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Designing for Engagement: A Human-Centred Approach to
Enhancing Student-Professor Collaboration Through a Mobile
App

Domen Bozic

Master Thesis

presented as partial requirement for obtaining a Master's Degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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Designing for Engagement: A Human-Centred Approach to Enhancing
Student-Professor Collaboration Through a Mobile App

by
Domen Bozic

Master Thesis presented as partial requirement for obtaining the Master's degree in
Information Management, with a specialization in Business Intelligence

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April, 2025

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism, any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honour from the NOVA Information Management School.

Lisbon, 01/04/2025
Domen Bozic

DEDICATION

To my family, whose unwavering support and encouragement have shaped the person I am today. To my girlfriend, whose patience, love, and belief in me provided constant motivation throughout this journey. And to the professors and mentors who have sparked my curiosity and inspired me to pursue knowledge with purpose and heart. This work is dedicated to you all.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to everyone who contributed to the development of this thesis. I am especially thankful to my supervisor and academic advisors for their guidance, feedback, and encouragement throughout this journey. I would also like to acknowledge the support of my professors, university staff, and colleagues, whose insights and discussions were invaluable.

A heartfelt thanks to the students and professionals who participated in the research process and provided thoughtful feedback that shaped this project. Your openness and engagement were vital to the development of the prototype.

Lastly, to my friends and family, I would like to thank you for your patience, love, and belief in me throughout this process.

ABSTRACT

This project explores how the integration of Design Thinking and Human-Centred Design (HCD) methodologies can enhance classroom collaboration and student engagement through the development of a mobile application. Focusing on the relationship between students and professors, the study aimed to create a digital platform that addresses challenges which students face during in-class participation while fostering meaningful academic interaction.

The research followed the three phases of Design Thinking: Inspire, Ideate, and Implement. During the Inspire phase, extensive user research was conducted using methods such as trend analysis, benchmarking, parallel universe analysis, and empathy mapping. These approaches revealed insights into student needs, classroom dynamics, and opportunities for improving engagement. The Ideate phase featured collaborative brainstorming sessions with professionals from education and design, generating and refining concepts aligned with user expectations. In the Implement phase, a functional mobile prototype was created using Adalo, a no-code development platform. Professional evaluators were assigned in-app tasks and later provided structured feedback through questionnaires and interviews. Their insights informed iterative improvements to both the user interface and functionality of the app.

Throughout the whole paper, this user-centred and feedback-driven approach demonstrated the effectiveness of combining creativity and technology to develop solutions that are intuitive, relevant, and grounded in real educational contexts. Findings offer valuable contributions to institutions and developers aiming to adopt design thinking principles in educational technology to better meet the evolving needs of students and faculty.

KEYWORDS

Design Thinking; Human-Centred Design; Student Engagement; Educational Technology;
Mobile App Development

Sustainable Development Goals (SDG):



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LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence: The simulation of human intelligence processes by machines, particularly computer systems, often used in educational technology to support personalized learning and adaptive feedback.
API	Application Programming Interface: A set of protocols and tools that allow different software applications to communicate with each other, enabling integration of external services (e.g., learning tools or analytics) into educational platforms.
Ba	A Japanese concept introduced by Nonaka, meaning a shared space (physical or virtual) that facilitates knowledge creation.
DT	Design Thinking – A human-centred methodology for solving complex problems through iterative phases of empathy, ideation, and prototyping.
HCD	Human-Centred Design – A design approach that deeply considers the human perspective throughout the problem-solving process.
LMS	Learning Management System: A digital platform used to deliver, manage, and track educational content, student participation, and performance, commonly used in both online and blended learning environments.
PDF	Portable Document Format – A file format used to present documents consistently across devices and platforms.
Q&A	Questions and Answers – An interactive feature allowing users to ask and receive responses in real-time or asynchronously.
SECI	Socialization, Externalization, Combination, Internalization – A model developed by Nonaka and Takeuchi to explain knowledge creation through continuous conversion between tacit and explicit knowledge.
UI	User Interface – The layout and design elements users interact with in a digital system or application.
UX	User Experience – The overall experience and satisfaction a user derives from interacting with a system or product.

1. INTRODUCTION

In today's educational landscape, several challenges impede effective knowledge creation and active participation in classrooms especially among students. A lack of student engagement, often rooted in low confidence, fear of making mistakes, or previous negative experiences, can foster passive learning environments that restrict curiosity and creativity (Herrmann, 2013; Ismail et al., 2022). Teacher-centred approaches persist in many institutions, limiting opportunities for collaboration, self-expression, and critical thinking. Moreover, factors such as ambiguous content, time constraints, and language barriers often prevent meaningful engagement with learning material. The absence of positive reinforcement further discourages student involvement, and many educational systems fall short in promoting essential soft skills like creativity, communication, and problem-solving skills which are vital for real-world knowledge application.

As education increasingly shifts toward digital and blended formats, the need for interactive, student-centred tools becomes more urgent. Research shows that student engagement is a multidimensional construct that is encompassing behavioural, emotional, and cognitive aspects which significantly correlates with academic success and classroom participation (Fredricks et al., 2004). Despite this, many classroom environments still lack the structural or technological support to foster such engagement, often leading to disengagement and minimal knowledge retention.

This thesis addresses a critical gap at the intersection of education, design, and technology. The lack of co-designed, interactive digital platforms that actively support in-class engagement remains a significant gap in modern education. Traditional learning management systems typically enable basic communication and content distribution but fall short in offering real-time interaction, emotional responsiveness, and personalized experiences that align with students' dynamic needs and preferences.

To address this, the current study adopts a Human-Centred Design (HCD) and Design Thinking (DT) methodology to develop a mobile learning platform that promotes active collaboration and improves the student-professor relationship. These approaches place users both students and educators at the centre of the design process to ensure the outcomes align with their lived experiences, cognitive needs, and emotional drivers (Sanders & and Stappers, 2008). Through

structured phases of Inspire, Ideate, and Implement, the research integrates both qualitative and quantitative methods to iteratively develop a prototype aligned with real classroom needs.

By engaging stakeholders throughout the design journey and focusing on creative, feedback-driven iterations, this study aims to create a platform that transforms passive learning into active collaboration. It further seeks to contribute to the broader discourse on digital transformation in education by providing practical and theoretical insights for user-centred educational technology design.

2. LITERATURE REVIEW

2.1. Design Thinking Purpose

Design thinking is increasingly recognized as a pedagogical approach in higher education, applicable across various disciplines beyond traditional design fields. It is utilized in areas such as business management, engineering, and education to tackle complex problems and foster innovation (Rusch, 2023). The essence of design thinking lies in its ability to foster civic literacy, empathy, cultural awareness, and risk-taking among participants. It encourages individuals to think and work like expert designers, which enhances their ability to address diverse challenges. The design thinking process typically includes several stages: empathizing with users, defining the problem, ideating solutions, prototyping, and testing. This iterative process allows for continuous refinement based on user feedback, making it adaptable to different contexts (Panke, 2019). Moreover, this structured problem-solving approach emphasizes understanding users' needs and challenges to develop innovative solutions. It follows a five-step process: empathise, define, ideate, prototype, and test. This methodology is particularly effective in educational settings as it encourages creativity and user-centred design, which are essential for fostering entrepreneurial competencies among students (Baltador et al., 2024).

2.1.1. Design Thinking Stages

Design thinking is a structured approach to problem-solving that involves several key stages. According to the Stanford University, the design thinking process consists of five main stages (Aflatoony et al., 2018). These are called empathize, define, ideate, prototype and test. These stages of design thinking provide a structured framework that facilitates collaboration and innovation in developing educational resources, particularly in the context of digital educational escape rooms. The process emphasizes the importance of understanding user needs, iterative testing, and fostering a creative team environment throughout the design journey (Moffett & Cassidy, 2023). Design thinking can be effectively summarized in three key stages: inspiration, ideation, and implementation. Each stage plays a crucial role in developing innovative solutions.

(Camacho, 2016). In this research the three-stage process (Shown in the figure 2-1) will be used for the purpose of simplicity and effectiveness.



Figure 2-1 – Design Thinking Steps

2.1.2. Design Thinking for Student Engagement and Digital Learning Tools

Recent studies have emphasized the potential of design thinking to address educational challenges related to student disengagement, particularly in digitally mediated environments (Razzouk & Shute, 2012). By positioning students as co-creators of learning experiences, design thinking can transform passive learning into active participation. This is especially relevant for mobile platforms designed to support in-class interaction, peer collaboration, and real-time feedback. When integrated into the development of educational apps, DT enables designers to respond to complex needs such as unclear learning goals, limited collaboration opportunities, or inconsistent student motivation (Carroll et al., 2010). Therefore, this approach not only supports user-centred app development but also contributes to pedagogical innovation by empowering both students and educators to take part in shaping more meaningful learning environments.

2.1.3. Fostering Innovation through Knowledge Sharing and Design Thinking

Innovative educational practices, such as experiential learning, allow students to engage actively with their learning material. It often involves breaking down silos between disciplines. Fostering a collaborative environment in a classroom, where diverse perspectives could lead to creative solutions, is crucial for addressing challenges. Moreover, the design thinking process emphasizes iteration, allowing

students to experiment, receive feedback, and refine their ideas. (Rusch, 2023). Design thinking emphasizes understanding the needs and experiences of students. By fostering empathy, educators can create a more inclusive classroom environment that addresses diverse learning styles and challenges. Furthermore, in classrooms that utilize design thinking, students are encouraged to collaborate in solving real-world problems. It promotes an iterative process of prototyping and feedback. In a classroom setting, this means students can experiment with ideas, receive constructive feedback, and refine their work. Design thinking equips students with the skills to navigate change and uncertainty. Preparing them for future challenges and incorporating design thinking into classroom practices can significantly enhance student engagement, collaboration, and ownership of learning (Rodney, 2020).

2.2. Knowledge And Knowledge Creation

Knowledge refers to the competence and proficiency developed through expertise or education, originating from data that transforms into information and finally into knowledge. It is generally classified into explicit and tacit knowledge. Explicit knowledge is transferable and expressed in formal, systematic language, often organized in tangible formats like books, databases, or electronic media, making it easy to share and store. In contrast, tacit knowledge is personal, context-specific, and difficult to formalize or express. Embedded in an individual's experience, it is typically shared through direct interactions such as mentoring, training, or collaborative projects (Wijaya & Gunawan, 2022).

The knowledge creation is a spiral process that grows out of three elements which are SECI process, "Ba" and knowledge assets. It is a continuous and self-transcending process where you acquire a new context, a new view of the world, and new knowledge. The boundary between self and others is transcended as knowledge emerges through interactions among and between individuals and their environments (Nonaka et al., 2000).

Furthermore, in today's educational landscape hinder that effective creation of knowledge with students is becoming very challenging. Main reasons for that are lack

of students engagement and collaboration which should force teachers to design teaching and learning to meet student’s needs (Nguyen et al., 2018). As educational systems worldwide shift from a knowledge-based to a competency-based approach, there is an increasing need to adopt effective teaching methods. Integrating the SECI model into pedagogical practices offers a pathway to enhance collaboration and improve student satisfaction in the learning process (Mendoza et al., 2022).

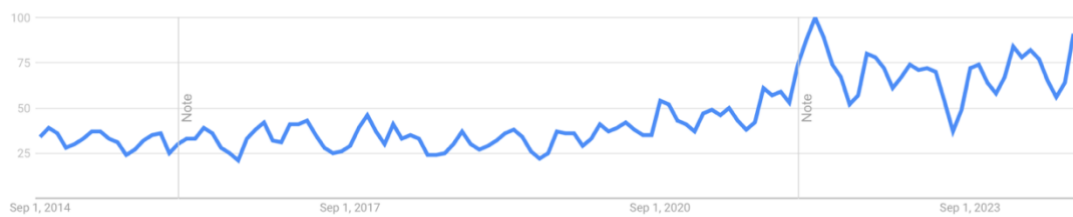


Figure 2-2 – Interest in Knowledge Creation after COVID-19 spiked

Knowledge creation has seen a steady increase in public interest over the past decade, as reflected in Google Trends data (2-2 Figure). The graph illustrates a gradual upward trend from 2014 to 2024, with notable spikes in search volume around 2020, possibly due to the global shift toward remote learning and digital collaboration during the COVID-19 pandemic. This sustained interest underscores the growing societal and academic focus on how knowledge is generated, shared, and applied, particularly in educational and technological contexts. The trend supports the relevance of integrating knowledge creation into student-centred design practices, especially when building digital learning environments.

