensuring that the system adheres to best practices for data security, especially when handling sensitive or personal information. Evaluating the security features of the chosen technologies and their robustness in terms of data protection and privacy compliance will be critical to safeguarding user data and maintaining trust.

3.2.2 Economic Feasibility

Determining the economic feasibility of the mind map generation project involves a thorough assessment of costs, resource allocation, potential returns, and funding opportunities.

The following steps outline the process for evaluating the economic viability of the project:

- **Cost Analysis:** A detailed cost analysis will be conducted to identify and evaluate the various expenses associated with the mind map generation system. This includes costs for software tools, such as LLM tools and APIs required for generating and integrating content. The analysis will cover the acquisition costs of these tools, including any subscription or usage fees associated with the APIs. Additionally, costs related to system development, user interface design, and integration will be considered. Ongoing maintenance and updates, along with any licensing fees for proprietary tools or libraries, will also be factored in. Indirect costs, such as training for end-users and technical support, will be included to ensure comprehensive budget planning
- **Resource Allocation:** The allocation of material and human resources will be assessed to ensure the project can be completed within budget. This includes evaluating the cost and availability of skilled personnel, such as developers, designers, and project managers, who are essential for the successful implementation of the mind map generation system. The

assessment will also consider the cost and availability of necessary hardware and software resources to ensure that all required resources can be effectively utilized [6].

- **Return on Investment (ROI):** The potential benefits and returns of the mind map generation system will be evaluated. This includes examining how the system can enhance educational outcomes, improve learning efficiency, and support personalized learning experiences. The ROI analysis will consider both direct benefits, such as improved student engagement and academic performance, and indirect benefits, such as increased adoption of innovative educational tools. Understanding the potential impact on educational institutions and students will help assess the long-term economic feasibility of the project [5].
- **Cost-Benefit Analysis:** A cost-benefit analysis will be performed to weigh the anticipated benefits of the mind map generation system against the estimated costs. Quantitative benefits may include increased efficiency in course content delivery, enhanced student comprehension, and potential reductions in the time and resources required for educational planning. Qualitative benefits might involve improvements in learning engagement, customization of educational content, and contributions to educational technology innovation. This analysis will provide a comprehensive understanding of the project's economic implications and its value to stakeholders
- **Financial Resources:** The availability and accessibility of financial resources will be examined. This includes exploring potential funding sources such as educational grants, research funding, partnerships with educational institutions, and sponsorships from technology companies. Identifying suitable funding opportunities and understanding their requirements will be crucial for securing the necessary financial backing for the project.

In summary, the economic feasibility study will provide a clear picture of the costs, benefits, and financial resources associated with the mind map generation project. By evaluating costs, resource allocation, potential returns, and funding opportunities, the study will determine whether the project is economically viable and capable of delivering value to educational stakeholders.

3.2.3 Schedule Feasibility

Assessing the viability and realizability of developing and deploying a mind map generation system within a specific timeframe is crucial for ensuring project success.

The following steps outline the process for determining schedule feasibility:

- **Research Plan:** A detailed research plan will be created, outlining the specific actions, tasks, and deadlines necessary to integrate the mind map component with the LMS. This plan will break down the project into phases, including component design, development, integration with the LMS, user interface customization, testing, and documentation. Dependencies and interdependencies between these phases will be defined to ensure a logical and efficient workflow.
- **Time Estimation:** The time required to complete each phase and task in the integration plan will be estimated. Factors such as the complexity of the integration, availability of resources, team expertise, and potential challenges will be considered. Time estimates will be developed in collaboration with team members and stakeholders to ensure accuracy and feasibility.