While various models such as Knowledge Building Theory, Engagement Theory, and the Community of Inquiry Framework offer valuable insights into collaboration and knowledge creation in educational contexts, the SECI model was chosen as the most appropriate. These models emphasize collaborative learning and community engagement, which align with certain aspects of the SECI model. For instance, Knowledge building theory focuses on the collective creation and refinement of knowledge through discourse and inquiry (Hong et al., 2011), while the Community of Inquiry (CoI) framework highlights the cognitive, social, and teaching presences

essential to meaningful online learning (Arbaugh et al., 2010). Engagement Theory, meanwhile, underlines the importance of student involvement in meaningful and interactive tasks to enhance satisfaction and learning outcomes (Zhang et al., 2023). However, the SECI model's unique emphasis on the dynamic transformation between tacit and explicit knowledge which offers a more structured, actionable, and contextually relevant approach for exploring knowledge co-creation and transfer between professors and students. This makes it particularly well-suited to the objectives of this research and its design thinking approach to classroom engagement.

2.3. SECI Model

The SECI model, developed by Ikujiro Nonaka, is a cyclical framework that describes the dynamic process of knowledge creation within organization. There are four phases which makes this model: Socialization, Externalization, Combination and Internalization (Bandera et al., 2017). In education, these processes facilitate the transformation of tacit knowledge (personal, context-specific knowledge) into explicit knowledge (formal, codified knowledge) and other way around. This dynamic process is crucial for fostering innovation and learning among educators. Moreover, the SECI model supports teacher development by enabling them to construct their 'know-why' knowledge. These processes facilitate continuous knowledge creation, which is essential for both innovation and learning within educational environments. In academic contexts, such as teacher-student collaboration, the SECI model offers valuable insight into how knowledge is shared, internalized, and re-applied to enhance learning outcomes (Mendoza et al., 2022). The findings from this research aim to provide actionable insights for educators and instructional designers. By integrating knowledge management frameworks like the SECI model into digital learning environments, educators can enhance the overall learning experience and effectiveness of their courses (Žatuchin, 2024). In the context of this research, the SECI model was used to inform the methodological structure for capturing and translating insights from both students and educators during the development of the student-centred mobile application.

The SECI model (Nonaka and Takeuchi)

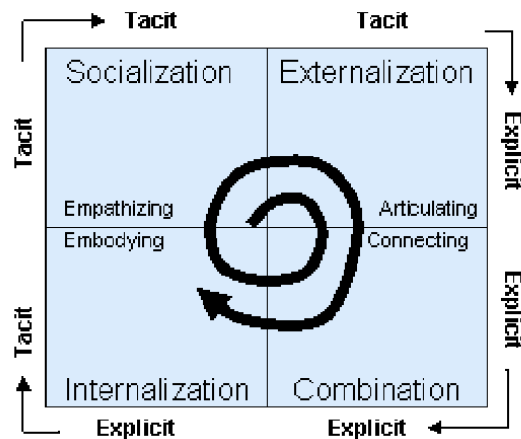


Figure 2-3 – Cycle of SECI Model

2.3.1. Socialization

Socialization refers to the transfer of tacit knowledge through shared experiences and interpersonal interaction. In educational settings, this process plays a crucial role in fostering collaborative learning environments, where students absorb unspoken norms, expectations, and ways of thinking by engaging with peers and instructors. In the context of this thesis, socialization aligns with the early classroom dynamics where students learn from each other informally which is through discussions, shared activities, or observing professors' teaching styles. These moments of unstructured exchange are essential for building a foundation of trust and engagement, which digital tools like educational apps can support. As stated in the article such tacit knowledge transfer is often more effective than traditional lectures in helping students grasp complex ideas, especially when it is embedded in face-to-face or digital collaborative settings (Guo & Xue, 2020).

2.3.2. Externalization

Externalization is where tacit knowledge is transformed into explicit knowledge. This requires individuals to articulate their intuitive knowledge in a way that can be understood by others. It often involves discussions, reflections, and the sharing of mental models, enabling the codification of insights into documents or processes. This process is crucial as it helps students express complex design concepts and

methodologies that are typically difficult to communicate. It transforms personal intuition and empirical knowledge into structured frameworks that can be shared and taught (Baldé et al., 2018; Guo & Xue, 2020). For this thesis, externalization is particularly relevant in how students and professors communicate knowledge within the app. This conversion not only facilitates better comprehension for professors but also encourages student agency in the learning process.

2.3.3. Combination

Combination is a process that involves the integration of different types of explicit knowledge to create new explicit knowledge. It includes gathering and synthesizing information from various sources, such as reports or databases, and disseminating it through presentations or meetings. This phase is crucial for making sense of previously unrelated knowledge domains and enhancing organizational learning. It is the hardest and most difficult way of sharing knowledge within organization and across different departments. One of the biggest concerns is that it cannot develop the problem-solving skill with students. However, it can be solved with professional development activities and regular school meetings. In educational environments, this might take the form of students integrating lecture materials, peer discussions, and digital content to produce presentations, reports, or collaborative outputs. Students making presentation and teachers giving feedback can be an example of combination in classrooms. Through the combination of knowledge, students also develop skills that prepare them for future roles as educators or leaders in the field. Moreover, the ability to reconfigure explicit knowledge collectively plays a central role in developing reflective, data-informed learning cultures. (Baldé et al., 2018; Guo & Xue, 2020). In the context of this thesis, the app prototype facilitates this phase through features like shared file repositories, visual analytics, and performance tracking. These tools allow students and professors to aggregate and interpret data such as quiz results, engagement levels, or participation trends in meaningful ways.

2.3.4. Internalization

The final phase is where explicit knowledge is converted back into tacit knowledge. This occurs through practice and experience, allowing individuals to absorb new

concepts and integrate them into their beliefs and values. It emphasizes the importance of applying learned knowledge in real-world situations to solidify understanding. In educational contexts, this occurs when students and professors engage with structured content or feedback and begin to integrate those lessons into their daily behaviours, mindsets, or teaching approaches. Moreover, internalization process is often described as “learning by doing”. Teachers learn and organize explicit knowledge through their professional practices, which helps them to apply this knowledge effectively in their classrooms. Successful internalization involves teachers having a deep understanding of their subject's teaching targets and tasks. This understanding allows them to integrate their individual knowledge into the teaching team, thereby enhancing overall team performance (Baldé et al., 2018; Mendoza et al., 2022). Within the app developed for this thesis, features such as real-time feedback, mood tracking, and adaptive learning recommendations aim to support this phase by encouraging reflection and continuous learning. When students act on personalized feedback or adapt their study habits based on visual analytics, they begin internalizing concepts that go beyond surface understanding.

2.3.5. Creating a Conducive Environment for Knowledge Sharing

The SECI model outlines four modes of knowledge conversion, providing a dynamic process that is essential for enhancing teachers' Pedagogical Content Knowledge (Zulfikar Alimuddin et al., 2021). While the SECI model explains how knowledge is transformed and shared, the concept of *Ba* focuses on where this exchange occurs. *Ba* represents a shared physical or virtual space that fosters relationships and supports a conducive atmosphere for knowledge sharing. In educational settings, *Ba* enables students, teachers, and staff to engage in meaningful interaction, making it a critical component for promoting knowledge creation and personal development (Attard et al., 2022).

2.4. BA In Education

Ba was introduced by Ikujiro Nonaka and Noboru Konno in 1996. It represents a shared space that facilitates knowledge creation and is deeply rooted in Japanese culture, making it challenging to translate into Western languages without losing its

essence. Ba serves as a platform for knowledge creation by providing a context where individuals can share emotions, experiences, and mental images. This sharing fosters socialization and allows individuals to transcend their limits, leading to effective knowledge internalization and action. Effective Ba is revealed through dynamic interactions that are based on a shared vision and collective knowledge efforts. These interactions strengthen relationships and contribute to a higher sense of self within the community. There are four distinct types of Ba, each defined by the nature of interactions (Fayard, 2003). While Ba is not a central design pillar of the app developed in this thesis, its concept offers insight into how spatial and relational dynamics influence knowledge creation and student participation

Originating Ba is a type that involves face-to-face interactions where individuals share their experiences and emotions. Originating Ba can be fostered through group discussions, collaborative projects, and peer-to-peer learning. This environment encourages students to socialize and share their tacit knowledge, which is crucial for building relationships and trust among learners. It helps in creating a supportive atmosphere where students feel comfortable expressing their thoughts and ideas (Nonaka et al., 2000).

Dialoguing Ba is characterized by collective and face-to-face interactions. It allows individuals to articulate their mental models and skills. This type can be seen in seminars, workshops, or debate sessions where students engage in dialogues to share and refine their understanding of concepts. Through discussions, students externalize their tacit knowledge, leading to deeper insights and collaborative learning. It emphasizes the importance of communication and critical thinking in the learning process (Nonaka et al., 2000).

Exercising Ba is defined by individual and virtual interactions. It focuses on internalization through the embodiment of explicit knowledge. This type of Ba can be implemented through online learning platforms, simulations, or virtual labs where students engage with materials and resources independently. For instance, students might use e-learning tools to practice skills or apply knowledge in simulated

environments, allowing them to internalize what they have learned through action and reflection (Nonaka et al., 2000).

Systemising Ba is not explicitly detailed in the provided contexts and typically refers to the organization and structuring of knowledge within a system. Furthermore, it is defined by collective and virtual interactions, which are essential in educational settings where students and educators collaborate. This environment allows for the combination of existing explicit knowledge, making it easier to share information widely through written forms such as textbooks, online resources, and academic papers (Nonaka et al., 2000)

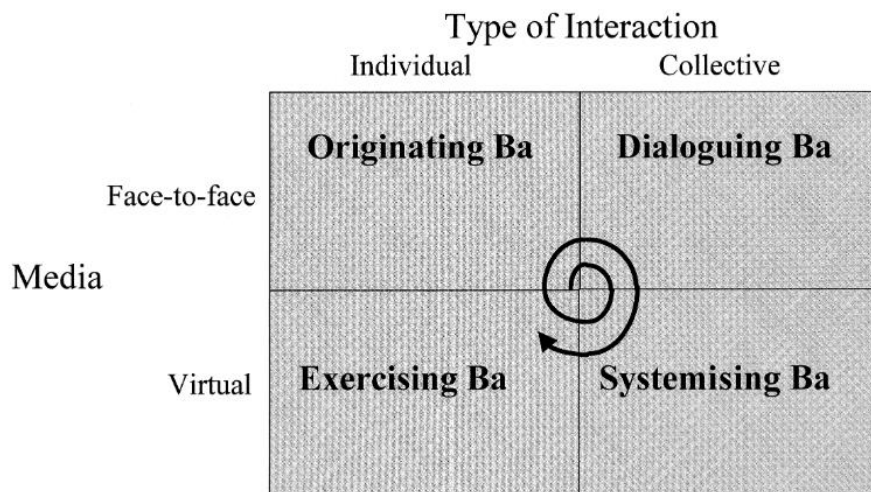


Figure 2-4 – Four types of Ba (Nonaka et al., 2000)

2.4.1. The significance of Ba in Classroom Environment

In a classroom setting, Ba serves as a conceptual meeting place where students can engage with one another. This interaction is crucial for knowledge creation, as it allows students to share ideas and build on each other's understanding, thus enhancing the learning experience. Moreover, it provides a platform for advancing both individual and collective knowledge creation. It allows students to recognize their own perspectives while also valuing the insights of others, fostering a sense of community and collaboration within the classroom. Ba can exist in various forms, including physical spaces like classrooms and virtual environments like online discussion

forums. This flexibility allows for diverse collaborative opportunities, enabling students to connect and collaborate regardless of their physical location. The integration of technology can enhance these interactions, making collaboration more accessible. The use of Ba in educational settings contributes to the development of a course culture that values collaboration and knowledge sharing. When students feel part of a community, they are more likely to engage actively in collaborative learning activities, leading to improved learning outcomes (Bryceson, 2007).

2.5. Students Engagement in Classroom

The integration of digital active learning strategies in blended environments has been shown to enhance students' social and emotional learning skills, thereby fostering greater engagement (Mujallid, 2024). Student engagement is a crucial aspect of the learning process, particularly in college environments. Smaller classroom sizes are often believed to facilitate better engagement due to lower student-to-teacher ratios. However, the effectiveness of small class sizes can vary depending on the context and the teaching methods employed. In some cases, small class sizes may not lead to increase engagement if the instructional approach is not interactive. The arrangement of seating in a classroom can significantly influence student engagement. Appropriate seating can help reduce distractions from digital devices and promote better interaction among students. This study emphasizes the importance of seating arrangements in fostering an engaging learning environment. Furthermore, the way instructors deliver content plays a vital role in student engagement. Engaging teaching methods, such as active learning and group activities, can enhance student participation. On the contrary, a monotonous teaching style can lead to disengagement, especially if students feel disconnected from the material being presented. This study employs computer vision techniques to measure student engagement through various attributes, such as facial expressions and attention levels. However, there are challenges in accurately assessing engagement due to the ambiguity in interpreting facial gestures and the influence of digital distractions (Duraishamy et al., 2019).

2.6. Students Collaboration in Classroom

Collaboration is a vital aspect of learning, especially in educational settings where students work together to achieve common goals. This paper discusses a hybrid learning model that emphasizes collaborative knowledge building among students. This approach allows learners to share insights and develop a deeper understanding of the subject matter through interaction and teamwork. The model integrates collaborative knowledge creation with advanced cognitive activities. This means that students not only work together but also engage in higher-order thinking, which enhances their learning experience. Moreover, this research employs an action research methodology to explore how collaborative learning can be effectively implemented. This approach allows for continuous improvement and adaptation of teaching strategies based on real-time feedback from students. The findings suggest that collaborative learning significantly impacts student engagement and motivation. When students work together, they are more likely to be invested in their learning and take ownership of their educational journey. However, Effective student collaboration can be significantly impacted by various challenges. Unequal participation is One of the primary challenges is the unequal participation of group members. Some students may dominate discussions while others may feel marginalized or reluctant to contribute, leading to an imbalance in collaboration and learning opportunities for all members. Effective communication is crucial for collaboration. However, students may face difficulties in expressing their ideas clearly or understanding their peers, which can lead to misunderstandings and hinder the collaborative process. Students often have different learning styles and preferences, which can create friction in collaborative settings. When group members do not align in their approaches to learning, it can lead to conflicts and reduce the overall effectiveness of the collaboration. Without clear objectives and goals, students may find it difficult to stay focused during collaborative activities. This lack of direction can lead to confusion and ineffective collaboration, as group members may not know what they are working towards (Zhao, 2015).

3. METHODOLOGY

This research utilizes the SECI model for knowledge creation, drawing insights from the literature review to be integrated into the prototype. Additionally, the paper adopts the design thinking process phases: Inspire, Ideate, and Implement (Victorino & Henriques, 2021).

The research was conducted in four steps:

1. Exploratory Research – Understanding student and professor needs through interviews with ten master's students.
2. Ideation and Brainstorming – A workshop with five professionals to define core features of the app.
3. Prototype Development – Designing a digital learning platform that enhances classroom engagement through technology using low-code tool called Adalo.
4. User Feedback via Demo Panel – Presenting the prototype to the same professionals for evaluation. Using feedback for future implications.

3.1. Samples and Procedures

The development of an innovative digital learning platform that enhances classroom engagement requires a structured and iterative design approach. The issue of student engagement in learning environments is complex, involving multiple factors such as motivation, collaboration, and technological accessibility. To ensure the platform meets the needs of both students and educators, this study follows a design-based research methodology, incorporating stakeholder input throughout the development process.

3.1.1. Sample size and participants characteristics

A total of ten master's students and five industry professionals participated in the research process, including interviews, brainstorming sessions, and prototype evaluations.

1. Inclusion Criteria:

- Master's students from Nova IMS enrolled in courses relevant to Business Intelligence, Data Science, and Knowledge Management.
- Professionals with experience in education technology, learning design, or digital innovation.
- Willingness to engage in discussions, provide feedback, and participate in prototype evaluations.

2. Exclusion Criteria:

- Individuals not enrolled in relevant courses or lacking experience in educational technology.
- Participants unwilling to complete all phases of the study.
- Undergraduate students or those not actively participating in classroom learning.

3.1.2. Procedure

Design thinking is a beneficial process because it fosters a user-centred, collaborative, and iterative approach to problem-solving in education, ultimately enhancing the learning experience for students and supporting teachers' professional growth (Holden et al., 2024). A three-stage process will be used in this paper, which consists of Inspiration, aimed at building empathy and understanding user needs; Ideation, where co-creative processes generate and refine potential solutions; and Implementation, involving iterative testing and continuous refinement of the developed prototype. Table 1 outlines the specific goals and research methods applied at each stage of the Design Thinking process.

Stage	Goal	Methods
Inspire	Capture students' and professors' perceptions of classroom engagement and explore potential digital solutions.	User research techniques: Interviews with 10 master's students, Trend Analysis, Benchmarking, Empathy Mapping.
Ideate	Co-create and prioritize interventions that align with engagement needs and existing classroom dynamics.	Disney Brainstorming Method, Group discussions with 5 professionals.
Implement	Develop, test, and refine the prototype, integrating feedback from users.	Prototype testing, usability evaluation through a panel of judges, and structured feedback questionnaires.

Table 3-1 – Goals and Methods for each Design Thinking Stage

1. Inspire

The Inspiration Stage focused on gathering insights about the challenges and needs of students and professors in classroom engagement. The goal was to define key problem areas and ensure the platform's development aligns with real world classroom experiences.

Techniques	Tasks
Trend Analysis	Researched existing educational technologies and engagement platforms to identify key trends.
Empathy Mapping	Conducted 10 in-depth interviews with master's students to understand their perspectives on learning, engagement, and collaboration.
Benchmarking	Evaluated current LMS platforms: Moodle, Blackboard, Google Classroom and Kahoot which are engagement tools to identify best practices and gaps.
Parallel Universe	Analysed non-educational platforms (e.g., gamification apps, social collaboration tools) to explore engagement strategies that could be applied to the learning experience.

Table 3-2 – Techniques used in the inspired stage.

2. Ideate

In the Ideation phase of this study, a 90-minute brainstorming session was conducted at NOVA Information Management School (NOVA IMS), utilizing the Disney Method to harness diverse perspectives and enhance creativity within the group. This technique involved participants adopting three distinct roles: Dreamer, Realist, and Critic. They were used to explore problems and solutions from multiple angles. The Dreamer phase encourages unrestricted imagination, allowing participants to propose innovative ideas without considering constraints. Subsequently, the Realist phase focuses on the practical Implementation of these ideas, assessing their feasibility and planning actionable steps. Finally, the Critic phase involves scrutinizing the plans to identify potential flaws and risks, ensuring a thorough evaluation before proceeding. By integrating the Disney Method into the brainstorming session, the team was able to systematically transition from creative ideation to practical planning and critical assessment. This structured approach ensured that the brainstorming process was both imaginative and grounded, leading to well-rounded and feasible solutions for the app development project (Tausch et al., 2015).

3. Implement

In the Implementation phase, I transitioned from Ideation to the co-design process, building upon the ideas generated by students and integrating established principles for effective mobile application design identified during the inspiration stage. To streamline development, I utilized Adalo, a user friendly no-code platform that enables the creation of native mobile and web applications through intuitive drag-and-drop functionality and real database. After developing the prototype, I conducted a feedback session with the participating professionals that were a part of brainstorming session to evaluate the application's usability and effectiveness. Participants were asked to explore the prototype, assessing aspects such as ease of navigation, readability, and overall clarity. They provided specific feedback on tasks like navigating to certain features and shared their general impressions, contributing to a comprehensive feedback grid. Participants assessed how well each aspect of the app matched the ideal and aligned with concepts from the Ideation phase.

3.2. Software and Techniques Used

3.2.1. Software's

1. Adalo: Selected for the creation and prototyping of the mobile application due to its intuitive interface and capability to build interactive, data-driven apps without extensive programming knowledge.
2. Microsoft Teams: Employed to conduct remote semi-structured interviews, facilitate online discussions, and ensure effective collaboration and data collection.

3.2.2. Techniques

1. Trend Analysis & Benchmarking: Analysis of existing educational technology platforms, including Moodle, Kahoot, and Google Classroom, to identify essential features, current best practices, and gaps for improvement (Aldalur et al., 2022).
2. Empathy Mapping: Conducted through 10 semi-structured interviews with master's students, allowing a deeper understanding of users' experiences, needs, challenges, and expectations regarding classroom engagement and app functionality.
3. Disney Brainstorming Method: Structured around three distinct phases (Dreamer, Realist, and Critic), this method guided participants in ideating creatively, assessing practicality, and critically evaluating app features.
4. Feedback Grid: Applied during the evaluation phase, enabling structured feedback collection from a panel of judges following the app demo, focusing on usability, engagement features, clarity, and overall effectiveness.
5. Quirkos: A qualitative data analysis software employed to systematically code and categorize interview data. This tool facilitated identifying recurring themes related to technology usage, classroom engagement, motivation, and collaboration, thus directly informing the prototype's core functionalities.

4. RESULTS

This section presents the results derived from each stage of the Design Thinking process: Inspire, Ideate, and Implement. The purpose was to systematically create a mobile application prototype that enhances student engagement in classroom settings, guided by insights gathered from qualitative research methods and iterative feedback loops.

4.1. Inspire

The Inspire phase focused on exploring students' needs, experiences, and barriers for engagement in the classroom. Data collection involved conducting ten semi-structured qualitative interviews with master's students from Nova IMS, analysed through thematic analysis using Quirkos software. Major themes identified were motivation and engagement, socialization and collaboration, teacher influence, technology use and app design. The key insights from these interviews revealed the importance of real-time feedback, gamification elements, personalized dashboards, and seamless communication channels, guiding the subsequent stages of the project.

4.1.1. Trend Analysis

To assess the current landscape of educational technology and engagement-focused tools, a trend analysis was conducted, examining platforms such as Moodle, Kahoot, Google Classroom, and other learning management systems. This analysis revealed several key trends shaping modern digital education. One of the most prominent developments is the integration of real-time feedback mechanisms and AI-driven adaptive learning. Many existing platforms now enable students to provide instant feedback on their comprehension, allowing educators to dynamically adjust their teaching strategies in response to student needs.

Another growing trend observed is the use of gamification techniques and community-driven learning environments. Features such as leader boards, badges, and interactive discussions have been shown to enhance student engagement and motivation. Additionally, the increasing shift toward mobile-first learning tools reflects the

demand for on-the-go accessibility and microlearning experiences, catering to students who require flexible and adaptive learning formats.

While these trends highlight advancements in student engagement and adaptive learning, my prototype introduces a unique approach by offering a live, real-time classroom interaction experience that is not commonly found in current platforms. Unlike Moodle and Google Classroom, which primarily support asynchronous learning and post-class discussions, my app is designed to enhance in-class engagement through real-time student-professor interactions. The system allows live participation, integrating mood tracking, instant feedback mechanisms, group work collaboration, and interactive discussions all within the classroom environment.

This focus on real-time engagement fills a gap in existing platforms, as most available tools prioritize either asynchronous learning (content repositories) or gamified quizzes outside of class. By bringing active student participation directly into the live classroom setting, my prototype differentiates itself as a digital tool for enhancing real-time educational experiences rather than just a post-class engagement platform.

4.1.2. Empathy map

To gain a comprehensive understanding of the challenges faced by students and professors in higher education, ten semi-structured interviews were conducted with master's students at Nova IMS. These interviews explored students' experiences with classroom engagement, learning behaviours, and their perspectives on digital learning tools. The qualitative data was analysed using Quirkos, a software that facilitates thematic analysis, enabling the identification of recurring patterns in participant responses. The insights were categorized into six dimensions: motivation and engagement, socialization and collaboration, technology use and app design, teaching methods and classroom dynamics, knowledge organization and practice application and knowledge sharing and reflection.



Figure 4-1 – Quirkos bubbles of qualitative data mentioned the most in interviews

A consistent theme that emerged from the interviews was the disconnect between traditional lecture formats and student engagement. Many students reported that passive learning environments made it difficult to remain attentive, with minimal interaction between professors and students leading to disengagement. Participants emphasized that incorporating interactive features such as quick polls, real-time surveys, and short discussion breaks would foster a more dynamic learning experience.

To deepen the understanding of user needs and behaviours, three representative user personas were created based on qualitative data collected through interviews with master's students. These personas reflect the diversity of student experiences in the classroom, each highlighting unique motivations, frustrations, and learning habits. By synthesizing recurring themes such as the need for real-time feedback, active participation, and better professor-student interaction, the personas serve as design anchors. They help ensure that the development of the mobile application remains

closely aligned with actual user expectations and pain points and providing a practical reference for user-centred decision making throughout the design process.