- **Milestone Definition:** Key milestones will be established to represent significant achievements throughout the project. These milestones will serve as checkpoints to monitor progress and ensure the project remains on track. By dividing the integration process into smaller, manageable phases with defined milestones, the schedule can be effectively monitored and adjusted as needed.
- **Critical Path Analysis:** A critical path analysis will be performed to identify the sequence of activities and tasks that determine the overall project duration. This analysis will help pinpoint critical tasks that must be completed on time to avoid delays. Prioritizing these critical tasks will ensure that resources and efforts are directed appropriately to meet project deadlines.
- **Risk Assessment:** Potential risks and challenges that could impact the project timeline will be identified and evaluated. This includes considering factors such as integration issues, technical challenges, resource availability, and any external influences. A risk mitigation plan will be developed to address these challenges and minimize their impact on the project schedule.
- **Resource Allocation:** The availability and allocation of resources, including funding, equipment, and human resources, will be assessed. This evaluation ensures that necessary resources are effectively distributed throughout the project. Any limitations or constraints will be noted, and solutions or workarounds will be considered to address resource-related challenges.
- **Contingency Planning:** Contingency plans will be developed to manage potential delays or disruptions that may occur during the project. This includes creating backup plans, alternative strategies, and incorporating flexibility into the timeline to accommodate unexpected events. Contingency planning will help mitigate the impact of disruptions and ensure the project continues smoothly.

Documentation of the research plan, milestones, critical path analysis, risk assessment, resource allocation, and contingency plans will be compiled to provide a comprehensive project roadmap. This documentation will offer direction and structure to ensure the successful development and deployment of the mind map generation system within the anticipated timeframe.

3.3 System Analysis

3.3.1 Software Solution

The development and implementation of the mind map generation component within the Learning Management System (LMS) will utilize a microservices architecture to enhance modularity, scalability, and integration. This approach will ensure that the component operates effectively within the LMS environment while supporting various user scenarios.

Software Requirements: The software requirements for the mind map generation component will be defined to include input and output specifications, data formats, and interoperability with the existing LMS. This will involve detailing the functional requirements for creating, editing, and visualizing mind maps, as well as addressing any specific constraints related to the LMS integration.

Software Architecture: The software architecture will adopt a microservices approach, providing a high-level framework that divides the system into discrete, independent services. Each microservice will handle a specific aspect of the mind map functionality, such as data management, user interface, and integration with the LMS. This architecture will define how data flows between microservices, ensuring that each service can be developed, deployed, and scaled independently. The modular design will facilitate updates and maintenance, allowing for efficient handling of various user scenarios and interactions with the LMS.

Algorithm Selection and Implementation: The algorithms and techniques for generating and managing mind maps will be selected based on their ability to create intuitive and interactive visual representations, particularly leveraging Large Language Models (LLMs) for enhanced functionality. This selection will focus on LLMs capable of understanding and generating complex hierarchical structures and text-based content to facilitate dynamic mind map creation. The LLMs will assist in generating, organizing, and visualizing the content within mind maps, providing sophisticated handling of user interactions and data integration. The chosen LLMs will be integrated using appropriate programming languages and frameworks to ensure robust and effective functionality within the mind map generation system.

Integration and Interoperability: Integration with the LMS will be achieved through well-defined APIs and data interchange formats, allowing seamless interaction between the mind map component and other LMS features. The microservices architecture will enable flexible and scalable integration, supporting smooth data exchange and interaction with existing LMS systems.

User Interface and Visualization: A user-friendly interface will be developed to facilitate interaction with the mind map generation component. This interface will be designed within a dedicated microservice, providing intuitive tools for creating and managing mind maps. Visualization features, including interactive nodes and branches, will enhance user experience and allow for customization of the generated maps.

Testing and Validation: The software solution will undergo comprehensive testing to ensure its accuracy, reliability, and performance. Testing will involve evaluating each microservice individually and in combination, assessing functionality, performance metrics, and integration with the LMS. Iterative refinement will address any identified issues, ensuring a robust and effective solution.

Documentation will be provided, including user manuals, technical specifications, and code documentation, to support the development, deployment, and maintenance of the mind map generation component. Regular updates may be required to incorporate improvements or address new requirements, with the documentation serving as a guide for ongoing development and integration within the LMS.

This microservices-based approach ensures that the mind map generation component is scalable, modular, and well-integrated with the LMS, delivering a reliable and user-friendly tool for enhancing learning experiences.