Persona	Profile	Motivations	Pain Points
Ana - The Engaged but Frustrated Learner	24, Master's in Business Intelligence, international student, highly motivated, mobile savvy	Real-time feedback, participation without disrupting class, clear structure	Fear of interrupting class, lack of interaction, delayed professor responses
Pedro - The Passive Follower	22, Master's in Data Science, low class participation, relies on passive materials, introverted	Easily accessible content, reminders, learning without speaking up	No follow-up from professors, difficulty staying engaged in lectures
Sara - The Independent Digital Native	23, Master's in Digital Marketing, tech-savvy, prefers self-paced and digital-first learning	Autonomy, smart digital tools, flexible mobile-based learning	Limited personalization in LMS, lack of app integration with learning needs

Table 4-1 – User Personas Presentation

Furthermore, the interviews revealed that students hesitate to ask questions during class, often resorting to external platforms like YouTube, Discord, or online forums to clarify doubts instead of engaging directly with their professors. This reliance on third-party resources highlighted a gap in real-time communication and immediate feedback within existing learning management systems. Additionally, delayed feedback from professors was frequently mentioned as a point of frustration, with students expressing a need for faster responses and a structured way to track their learning progress.

In addition to engagement and feedback, collaboration and usability were identified as essential factors. Students emphasized the necessity of seamless navigation and intuitive application design to ensure that learning platforms are user-friendly and promote efficient collaboration. Many participants expressed a preference for a centralized system that integrates professor feedback, discussion forums, and

structured learning pathways, providing a more cohesive and interactive educational experience.

These findings were instrumental in shaping the core features of the prototype, ensuring that it directly addressed real user needs. By prioritizing real-time student engagement tracking, instant professor feedback mechanisms, and collaborative learning tools, the platform was designed to bridge the gaps identified in existing educational technologies, creating an environment that fosters active participation, streamlined communication, and interactive learning.

4.1.3. Benchmarking

To assess the current landscape of educational technology and engagement-focused tools, a trend analysis was conducted, examining platforms such as Moodle, Kahoot, Google Classroom, and other learning management systems. This analysis revealed several key trends shaping modern digital education. One of the most prominent developments is the integration of real-time feedback mechanisms and AI-driven adaptive learning. Many existing platforms now enable students to provide instant feedback on their comprehension, allowing educators to dynamically adjust their teaching strategies in response to student needs.

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Platform	Strengths	Weaknesses
Moodle	Customizable, supports diverse content formats. Integrated assessments and discussion forums	Lacks real-time engagement, complex user interface, steep learning curve for new users
Blackboard	Structured LMS, integrates with institutions, secure grading, and assessment tools	Limited collaboration tools, not mobile-first, Outdated UI in comparison to modern ed-tech platforms
Google Classroom	Simple UI, integrates with Google Drive and Docs, easy assignment tracking	No built-in real-time interaction beyond Google Meet, lacks engagement features like polls, feedback tracking, or collaborative tools
Kahoot	Gamification boosts motivation, real-time quizzes for engagement, Interactive & competitive learning	No structured learning, lacks discussion tools, cannot replace comprehensive LMS functionalities

Table 4-2 – Benchmarking of platforms

4.1.4. Parallel Universe

To explore innovative approaches to student engagement beyond the traditional education sector, a Parallel Universe analysis was conducted. This method involves examining strategies and technologies used in different industries and assessing how they can be adapted to enhance classroom learning. By analysing engagement

techniques from sectors such as gaming, social media, corporate training, and AI-driven platforms, new ideas emerged for improving student interaction, motivation, and real-time engagement.

Drawing Inspiration from Non-Educational Sectors:

1. Gamification & Social Platforms (Duolingo, Discord, and Twitch)

- Platforms like Duolingo leverage gamified learning experiences, including streaks, leader boards, and personalized learning paths, which keep users engaged over time.
- Twitch and Discord introduce real-time interaction and community-driven engagement, creating an environment where users actively participate in discussions.
- Adaptation: These elements were considered in the development of the real-time engagement features of the prototype, particularly in interactive discussions, live feedback, and collaborative learning groups.

2. AI-Powered Personalized Learning (Netflix & Spotify Recommendation Models)

- Netflix and Spotify utilize AI-driven personalization to curate content based on user preferences and behaviour.
- In education, similar AI-driven recommendations could enhance learning by suggesting relevant study materials, quizzes, and peer discussions tailored to each student's engagement level.
- Adaptation: While the prototype does not yet include AI-driven personalization, future iterations could incorporate adaptive learning pathways based on student interaction data.

3. Real-Time Performance Tracking (Corporate Training & Productivity Tools)

- Corporate e-learning platforms such as LinkedIn Learning and Coursera for Business employ real-time performance tracking and adaptive feedback.
- Similarly, workplace collaboration tools like Slack and Microsoft Teams enhance engagement through live discussions, task tracking, and instant feedback loops.

- Adaptation: The prototype integrates mood tracking and live feedback systems to provide professors with real-time insights into student engagement, like corporate performance dashboards.

4. Immersive & Interactive Learning (VR & Augmented Reality in Healthcare and Military Training)

- The healthcare and military sectors have integrated Virtual Reality (VR) and Augmented Reality (AR) for simulation-based training, offering interactive and experiential learning.
- Adaptation: While the prototype does not incorporate VR or AR, it prioritizes interactive learning within the classroom by allowing live student participation, real-time feedback, and engagement analytics.

4.2. Ideate

The ideation phase was dedicated to transforming insights from the inspire phase into concrete solutions for the digital learning platform. To achieve this, a Disney Brainstorming Method session was conducted with five industry professionals specializing in education technology, UX design, and digital learning. This structured session allowed participants to generate, evaluate, and refine ideas for enhancing student engagement in the classroom. Following the brainstorming session, participants engaged in a wireframing exercise, where they sketched potential interface designs for both students and professors, ensuring that the proposed features translated into a user-friendly design. Finally, a feature prioritization process was carried out by reviewing the most frequently mentioned ideas throughout the brainstorming session. This structured approach helped define the key functionalities of the prototype and ensured that they aligned with the needs identified in previous research phases.

4.2.1. Disney Brainstorming Method

To foster creativity, structured problem-solving, and critical evaluation, the Disney Brainstorming Method was employed as the primary Ideation framework. Inspired by Walt Disney's creative approach, this method enabled a multi-perspective exploration of ideas through three distinct roles: Dreamer, Realist, and Critic. The brainstorming

session took place at Nova IMS and lasted 90 minutes, bringing together five professionals specializing in education technology, digital learning, and UX design. Participants moved through three designated rooms, each representing a different stage of the brainstorming process, allowing for a structured yet dynamic evaluation of ideas.

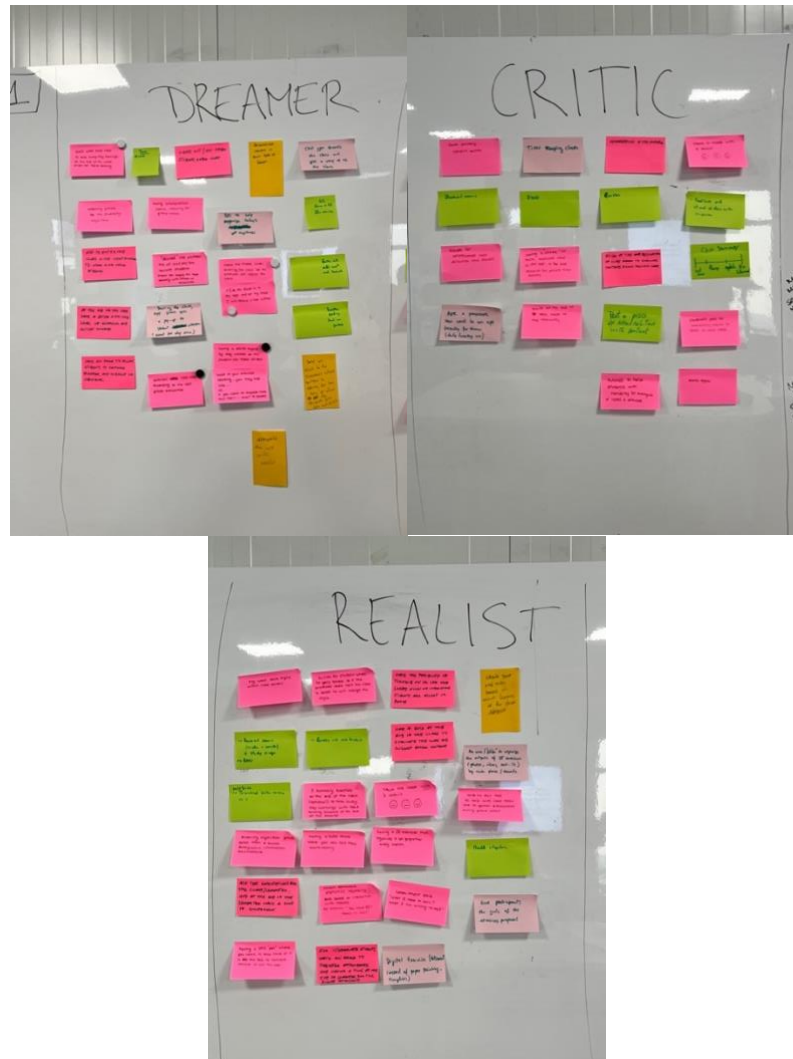


Figure 4-2 – Professionals express their thoughts with stickers forming the empathy map.

1. Dreamer Phase – Generating Bold and Unconstrained Ideas

The Dreamer Phase encouraged participants to think freely without limitations, fostering a space where no idea was considered too ambitious or unrealistic. The focus was on imagination and innovation, generating creative solutions that could potentially

enhance classroom engagement. During this phase, participants envisioned an interactive digital learning environment where students and professors could engage in real-time using intuitive digital tools. Some of the most promising ideas included mood tracking features to allow students to indicate their engagement levels during lectures, instant feedback mechanisms to help professors adjust their teaching strategies, and in-class gamification elements such as leader boards and participation-based rewards. Additionally, participants discussed the integration of AI-powered features that could personalize learning experiences, such as adaptive learning pathways based on student performance and participation. The Dreamer Phase provided a broad range of creative solutions, many of which were noted for further refinement in the next stage of the process.

2. Realist Phase – Assessing Feasibility and Practical Implementation

Following the Dreamer Phase, participants transitioned to the Realist Phase, where they critically evaluated the practicality of the ideas generated earlier. In this stage, the emphasis shifted toward identifying which features could be realistically implemented within the prototype while considering technical, user experience (UX), and resource constraints. Participants recognized that while AI-driven adaptive learning might be valuable, its implementation would be too complex for the initial prototype. Instead, the focus shifted to practical features that could be built using Adalo, such as real-time student feedback, interactive discussion boards, and professor dashboards for monitoring engagement trends. Additionally, the importance of UX design was discussed, ensuring that students and professors would have an intuitive and seamless experience. Mobile accessibility was also identified as a crucial factor, as many students prefer to interact with educational platforms through their smartphones. The Realist Phase helped refine and prioritize the most feasible features, ensuring that the final implementation plan aligned with both technological constraints and user needs.

3. Critic Phase – Identifying Challenges and Refining Solutions

The final phase of the session, the Critic Phase, was dedicated to analysing potential weaknesses, risks, and limitations of the proposed solutions. Participants adopted a critical perspective to identify areas for improvement and ensure that the features met real-world educational challenges. One of the main concerns raised was potential

distractions caused by in-class gamification elements. To mitigate this, it was decided that rewards should be academic-focused rather than competitive, such as participation-based achievements instead of leader boards. Another key issue was privacy concerns regarding mood tracking—participants suggested incorporating optional engagement indicators rather than mandatory mood tracking to respect student autonomy. Additionally, the challenge of faculty adoption was discussed. Some professors might resist using new engagement tools, leading to the recommendation that faculty training and onboarding support should be included in future implementations. Participants also raised concerns about the integration of the app with existing LMS platforms, noting that while this feature would be valuable, it should be considered for future iterations rather than the initial prototype.

4.2.2. Wireframing Exercise: Translating Ideas into Interface Design

Following the Disney Brainstorming Method, professionals engaged in a wireframing exercise to translate the conceptual ideas discussed during the brainstorming session into preliminary visual representations of the application’s interface. This step was instrumental in ensuring that the proposed features could be effectively structured within an intuitive and user-friendly design. The wireframing process served as a bridge between Ideation and Implementation, allowing professionals to visually conceptualize key functionalities for both students and professors, ensuring that the final application design would support the unique needs of each user group.

1. Wireframing the Student Interface

The student interface wireframes were designed to provide easy access to interactive learning tools, fostering a more engaging and participatory classroom experience. Participants emphasized that students should be able to quickly navigate the platform without feeling overwhelmed.