3.4 System Development and Implementation

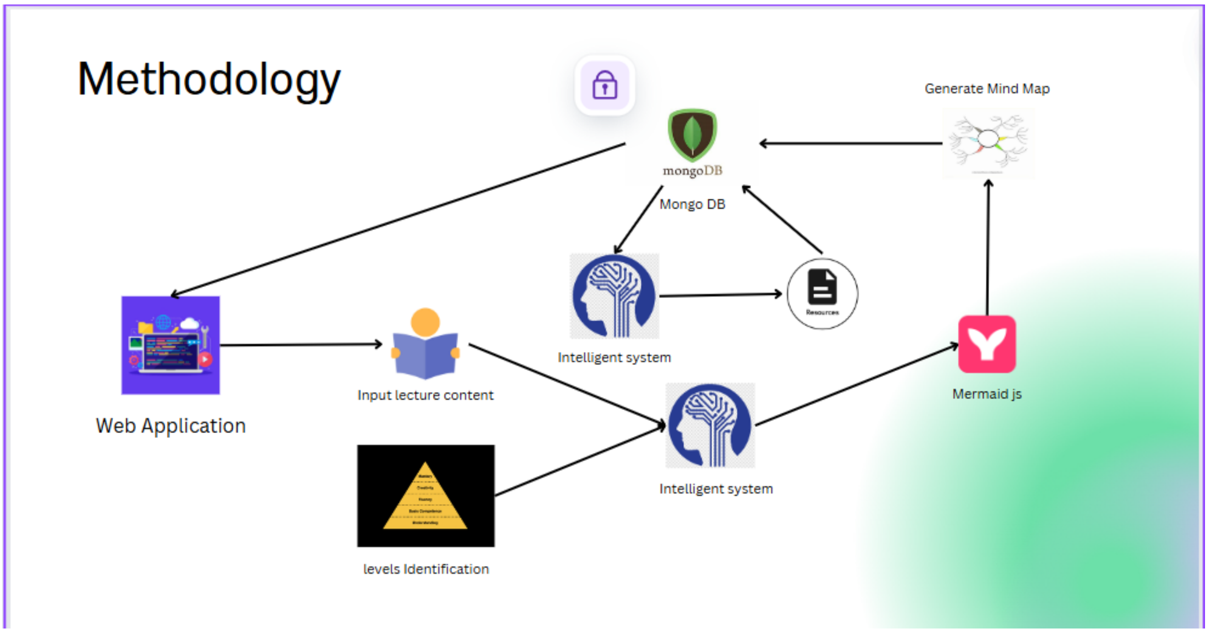

Figure 3:System Architecture of mind map generation

The system architecture for personalized mind map generation is an integration of advanced AI models, web technologies, and database management, aimed at creating tailored educational tools for students. The development workflow adopts a structured approach leveraging a combination of technologies to ensure accurate and efficient mind map creation.

Initially, the process begins with the input of lecture content into the system, accompanied by the assessment of user levels through an intelligent system, such as GPT-3.5, GPT-4, or another similar AI model. The intelligent system plays a crucial role in customizing the lecture content based on the identified user levels, effectively creating content that aligns with the educational needs of different students.

Once the content is customized, it is formatted into PDF documents tailored for each user level. These PDFs are then processed through the Mermaid.js library, which is used to generate unique mind maps for each student. The mind maps are designed to be specific to the user's level of understanding, ensuring that each student receives a personalized and relevant educational tool.

The generated mind maps are then stored in a MongoDB database, which serves as the primary repository for all personalized educational content. Following this, the stored mind maps undergo further enhancement through the intelligent system, where additional resources, references, and links are embedded into each node of the mind maps. This step enriches the mind maps, providing students with comprehensive learning materials linked directly to relevant content.

The final enhanced mind maps are saved back to MongoDB, ensuring that the latest version with all added resources is securely stored. These mind maps are then made accessible through a web application, where students can view their personalized content. Each student interacts with their unique mind map through the web interface, providing an interactive and user-friendly experience tailored to their learning needs.