The key features outlined for the student interface included:

- **Live Engagement Tools:** A dedicated space for students to provide real-time feedback, such as quick polls, emoji reactions, and survey responses during lectures.

- **Mood Tracking System:** A feature enabling students to indicate their level of understanding, focus, or engagement, allowing professors to adapt their teaching dynamically.
- **Dashboard Overview:** A personalized homepage displaying upcoming assignments, group activities, and classroom discussions to ensure students stay informed.
- **Group Work Integration:** A structured collaboration feature allowing students to join group discussions, track progress on collaborative assignments, and receive direct feedback from peers and professors.

Participants prioritized accessibility and simplicity, ensuring that students could effortlessly navigate the platform and utilize its interactive components without disrupting the flow of the lecture. Special attention was given to mobile responsiveness, as many students rely on their smartphones or tablets for class-related activities.

2. Wireframing the Professor Interface

The professor interface wireframes were designed to provide educators with the necessary tools to monitor student engagement, facilitate group work, and adjust their teaching strategies in real-time.

The key features outlined for the professor interface included:

- **Live Student Engagement Dashboard:** A real-time heatmap displaying engagement levels, participation trends, and student feedback, allowing professors to identify students who may need additional support.
- **Aggregated Student Feedback Visualization:** A tool for professors to instantly view student responses from mood tracking, polls, and discussions, helping them assess comprehension and engagement levels.
- **Group Work Monitoring Tools:** A feature allowing professors to create, assign, and oversee student groups, ensuring that teamwork is structured, and collaborative learning is optimized.

- Content Sharing and Interaction Tools: Professors can push interactive materials, such as discussion prompts, quizzes, and collaborative exercises, to students during class to encourage real-time participation.

Participants emphasized usability and efficiency, ensuring that the professor interface was not overloaded with complex features, making it easy to navigate while delivering valuable insights into student engagement. Discussions also revolved around the balance between automation and manual controls, ensuring that while the system provides real-time insights, professors retain full control over how they interact with students.

The wireframes created during this session provided a strong foundation for the later stages of development in Adalo. By translating abstract brainstorming insights into clear, structured interface designs, professionals ensured that the prototype would be both pedagogically effective and technologically feasible. The detailed layouts allowed for an early-stage usability assessment, enabling refinements before full-scale development began.

The structured wireframing session reinforced the importance of differentiation between student and professor needs, ensuring that the final prototype would support real-time classroom engagement, streamline communication, and enhance collaboration in a way that existing learning management systems do not. These early design sketches played a crucial role in guiding the development of an application that offers an intuitive, interactive, and user-centred learning experience.



Figure 4-3 – Professionals designing wireframes.

4.2.3. Feature Prioritization: Identifying Core Functionalities

To consolidate the most valuable and frequently discussed ideas from the brainstorming session, a feature prioritization process was conducted. By analysing insights from the Disney Brainstorming Method, wireframing exercises, and discussion transcripts, the most frequently referenced functionalities were identified. These features reflect the core elements necessary for enhancing classroom engagement and bridging the gap between students and professors through real-time interaction.

The table below summarizes the most prioritized features based on the frequency of mentions across the brainstorming phases (Dreamer, Realist, and Critic) and their relevance to the prototype development:

Feature	Description	Mentioned In
Real-Time Feedback	Allows professors to receive instant student reactions to content	Dreamer, Realist
Mood Tracking	Enables students to indicate their level of engagement or difficulty	Dreamer, Critic
Group Work Management	Organizes students into structured learning groups for collaboration	Realist
Professor Dashboards	Displays live class engagement metrics and student analytics	Realist, Critic
Interactive Q&A	Students can submit questions and upvote relevant ones	Dreamer
Gamification Elements	Incorporates badges, leader boards, and rewards to drive engagement	Dreamer, Critic
Live Polling and Surveys	Allows professors to conduct real-time polls and surveys during lectures	Dreamer, Realist
Student Progress Tracking	Enables students to monitor their learning progress and receive performance insights	Realist, Critic
Anonymous Participation	Gives students the option to engage anonymously to reduce hesitation in participation	Critic
Classroom Insights & Analytics	Provides professors with aggregated insights into student participation trends	Realist, Critic
Customizable Learning Paths	Allows students to tailor their learning experience by selecting focus areas	Dreamer
Smart Notifications	Notifies students about important updates, deadlines, and group discussions	Realist
Resource Sharing Hub	A space for professors to share lecture slides, external articles, and additional materials	Realist, Dreamer
Speech-to-Text Transcriptions	Converts lecture discussions into transcribed text for later review	Critic

Table 4-3 – Features mentioned in the brainstorming session

The most frequently discussed features, including real-time feedback, mood tracking, group work management, and interactive Q&A, emerged as critical components for enhancing student engagement and professor-student communication. Several features were also highlighted during the wireframing phase, such as dashboard functionalities, real-time participation tracking, and engagement analytics, emphasizing their importance in shaping the final application.

By combining insights from brainstorming, wireframing, and feature prioritization, the Ideate phase successfully laid the foundation for the prototype development phase. These prioritized features ensured that the application design was user-driven, interactive, and supportive of an engaging classroom experience, addressing the gaps identified in existing learning management systems.

These prioritized features served as the guiding framework for the next stage which was development and implementation of the prototype. With a clear understanding of the essential functionalities needed to enhance student engagement and professor-student interaction, the transition to the Implement phase focused on translating these ideas into a fully functional application.

In this phase, Adalo was utilized as the primary development platform, allowing for the integration of the most frequently discussed features from the brainstorming and wireframing sessions. The iterative design process ensured that feedback from stakeholders was incorporated continuously, refining the application for optimal usability. The following section details the steps taken in transforming these conceptualized features into a working prototype, the challenges encountered, and the evaluation methods used to assess its effectiveness.

4.3. Implement

Following the Ideate phase, where key user needs and engagement strategies were identified, the Implementation phase translated these insights into a tangible prototype. This ensured that the solution effectively addressed the challenges faced in student engagement and real-time class interaction. In this phase focus was translating the ideas generated during the Ideate phase into a functional prototype using Adalo, a no-code development platform. The development aimed to enhance classroom

engagement, provide real-time analytics for professors, and streamline communication between students and instructors.



Figure 4-4 – Screens created for the prototype

4.3.1. Prototype Development in Adalo

To streamline development and enable rapid prototyping, Adalo was chosen as the primary platform due to its intuitive drag-and-drop interface, integrated database capabilities, and quick deployment features. Unlike traditional development platforms that require extensive coding expertise, Adalo allowed for an accelerated development cycle, enabling iterative testing and refinements based on real-time user feedback.

The development process began with setting up user authentication, ensuring that students and professors had distinct access rights based on their roles. The student interface was designed to support engagement tracking, real-time feedback, and interactive learning tools, while the professor dashboard focused on providing data-driven insights and class management features. Each screen was carefully structured to align with the priorities established during the Ideate phase, ensuring usability, accessibility, and ease of navigation.

A core focus was placed on real-time engagement features, including mood tracking, interactive Q&A, and professor feedback tools. These elements were directly influenced by brainstorming insights, particularly the need for in-class engagement mechanisms that went beyond traditional learning management systems. The database structure in Adalo was configured to store student responses, track participation, and allow professors to visualize engagement trends dynamically.

4.3.2. Feature Implementation and Testing

Once the initial prototype was built, an iterative testing process was conducted to refine functionality and optimize the user experience. Each feature underwent extensive usability testing to ensure seamless interaction between students and professors.

The user roles were clearly differentiated, allowing students to engage with quizzes, live discussions, and feedback tools while professors could monitor engagement trends and access real-time participation data. The feedback grid from the Ideate phase was instrumental in guiding refinements, ensuring that the final prototype aligned with actual user expectations and classroom requirements.

During testing, several technical challenges emerged, including:

- **Real-time Data Synchronization:** Initially, there were delays in student engagement updates when professors monitored responses live. This was resolved by optimizing database queries and implementing asynchronous data handling for real-time updates.
- **Scalability Concerns:** As the number of users increased, performance bottlenecks occurred, particularly when multiple students submitted mood updates simultaneously. To address this, backend optimizations were made to ensure seamless data processing.
- **User Feedback Implementation:** Early testers found that the interactive Q&A lacked clear organization, making it difficult for professors to track unanswered questions. This led to the introduction of categorization and filtering options for better visibility.

By continuously refining these technical aspects, the application was optimized for real-world classroom interactions, ensuring smooth performance across all user roles.

4.3.3. User Interface and Experience Design


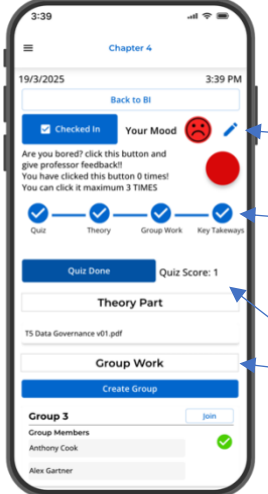
A user-centred design approach was applied to create an interface that is both intuitive and visually engaging. The goal was to minimize cognitive load, ensuring smooth navigation, clear layouts, and well-defined interaction elements.

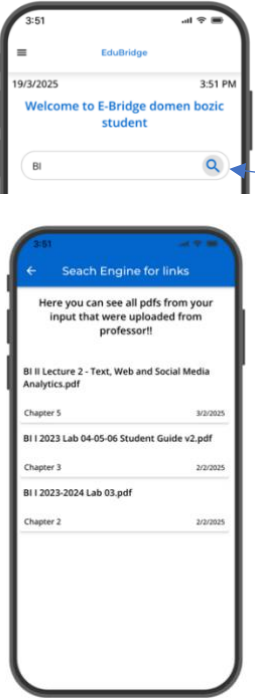
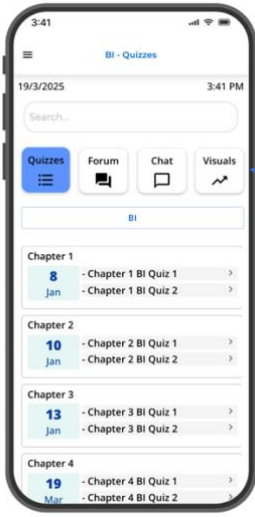
Key UX considerations included:


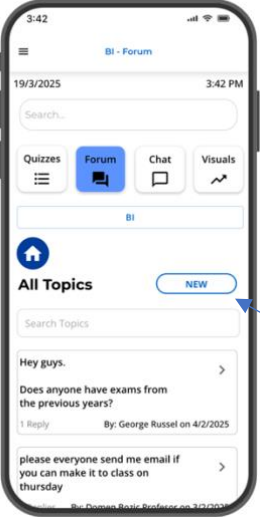
- **Easy Navigation:** A clean, structured layout was implemented to ensure users could quickly access quizzes, forums, and resources without unnecessary complexity.
- **Visual Hierarchy:** Important elements, such as engagement tracking and real-time mood updates, were visually distinct, ensuring students and professors could interpret data immediately.
- **Accessibility Features:** Text contrast, button sizes, and simple interactions were optimized to ensure usability for all students, including those with accessibility needs.

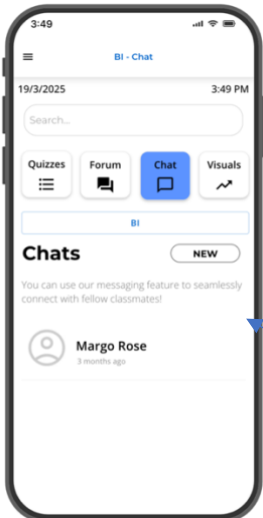

To illustrate how the final prototype aligns with the initial wireframing, the following sections present key screenshots from both the student and professor perspectives. The tables below provide a structured overview of the main features implemented in the application, along with descriptions of their functionality.

4.3.3.1. Student Interface Features:

Corresponding Photo	Feature Name	Description
	<p>Home Dashboard</p> <p>Search Engine to look for files</p> <p>Progress Bar</p>	<p>Displays an overview of student progress, course participation, and quick access to essential features like quizzes, forums, and chats. The dashboard also includes a progress bar, encouraging students to maintain engagement and track attendance.</p>
	<p>Live Class Interaction</p> <p>Real-Time Mood Tracking</p> <p>Class Progress</p> <p>Parts of classes that follow the progress</p>	<p>Provides a real-time engagement hub where students can check-in, track their progress, and participate in discussions. This feature aims to enhance classroom interactivity and provide a seamless digital learning experience.</p>


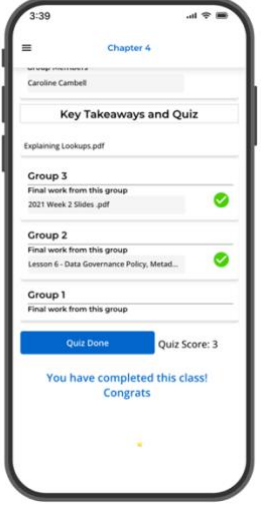
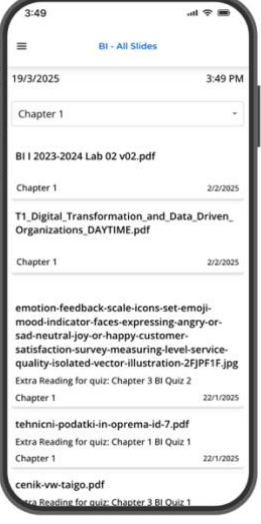
	<h3>Search Engine for Uploaded Materials</h3>	<p>Allows students to search for and access course-related PDFs uploaded by professors. This feature helps centralize learning materials, making it easier for students to find relevant documents.</p>
	<h3>Quizzes Module</h3>	<p>Enables students to take quizzes for different course chapters, helping them assess their learning progress. Quizzes are categorized by date and chapter, making them easy to navigate and revisit.</p>

	<p>Interactive Q&A Section</p>	<p>Students can submit questions during lectures, with an anonymous option to encourage participation. Professors can review and address these questions live, fostering better engagement.</p>
	<p>Forum for Discussion</p>	<p>Provides a structured platform where students can discuss topics, ask for help, and share resources. Posts and replies help create an active learning community beyond the classroom.</p>

	<p>Chat Feature for Peer Collaboration</p>	<p>A direct messaging system that allows students to connect and collaborate on projects or assignments. Professors can also use this to send announcements or answer student queries in real-time.</p>
	<p>Visual Analytics and Performance Tracking</p>	<p>Displays student performance through graphs and charts, providing insights into quiz scores, progress trends, and comparisons with class averages. This feature helps students self-assess and improve study habits through visual feedback.</p>

Chat Area with all Chats

Visual Dashboards

	<p>Real-Time Mood Tracking</p> <p>Real-Time Editing of Mood</p>	<p>Students can indicate their engagement level by selecting an emoji that represents their current mood during class. Professors can then adjust their teaching style, accordingly, improving responsiveness to student needs. It also monitors student participation levels and provides feedback on their involvement throughout the course. A tracking system ensures students remain engaged and motivated, offering professors a better overview of class dynamics.</p>
	<p>Group Work Collaboration Tool</p>	<p>Allows students to form and manage study groups for collaborative assignments and discussions. Groups can share resources, submit collective work, and track their progress on tasks efficiently.</p>
	<p>Lecture Materials Library</p>	<p>A structured repository where students can find slides, notes, and other course-related documents. Materials are sorted by chapter and easily accessible, ensuring students always have access to necessary resources.</p>

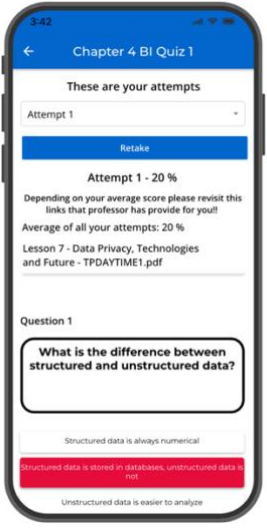
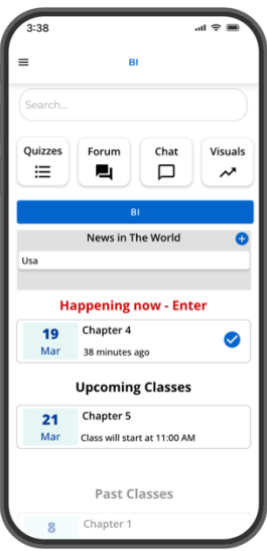
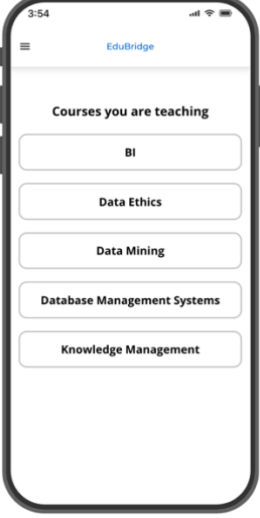
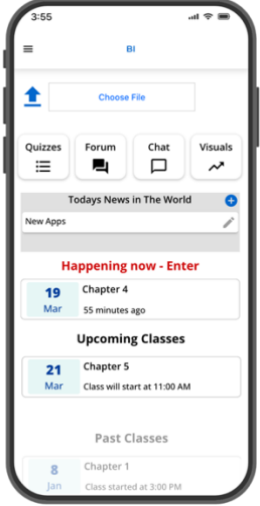

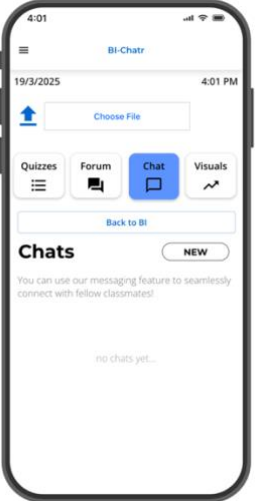
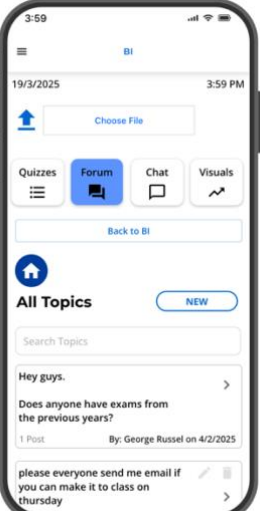
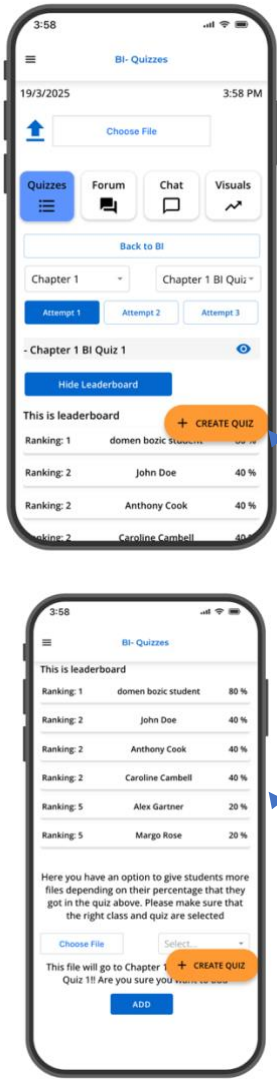
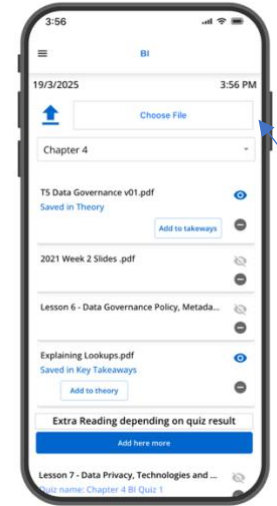
	<p>Adaptive Learning Recommendations</p>	<p>Based on quiz performance and engagement levels, the platform recommends additional readings or exercises to help students improve their understanding. This feature personalizes the learning experience.</p>
	<p>Upcoming & Past Class Schedule</p>	<p>Displays a calendar with upcoming classes, live session availability, and past classes, allowing students to track their academic schedule efficiently and plan their study time accordingly.</p>

Table 4-4 – Design of student’s side of the prototype

4.3.3.2. Professor Interface Features:

Corresponding Screenshot	Feature Name	Description
	<p>Professor Course List</p>	<p>This screen displays the list of courses the professor is teaching, allowing easy navigation between different subjects.</p>
	<p>Live Class and Schedule</p>	<p>Professors can manage live classes, see upcoming and past sessions, and keep track of students' participation in real-time.</p>

	<h3>Class Mood Analytics</h3> <p>Professor view of Q&A</p> <p>Professor view of how many people is bored</p>	<p>Displays an overview of student engagement through a mood-tracking feature, enabling professors to assess class participation and engagement in real-time.</p>
	<h3>Chat Management</h3>	<p>Professors can oversee and facilitate discussions in the chat section, encouraging student interaction and resolving queries efficiently.</p>
	<h3>Forum Moderation</h3>	<p>Professors can moderate discussion topics, respond to student inquiries, and manage class-wide discussions to enhance collaborative learning.</p>

 <p>The top screenshot shows a mobile app interface for 'BI- Quizzes'. It displays a 'Chapter 1 BI Quiz' with a 'Hide Leaderboard' button and a '+ CREATE QUIZ' button highlighted in orange. Below the button is a table of student rankings:</p> <table border="1"> <tr><td>Ranking: 1</td><td>domen bozic student</td><td>40 %</td></tr> <tr><td>Ranking: 2</td><td>John Doe</td><td>40 %</td></tr> <tr><td>Ranking: 2</td><td>Anthony Cook</td><td>40 %</td></tr> <tr><td>Ranking: 2</td><td>Caroline Cambell</td><td>40 %</td></tr> </table> <p>The bottom screenshot shows the 'View of Quiz Leaderboard' with a list of students and their scores:</p> <table border="1"> <tr><td>Ranking: 1</td><td>domen bozic student</td><td>80 %</td></tr> <tr><td>Ranking: 2</td><td>John Doe</td><td>40 %</td></tr> <tr><td>Ranking: 2</td><td>Anthony Cook</td><td>40 %</td></tr> <tr><td>Ranking: 2</td><td>Caroline Cambell</td><td>40 %</td></tr> <tr><td>Ranking: 5</td><td>Alex Gartner</td><td>20 %</td></tr> <tr><td>Ranking: 5</td><td>Margo Rose</td><td>20 %</td></tr> </table> <p>Below the table is a note: 'Here you have an option to give students more files depending on their percentage that they got in the quiz above. Please make sure that the right class and quiz are selected.' At the bottom, there is a 'Choose File' button, a 'Select' dropdown, and a '+ CREATE QUIZ' button highlighted in orange.</p>	Ranking: 1	domen bozic student	40 %	Ranking: 2	John Doe	40 %	Ranking: 2	Anthony Cook	40 %	Ranking: 2	Caroline Cambell	40 %	Ranking: 1	domen bozic student	80 %	Ranking: 2	John Doe	40 %	Ranking: 2	Anthony Cook	40 %	Ranking: 2	Caroline Cambell	40 %	Ranking: 5	Alex Gartner	20 %	Ranking: 5	Margo Rose	20 %	<h3>Quiz Leaderboard & Quiz Creation</h3> <p>Creation of Quiz</p> <p>View of Quiz Leaderboard</p>	<p>Displays student rankings based on quiz scores, helping professors track performance and encourage a competitive learning environment. Enables professors to create and manage quizzes, providing options for multiple attempts and performance tracking.</p>
Ranking: 1	domen bozic student	40 %																														
Ranking: 2	John Doe	40 %																														
Ranking: 2	Anthony Cook	40 %																														
Ranking: 2	Caroline Cambell	40 %																														
Ranking: 1	domen bozic student	80 %																														
Ranking: 2	John Doe	40 %																														
Ranking: 2	Anthony Cook	40 %																														
Ranking: 2	Caroline Cambell	40 %																														
Ranking: 5	Alex Gartner	20 %																														
Ranking: 5	Margo Rose	20 %																														
 <p>The screenshot shows a mobile app interface for 'BI'. It displays a 'Choose File' button highlighted in blue. Below it is a list of files:</p> <ul style="list-style-type: none"> TS Data Governance v01.pdf (Saved in Theory) with an 'Add to takeaways' button. 2021 Week 2 Slides .pdf Lesson 6 - Data Governance Policy, Metada... Explaining Lookups.pdf (Saved in Key Takeaways) with an 'Add to theory' button. <p>At the bottom, there is a section titled 'Extra Reading depending on quiz result' with an 'Add here more' button.</p>	<h3>File Sharing & Resources</h3> <p>Uploading Files</p>	<p>Professors can upload additional learning materials based on quiz performance, ensuring personalized content delivery.</p>																														

	<p>Group Work & Collaboration</p>	<p>Facilitates the assignment of students into collaborative groups and allows professors to monitor group activities.</p>
	<p>Live Q&A Interaction</p>	<p>Enables professors to respond to student questions in real-time, ensuring an interactive and engaging class experience.</p>
	<p>Visual Analytics Dashboard</p>	<p>This section enables professors to track student activity, including check-ins, quiz attempts, and highest and lowest scores.</p>

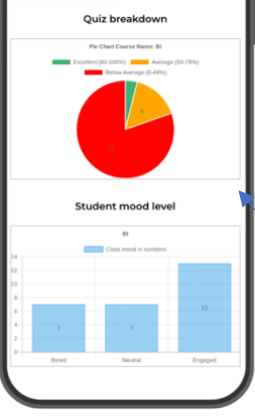
 <p>The image shows a mobile app interface. The top section is titled 'Quiz breakdown' and features a pie chart with a legend for 'Excellent (20-30%)', 'Average (50-70%)', and 'Below Average (40-60%)'. Below this is a 'Student mood level' section with a bar chart showing mood levels for 'Satisfied', 'Neutral', and 'Disappointed' categories. A blue arrow points from a box labeled 'Engagement Tracker' to the 'Student mood level' chart.</p>	<p>Engagement Tracking</p>	<p>Provides a detailed breakdown of quiz performance and student engagement metrics, helping professors refine their teaching methods.</p>
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Table 4-5 – Design of professor’s side of the prototype

With the prototype successfully developed and refined through iterative testing, the next phase involved evaluating its usability and effectiveness. A panel of judges, consisting of professionals from the brainstorming session, was invited to interact with the application and provide structured feedback. This evaluation process allowed for a comprehensive assessment of the prototype’s strengths and areas for improvement, leading to valuable insights for potential future enhancements.