This methodology ensures a seamless flow from content input to personalized educational delivery, leveraging AI and web technologies to create a scalable, efficient, and effective learning tool for students.

3.5 Technologies and Techniques

- **Technologies**

- ✓ Angular / React
- ✓ Express
- ✓ React Native
- ✓ Node Js
- ✓ Mermaid Js
- ✓ Mongo DB

- **Techniques**

- ✓ Zoom and pan
- ✓ Node Expansion/Collapse
- ✓ Adaptive Learning Technique
- ✓ Data Pre-processing

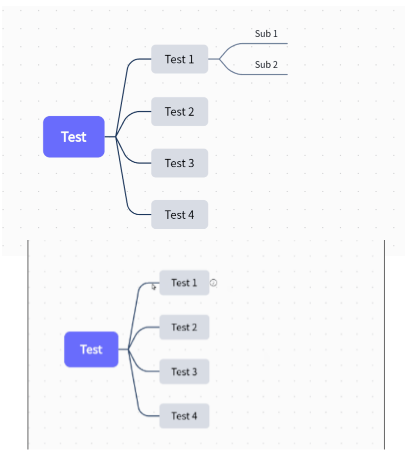

Figure 4:Collapse

3.6 Project Requirements

3.6.1 Functional Requirements

Following are the functional requirements of the proposed system.

- Mind Map Generation
- Export
- Search and Filtering
- Resource Integration
- Personalization

3.6.2 Non-Functional Requirements

The following are the non-functional requirements focused on during the proposed system's development.

- Accuracy
- Performance
- Reliability
- Security and Privacy
- Usability
- Robustness

3.6.3 Ethical Requirements

To proceed with the research ethical requirements are another area that should be focused on. As ethical requirements following can be addressed.

- Accuracy and Integrity
- Data Security
- Bias and Fairness
- Institution’s approval on study
- Ethical clearance

3.7 Testing

For the successful integration and functionality of the mind map generation component within the Learning Management System (LMS), thorough testing is crucial. The testing process will begin with creating a comprehensive test plan that outlines the objectives, methodologies, and various types of tests to be performed. This plan will include both functional and non-functional testing to ensure the component meets all required standards.

Functional testing will focus on verifying that core functionalities of the mind map generation tool—such as creating, editing, and deleting mind maps—are operating as expected. This involves testing the integration of the component with the LMS to ensure seamless data exchange and correct functionality. Performance testing will evaluate how efficiently the component handles large datasets and multiple user interactions, ensuring that it performs optimally without causing delays or affecting the LMS's overall performance.

Usability testing will involve end-users interacting with the mind map generation tool to assess its user interface and overall experience. Feedback collected during this phase will help refine the design to ensure it is intuitive and user-friendly. Security testing will be conducted to ensure the component adheres to data protection standards and is resilient against potential vulnerabilities.

Accuracy testing will measure how well the component generates mind maps based on the provided data, ensuring that the output aligns with user expectations and system requirements. The component's robustness will be tested by exposing it to various real-world scenarios, such as handling incomplete or inconsistent data, to assess its ability to maintain functionality under challenging conditions.

Finally, any issues identified during testing will be addressed through iterative improvements, including optimizing algorithms, adjusting settings, and incorporating new features as needed. The testing outcomes will be thoroughly documented, including test design, data, metrics, and analysis, to ensure that the mind map generation component is reliable, efficient, and fully integrated within the LMS.