4.4. Jury Panel and User Feedback

To evaluate the effectiveness, usability, and overall design of the prototype, a structured user testing session was conducted with a jury panel composed of five professionals. These participants were previously involved in the Ideation phase and brought experience in educational technology, UX/UI design, and digital learning strategy. Their diverse backgrounds ensured a holistic assessment of the prototype from pedagogical, technical, and user experience perspectives

The evaluation process included two key components: performing a set of guided tasks within the app while their interactions and verbal reflections were recorded and followed by the completion of a detailed questionnaire. This mixed-method approach enabled both qualitative and quantitative insights to be gathered, allowing for a well-rounded understanding of the app’s current strengths and future opportunities.

Firstly, each professional was given a set of predefined exploratory tasks to complete in the app, such as navigating the student dashboard, submitting a quiz, using the mood

tracker, and reviewing discussion threads. These tasks reflected real-use scenarios, designed to test the app's clarity, logic, and feature relevance.

After completing the tasks, the panelists were invited to share their impressions via audio-recorded feedback and complete a structured questionnaire that assessed key dimensions like ease of use, relevance of features, and potential to enhance classroom engagement. The combination of qualitative and quantitative feedback provided critical insights that guided the final refinement of the app. The questionnaire consisted of 12 evaluative statements regarding the app's interface, features, user experience, and relevance to classroom learning (Can see in the table 4-6). Each statement was rated on a 1 to 5 scale (from strongly disagree to strongly agree). The feedback was then synthesized to highlight positive impressions, areas for improvement, and potential enhancements for future versions.

4.4.1. Positive Feedback

Overall, the jury panel responded favourably to the app, with appreciation for its usefulness in enhancing classroom engagement, enabling real-time interaction, and fostering transparency between students and professors. Many participants pointed out that the app provides a much-needed structure for modern learning environments. Key highlights included the quiz and knowledge-sharing features, the professor's dashboard for tracking participation, and the group work module, which were seen as effectively supporting classroom collaboration. Respondents valued how the app brought together multiple learning tools in a single, easy-to-access platform that both students and professors could navigate with relative ease.

4.4.2. Areas for Improvement

Despite the positive overall reception, certain aspects were flagged for refinement. Several reviewers suggested that the app's user interface could benefit from additional polish to improve clarity and aesthetic appeal. In particular, the structure of side menus and the visual design of some features (such as the mood tracker) were noted as areas that might confuse new users. Suggestions included limiting the number of times students can interact with certain buttons to prevent wrong use and making it easier to

distinguish which materials are visible to students versus professors. These reflections highlight the importance of iterative testing and responsive design in app development.

4.4.3. Questions and Curiosities

During interviews and the task-based testing process, panellists raised thoughtful questions regarding how specific features would be implemented in real classroom settings. A few expressed curiosities about how mood data and student feedback would be interpreted and whether it would influence teaching methods in real-time. Others wondered about the longevity and scalability of the app: how would it perform across different courses, student groups, or institutions? These reflections provided useful context for considering the app's future impact and integration into academic ecosystems.

4.4.4. New Ideas and Innovations

The feedback process also sparked creative ideas for future updates. Participants suggested introducing a short onboarding video to familiarize new users with the app's functions. Others proposed allowing subtasks in group projects to clearly delegate responsibilities among students. There were also recommendations to customize the app's colour scheme, avoiding tones like red that might be perceived negatively by students. Finally, the idea of integrating the app with learning management systems such as Moodle was raised, to unify the digital learning environment.

4.4.5. Summary of Evaluation Questionnaire Results

To quantify the user feedback, the following table presents the average ratings received for each item on the evaluation questionnaire, based on responses from all jury panel participants:

Question	Average Rating
The app's user interface is intuitive and easy to navigate.	3.6
The app successfully integrates key functionalities requested during the brainstorming session.	4.4
The app enhances student engagement in the classroom.	4.6
The student side of the app provides useful features for classroom engagement.	4.6
The professor side of the app includes all necessary tools for managing classroom activities efficiently.	4.4
The professor's dashboard provides relevant insights about student engagement.	4.8
The app's group work feature effectively supports collaboration among students.	4.4
The 'check-in' and mood tracking feature is useful for understanding student engagement in class.	4.5
The quiz and knowledge-sharing features are beneficial for enhancing the learning experience.	5
The overall experience of using the app is positive.	4.8
How well does the app align with the objectives of enhancing classroom engagement and interaction?	4.6
Would you recommend this app for implementation in real classroom settings?	4.8
Overall Average	4.6

Table 4-6 – Summary of questionnaire results

These results confirm that the app prototype is meeting its goals in most areas, especially in facilitating engagement, promoting transparency, and supporting collaboration. Even though there is room for refinement, particularly in the user interface, participants endorsed the application's potential for use in real educational settings.

5. DISCUSSION AND IMPLICATIONS

5.1. Discussion

The development of the digital learning platform in this study illustrates how co-design and design thinking methodologies can meaningfully contribute to improving student engagement in the classroom. By following the three iterative phases of the Design Thinking model Inspire, Ideate, and Implement, the project maintained a strong user-centred focus and responded directly to the needs of both students and professors identified throughout the research process.

5.1.1. Inspire Phase

In the Inspire phase, user research methods including trend analysis, benchmarking, and qualitative interviews were utilized to gain a comprehensive understanding of the current digital education landscape and user challenges. The trend analysis identified key developments in educational technology, including real-time feedback, mood tracking, and mobile-first design. Benchmarking platforms such as Moodle, Kahoot, and Google Classroom exposed deficiencies in real-time classroom engagement. This underscores the necessity for an application that enhances live interaction within the classroom setting.

Ten semi-structured interviews with master's students provided rich qualitative insights. These were analysed using Quirkos, resulting in six themes: : motivation and engagement, socialization and collaboration, technology use and app design, teaching methods and classroom dynamics, knowledge organization and practice application and knowledge sharing and reflection. These insights shaped the initial conceptual direction of the app and helped identify key features needed to address frustrations with current LMS tools, such as delayed feedback, passive learning formats, and lack of collaborative tools.

5.1.2. Ideate Phase

A 90-minute workshop using the Disney Brainstorming Method involved five professionals from educational technology and UX design. Participants explored

solutions from the perspectives of Dreamer, Realist, and Critic, balancing creativity, feasibility, and critique. Insights were gathered on features to enhance classroom engagement.

The session concluded with a wireframing activity, where participants sketched interface ideas for both the student and professor sides of the app. These sketches provided the foundational structure for the prototype developed in the next phase. Additionally, a feature prioritization process identified core functionalities real-time feedback, mood tracking, engagement analytics, and group collaboration which are essential components of the platform.

5.1.3. Implement Phase

During Implementation, the app prototype was developed using Adalo, a no-code platform ideal for quick development, real-time interaction, and database integration. Screens were created for both student and professor experiences, enabling mood tracking, live participation, quizzes, chat forums, and analytics dashboards. The design process closely followed insights from the Ideate phase and translated wireframing ideas into functional components. Iterative testing allowed for refinement of user flows, performance optimization, and feature alignment with prior feedback.

5.1.4. User Feedback

A demo session was held with the same professionals who participated in the brainstorming session. They were guided through a series of tasks on the app, followed by a structured questionnaire. The feedback was overwhelmingly positive. Professionals highlighted the app's practical features, such as the real-time feedback and mood tracking system, as well as its potential for facilitating a more dynamic classroom experience. Suggestions for improvement included better visibility of upcoming features, enhanced onboarding for new users, and small UX refinements. Additionally, participants offered new ideas, such as course progress comparisons, offline access to materials, and the inclusion of short animations or video content.

These evaluations confirmed that the prototype succeeded in addressing gaps in current classroom technology by offering an experience tailored to both students' learning behaviours and professors' needs for real-time engagement and feedback.

5.2. Future Implications

5.2.1. Refinement of Features and Interface

Future versions of the app could benefit from deeper personalization, improved onboarding, and further testing across a broader student population. Simplifying certain navigation elements and ensuring clearer call-to-actions will help reduce cognitive load and improve usability.

5.2.2. Integration with Institutional LMS

One challenge faced during development was the inability to connect with Moodle due to API restrictions. Future work could explore institutional partnerships to integrate features such as grade synchronization, notifications, and user verification with official LMS systems.

5.2.3. AI-Powered Personalization

Leveraging machine learning models to analyse student performance and suggest personalized content could further increase engagement. For instance, students struggling with certain topics could receive recommended videos, articles, or quizzes tailored to their needs.

5.2.4. Data Privacy and Ethics

As real-time feedback and mood tracking become more central to the experience, future iterations must address how sensitive data is stored, anonymized, and shared. Clear data privacy policies and ethical considerations will be necessary for institutional adoption.

5.2.5. Cross-Platform Compatibility

While the app functions well on mobile, future development should ensure consistent experiences across tablets and desktops, especially for professors who may prefer larger screens for classroom management and analytics.

5.2.6. Expanding Evaluation and Longitudinal Studies

While feedback from a panel of experts provided valuable early insights, testing the app with a larger student population over a longer period could offer a deeper understanding of its sustained impact on engagement, learning outcomes, and classroom dynamics.

5.2.7. Scalability and Customization for Institutions

With minor adjustments, the platform could be adapted for different institutions and subjects. Offering customizable templates for course structure, grading schemes, or visual themes could allow broader use across educational contexts.

5.2.8. Community Building and Collaboration Tools

Future iterations might include a community board, group challenges, or study groups across classes and institutions to promote peer learning and build a stronger academic network.

6. CONCLUSIONS

6.1. Challenges of Implementing Human-Centred Design (HCD)

Implementing a human-centred design approach in the context of educational app development presented a range of challenges, particularly when addressing the complex and dynamic needs of university students and educators. One major difficulty was capturing a wide spectrum of classroom engagement experiences through interviews. Although ten semi-structured interviews were conducted with master's students, analysing this data required careful interpretation using Quirkos to ensure nuanced insights without misrepresentation or bias.

The co-design process involved ongoing collaboration with professionals during the Ideation workshop. The Disney brainstorming method enabled structured and creative discussions, managing various professional viewpoints. Ranging from education technology to UX design. It demanded moderation to maintain focus while embracing diverse ideas. There were also challenges in moving from abstract ideas to actionable features, particularly when prioritizing functionalities that were feasible within the limits of a no-code platform like Adalo.

The development of the prototype highlighted further challenges related to balancing technical feasibility and user expectations. Adalo enabled fast prototyping and iterative design. However, limitations in customization and database logic introduced constraints that needed workarounds. Integrating real-time feedback, engagement analytics, and role-based navigation for both students and professors required iterative testing to ensure seamless functionality.

Moreover, applying HCD in a classroom setting meant ensuring that the app was intuitive for both digital-native students and professors with varying degrees of tech-savviness. Accessibility, ease of use, and alignment with real classroom dynamics needed to be continuously evaluated, especially during the feedback session with the panel of professionals.

6.2. Effectiveness of the DT Methodology in Addressing Student Needs

The Design Thinking methodology proved to be a robust framework for tackling the challenge of improving classroom engagement. Its three phases Inspire, Ideate, and Implement have ensured that user needs were deeply explored, co-designed, and tested through iterative feedback.