3.8 Timeline

No	Assessment / Milestone	2024- 2025													
		April	May	June	July	August	September	October	November	December	January	February	March	April	May
1	Research group formation														
2	Supervisor selection														
3	Brainstorming workshop 1														
4	Selection of research topic														
5	Co-supervisor selection														
6	Brainstorming workshop 2														
7	Feasibility and background study														
8	Topic registration from submission														
9	In-depth feasibility and background study 1														
10	External supervisor selection														
11	Topic assessment form submission														
12	Topic assessment from evaluation														
13	In-depth feasibility and background study 2														
15	Proposal presentation														
16	Individual proposal report submission														
17	Implementation of research work(upto 50%)														
18	Progress presentation 1														
19	Prepare and submit research paper														
20	Implementation of research work(upto 90%)														
21	Progress presentation 2														
22	Integration of the research work														
23	Project completion														
24	System testing														
25	Website and final report preparation														
26	Final presentation														
27	Final report submission														

Table 1: Timeline

3.9 Work Breakdown Chart

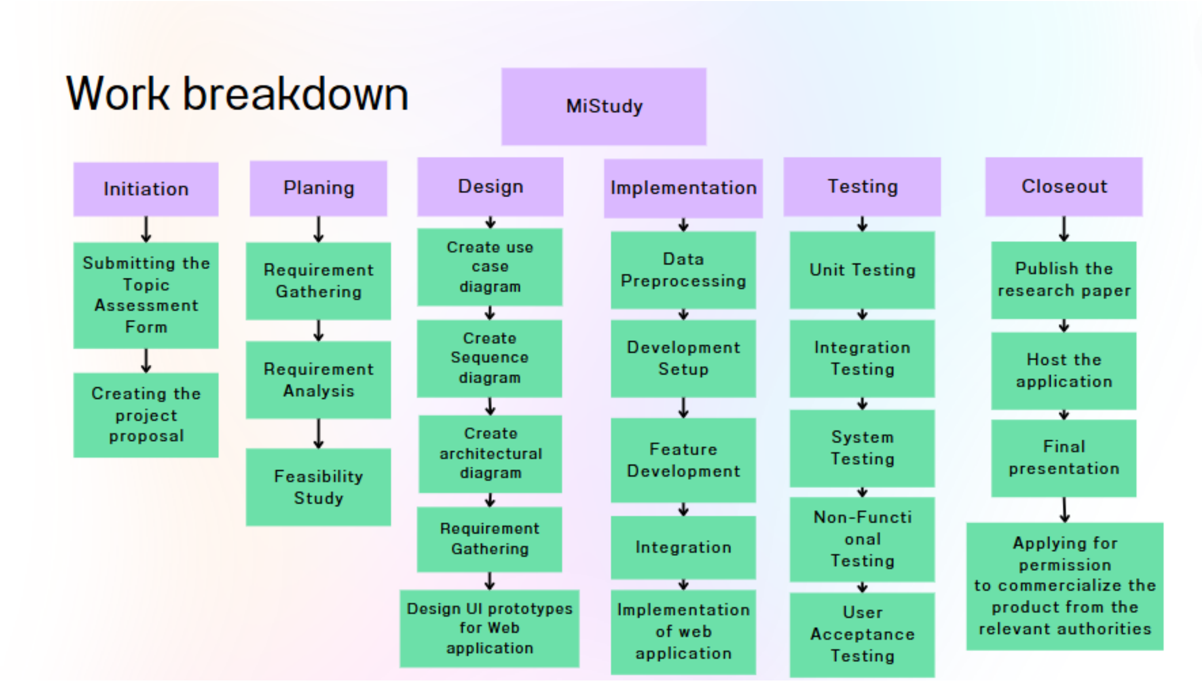

Figure 5:Work breakdown Chart

4.0 PERSONNEL AND FACILITIES

<table>
<tr><td>Name</td><td>Tasks</td></tr>
<tr><td>Sri Samadhi L.A.S.S</td><td>
Development of a system capable of creating and managing interactive mind maps integrated with an LMS.
Structuring and optimizing the data for effective representation within the mind maps.
Designing and implementing personalization features to tailor the mind map generation system to individual user preferences and needs.
Developing functionality to link and integrate relevant resources within the mind maps.
Conducting thorough testing of the mind map generation system to ensure it meets functional requirements and performs effectively within the LMS environment.
Note cards and forums creations
</td></tr>
</table>

Table 2:personnel and facilities

5.0 COMMERCIALIZATION

The commercialization of the personalized mind map generation system in a Learning Management System (LMS) environment focuses on transforming research outcomes into a viable product or service that educators, students, and academic institutions can utilize for enhanced learning experiences. The process begins with a comprehensive market analysis to understand the current educational technology landscape and identify potential opportunities for the system. The target market, primarily educational institutions and e-learning platforms, is analyzed to assess the demand for personalized learning tools and the potential impact of the mind map generation system.

A critical step in the commercialization process is defining a unique value proposition that highlights the system’s ability to tailor educational content to individual student needs through AI-driven mind maps. This system's unique selling points, such as personalized learning paths, real-time content customization, and enhanced student engagement, are emphasized to differentiate it from existing educational technologies.

To protect intellectual property, patents will be sought for the innovative methods, algorithms, and AI models developed during the research. This protection ensures a competitive advantage in the market. A robust business model will be formulated, considering options like a software-as-a-service (SaaS) platform, licensing agreements with LMS providers, or direct sales to educational institutions.

Regulatory compliance will be addressed, ensuring that the product meets educational standards and privacy regulations, particularly concerning student data. Strategic marketing initiatives, including collaborations with educational influencers, participation in academic conferences, and targeted online campaigns, will be implemented to build product awareness and drive adoption.

To validate the effectiveness of the system, pilot programs will be conducted in real-world educational settings, gathering feedback from educators and students to refine the product. Ethical considerations, including data privacy and consent, will be paramount, ensuring trust and integrity in the system's deployment.

Business development efforts will focus on forming partnerships with educational institutions, securing pilot projects, and accessing user data to enhance the AI algorithms. Financial considerations, including initial investment, projected revenue, and return on investment, will be carefully analyzed to ensure the product's long-term viability.

Funding avenues such as educational grants, venture capital, and strategic partnerships will be explored to support the commercialization process. The successful commercialization of the personalized mind map generation system will enable widespread adoption in the educational sector, significantly benefiting students, educators, and academic institutions by offering a tailored and effective learning tool.

6.0 BUDGET

A budget is a critical financial tool that outlines the estimated costs associated with a project. It provides a structured financial plan that ensures resources are allocated efficiently to meet the project's objectives while maintaining financial discipline throughout the project's lifecycle.

The proposed budget for the personalized mind map generation system in a Learning Management System (LMS) is estimated to be **20,000/=.** The budget is distributed across the most essential phases of the project to ensure a focused and effective use of resources.

6.1 Development Phase - 50% (10,000/=)

The development phase is the core of the project, where the system's functionalities are built using cutting-edge technologies. This phase covers the costs associated with coding, integrating APIs (including the use of GPT-3.5/GPT-4 for content customization), and developing the intelligent system that generates personalized mind maps. This allocation ensures that the project leverages the latest tools and techniques to create a robust and scalable solution.

6.2 Testing Phase - 30% (6,000/=)

Testing is a crucial stage, especially for a system designed to cater to personalized learning experiences. This phase includes rigorous testing of the system’s performance, functionality, and user experience in real-world scenarios. The testing budget ensures that the system meets the required standards before deployment, minimizing risks and ensuring a high-quality product.

6.3 Marketing and Sales - 20% (4,000/=)

This allocation is dedicated to promoting the mind map generation system to the target audience, including educational institutions, e-learning platforms, and individual educators. Marketing efforts will focus on highlighting the system’s unique features, such as personalized learning paths and AI-driven content customization. This budget also covers the cost of launching strategic campaigns to drive adoption and market penetration.

6.8 Summary of Budget Allocation

Phase	**Percentage**	**Amount (=/=)**
Development	50%	10,000
Testing	30%	6,000
Marketing and Sales	20%	4,000
Total	**100%**	**20,000**

Table 2: Budget Plan

This budget plan ensures that the project is well-financed across all essential phases, from planning to market entry, providing a solid financial foundation for the successful commercialization of the personalized mind map generation system.

7.0 SUMMARY

The project aims to develop an integrated system for mind map generation that enhances the visualization and organization of information within Learning Management Systems (LMS). This system will facilitate the creation and management of interactive mind maps, allowing users to intuitively structure and explore complex concepts. Additionally, it will support note card functionality and forums for student-teacher interactions, enriching the learning experience by promoting organized knowledge sharing and active engagement. By leveraging personalized features and resource linking, the system seeks to improve educational outcomes and streamline communication within academic environments.

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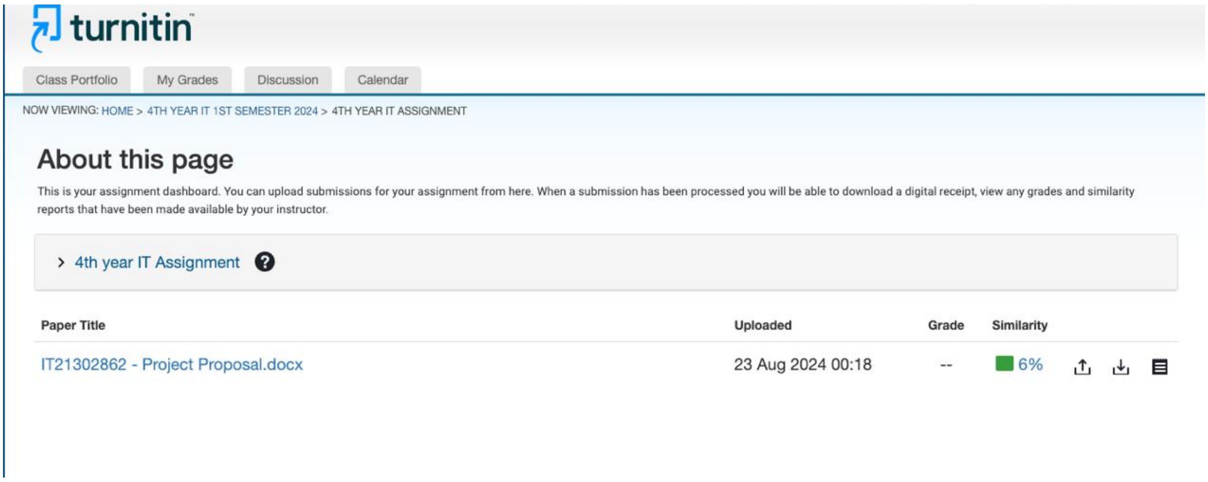
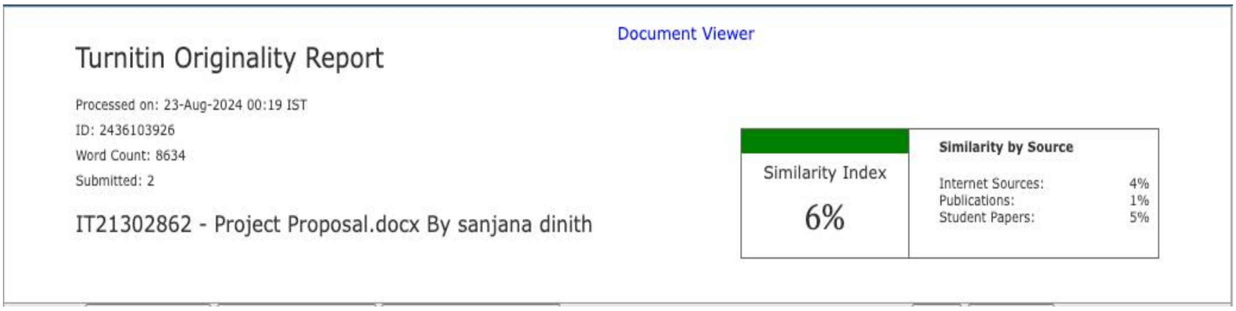
Appendix

Similarity Report





Similarity Report

DECLARATION

We declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
Sri Samadhi L.A.S.S	IT21302862	

The supervisor/s should certify the proposal report with the following declaration.

The above candidates are out research for the undergraduate Dissertation under my supervision.

Signature of the Co-Supervisor: Date:

Thilini. 23/8/24

Ms. Thilini Jayalath