In the Inspire phase, insights gathered from student interviews revealed key barriers to engagement, such as delayed feedback, lack of interactivity, and reliance on external tools for learning support. These findings informed the creation of user needs and problem statements, which laid the foundation for brainstorming.

The Ideate phase enabled meaningful co-creation. Using the Disney brainstorming method, professionals were able to explore innovative features across the dreamer, realist, and critic phases. The wireframes and discussions shaped the core functionalities, such as real-time mood tracking, student-professor interaction tools, and dashboards. Feature prioritization ensured that the prototype was aligned with both feasibility and user value.

During the Implement phase, the prototype was developed and tested using Adalo. The final product incorporated the prioritized features and was iteratively improved through feedback from a panel of judges. The feedback session validated that the app addressed core engagement challenges and provided a more interactive, real-time classroom experience. This is something that is lacking in many current LMS tools.

6.3. Comparison with Traditional Educational Platforms

Traditional educational platforms, particularly those developed without HCD or DT methodologies, often prioritize administrative efficiency over meaningful student engagement. These platforms typically provide static content, such as lecture materials, course outlines, or scheduling tools, with limited opportunities for real-time interaction or personalized learning experiences.

One of the most noticeable differences lies in the lack of empathy-driven design. Traditional systems rarely involve end-users—students and educators—throughout the design and development process. As a result, the platforms often fail to address

nuanced challenges faced in the classroom, such as fluctuating attention spans, the need for real-time feedback, or the desire for peer-to-peer collaboration. These systems operate under a top-down model, where features are implemented based on institutional assumptions rather than lived experiences of their users.

By contrast, the platform developed in this thesis incorporated co-design methods from the outset, ensuring that both student and professor perspectives informed the design. For example, features like the real-time “check-in” and mood tracking tool were implemented in direct response to student feedback, enabling professors to adapt their teaching dynamically based on classroom energy levels. This is a functionality entirely absent in most traditional learning management systems.

Similarly, the interactive Q&A feature, which allows students to ask questions anonymously during lectures, addresses a common barrier in classroom engagement—hesitation to speak publicly. Traditional systems may provide forums or email access, but they often lack tools designed to encourage spontaneous, low-pressure interaction within live sessions.

The platform also integrates visual analytics for professors, enabling them to track participation, quiz performance, and class mood in real-time. These tools provide data-driven insights that help educators adjust their strategies to better meet student needs—something traditional platforms rarely offer in an accessible, intuitive format.

Moreover, the group collaboration module promotes active, student-led learning by allowing peers to form and manage groups, share resources, and submit collective work. This supports a learning culture based on mutual accountability and shared knowledge creation, which goes far beyond the passive consumption model of conventional e-learning systems.

In summary, the thesis project demonstrates how integrating HCD, and DT methodologies results in an adaptable, empathetic, and highly engaging educational platform. Unlike traditional systems that treat students as passive recipients of content, this approach empowers them as co-creators of their learning journey and enhancing both the classroom experience and overall learning outcomes.

7. LIMITATIONS AND FUTURE WORK

This study faced several limitations that should be acknowledged to contextualize the findings and guide future iterations of the platform. One of the primary limitations was the relatively small and homogenous sample size used during the user testing and evaluation phases. Although the feedback provided by students and professionals was insightful, it may not fully represent the broader diversity of university populations across disciplines, cultural backgrounds, or varying levels of digital fluency. A more expansive user base would offer a deeper and more generalizable understanding of user needs and behaviours.

In addition, the pilot implementation occurred over a short period, which limited the ability to observe long-term usage patterns and sustained user engagement. While short-term feedback highlighted positive initial reactions and strong alignment with user needs, the long-term impact of the app on student motivation, participation, and academic outcomes remains uncertain. Future studies should consider extended testing phases to examine the effectiveness of the platform over an entire semester or academic year.

Another constraint involved the use of self-reported data in both the professional feedback sessions and the questionnaire-based evaluation. Although this approach enabled rich, qualitative insights, it also introduced potential biases, such as social desirability or inconsistent interpretations of rating scales. Future research should use objective data (such as logins, interaction frequency, completion rates) and participant feedback to evaluate app performance more comprehensively.

From a technical perspective, the decision to use Adalo, a no-code development platform, while advantageous for rapid prototyping, limited the customization and scalability of certain features. Challenges included limited backend control, restrictions on real-time data synchronization, and fewer options for advanced data analytics. While these trade-offs were acceptable for the scope of a master's-level prototype, future development phases could benefit from transitioning to custom-built solutions that offer greater flexibility and performance.

Looking ahead, several directions can be pursued to enhance the app and broaden its impact. Firstly, expanding the content and features of the app based on user suggestions would be valuable. Participants expressed a desire for more structured visualizations, clearer navigation for professors, and improved onboarding experiences such as a tutorial or walkthrough. Additionally, the integration of real-time analytics, intelligent notifications, or adaptive learning features that would be enabled by artificial intelligence could provide more personalized experiences and support student learning in a dynamic way.

Mobile-first development is also a crucial next step. Although the current prototype was mobile-responsive, a dedicated mobile application with offline capabilities, push notifications, and integration with classroom technologies (e.g., projectors, LMS platforms) would significantly enhance accessibility and usability. Expanding cross-platform compatibility would allow the app to become a seamless companion tool in both physical and blended learning environments.

Furthermore, increasing the app's focus on community-building features could support peer collaboration and foster a sense of belonging. Tools like discussion forums, live polls, classroom leader boards, or group challenges could deepen student engagement while also offering professors a more holistic view of classroom dynamics.

Lastly, the success of a student-centred educational app depends on iterative development driven by longitudinal user feedback. Conducting usability studies over time, alongside continued collaboration with both academic institutions and educators, will be essential to ensure that the platform evolves in step with changing educational needs. By combining these strategies, future versions of the app can move beyond the prototype phase into a robust, scalable solution that actively contributes to more engaging, inclusive, and responsive learning environments.

The design and evaluation of this mobile app prototype offered several insights that may guide future research and practice in applying Design Thinking to enhance student engagement. Drawing from the principles of empathy, iteration, and user-centered feedback, the process revealed actionable strategies that extend beyond this specific context. These learnings can support educators, researchers, and developers working

to build more engaging and inclusive educational technologies. The table below summarizes key findings and how they may be transferred to other studies seeking to foster meaningful student engagement through design-driven methodologies.

The design and evaluation of this mobile app prototype offered several insights that may guide future research and practice in applying Design Thinking to enhance student engagement. Drawing from the principles of empathy, iteration, and user-centred feedback, the process revealed actionable strategies that extend beyond this specific context. These learnings can support educators, researchers, and developers working to build more engaging and inclusive educational technologies. The table below (Table 7-1) summarizes key findings and how they may be transferred to other studies seeking to foster meaningful student engagement through design-driven methodologies.

Learning	Description	Potential for Transfer
Empathy-driven Research is Essential	Conducting interviews and mapping user pain points provided deep insights into the students' classroom frustrations and needs.	Other educational design projects should begin with empathy-building activities to uncover real, often unspoken, user needs.
Prototyping in Low-Code Tools is Effective	Using Adalo allowed rapid development and real-time iteration based on feedback without needing extensive technical expertise.	DT initiatives in education can benefit from low-code platforms for early-stage validation of ideas.
Mixed-Method Feedback Strengthens Design	Combining structured questionnaires with qualitative feedback from professional juries led to more nuanced evaluations.	Hybrid evaluation methods help uncover both user sentiment and functional gaps—this can improve DT cycles.
Collaboration Tools Increase Student Voice	Features like anonymous Q&A and real-time check-ins empowered students to participate without fear.	These elements can be replicated in other digital tools to reduce classroom hierarchy and increase student confidence.
SECI and Ba Can Inform Digital Learning Spaces	Knowledge creation frameworks helped conceptualize collaboration and engagement more holistically.	Applying SECI and Ba can enhance understanding of how knowledge is shared and transformed in learning apps.

Table 7-1 – Transferable Insights for Applying Design Thinking to Student Engagement

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9. APPENDIX



This is to certify that

Project No.: **GEO2025-4-292548**

Project Title: **Designing for Engagement: A Human-Centred Approach to Enhancing Student-Professor Collaboration Through a Mobile App**

Principal Researcher: **Domen Bozic**

according to the regulations of the Ethics Committee of NOVA IMS and MagIC Research Center this project was considered to meet the requirements of the NOVA IMS Internal Review Board, being considered **APPROVED** on 4/29/2025.

It is the Principal Researcher's responsibility to ensure that all researchers and stakeholders associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Ethics Committee, via amendment or progress report, of

- Any significant change to the project and the reason for that change;
- Any unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in that role or any other change in research personnel involved in the project.

Lisbon, 4/29/2025

NOVA IMS Ethics Committee

ethicscommittee@novaims.unl.pt

1. Interview questions for students

Interview Introduction

- **Greeting:** "Thank you for participating in this interview. I am interested in understanding how you learn in the classroom, how different activities contribute to your learning experience, and how technology, specifically a learning app, could support you."
- **Purpose:** "The interview will focus on different aspects of knowledge creation and learning based on your experiences, as well as exploring how an app could enhance your classroom engagement."
- **Confidentiality:** "Your responses will remain confidential and will only be used for research purposes."
- **Consent:** "Do I have your consent to proceed with this interview?"

1. Opening and General Engagement

- How would you describe your general level of engagement in your courses? What factors typically affect your engagement?
 - Can you share an experience where you felt highly engaged in a classroom? What contributed to that feeling?
2. Socialization and Collaboration (SECI: Socialization)
- How do informal conversations or collaborations with classmates and professors (such as in group work or discussions) help you better understand course material? (*SOCIALIZATION*)
 - Can you describe a situation where you learned something important through a discussion or activity with your classmates? (*SOCIALIZATION*)
3. Teaching Methods and Classroom Dynamics
- What specific teaching methods (like lectures, discussions, group work, or projects) make it easier or harder for you to stay engaged in class?
 - How does classroom environment (Length of class, class size, room setup, or time of day) impact your level of engagement?
4. Sharing Knowledge (SECI: Externalization)
- Have you ever had to present or explain your ideas to others? How did that help you clarify your understanding or organize your thoughts? (*EXTERNALIZATION*)
5. Knowledge Organization and Application (SECI: Combination and Internalization)
- How do you typically combine information from different sources, like lectures, readings, or discussions, to form a better understanding of the subject matter? (*COMBINATION*)
 - How do you feel about learning by doing—through exercises, case studies, or projects? How does that impact your understanding? (*INTERNALIZATION*)
6. Technology and Communication
- Have you used any online platforms or apps to communicate with professors or classmates? If so, which ones, and what did you find helpful or challenging about them?
 - What motivates you to engage more in class, and how do you think an app could help with that?
7. Suggestions for Improvement
- How important are features like gamification (e.g., earning points, badges, or rewards) in keeping you engaged? Would you use those features in a learning app?
 - Are there particular aspects of professor-student interaction that you think are often overlooked but are important to engagement?

Conclusion

- Wrap-up Question: “Is there anything else you would like to share about how an app could support your learning and engagement in class?”

Thank You: “Thank you again for your time and valuable insights. Your feedback will help us design an app that enhances learning and engagement in the classroom.”

APPENDIX A – Interview questions for students

2. Questionary for Jury

Prototype App Evaluation Questionnaire

Thank you for participating in this evaluation. **Instructions:** Please rate the following statements on a scale of **1 to 6**, where:

1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree

1. The app's user interface is intuitive and easy to navigate.
1 2 3 4 5
2. The app successfully integrates key functionalities requested during the brainstorming session.
1 2 3 4 5
3. The app enhances student engagement in the classroom.
1 2 3 4 5
4. The student side of the app provides useful features for classroom engagement.
1 2 3 4 5
5. The professor side of the app includes all necessary tools for managing classroom activities efficiently.
1 2 3 4 5
6. The professor's dashboard provides relevant insights about student engagement.
1 2 3 4 5
7. The app's group work feature effectively supports collaboration among students.
1 2 3 4 5
8. The "Check-in" and mood tracking feature is useful for understanding student engagement in class.
1 2 3 4 5
9. The quiz and knowledge-sharing features are beneficial for enhancing the learning experience.
1 2 3 4 5
10. The overall experience of using the app is positive.
1 2 3 4 5
11. How well does the app align with the objectives of enhancing classroom engagement and interaction?
1 2 3 4 5
12. Would you recommend this app for implementation in real classroom settings?
1 2 3 4 5

Open-Ended Feedback:

11. What do you think are the strongest features of the app?

12. What improvements or additional features would you suggest?

13. Do you have any additional comments or feedback?

Thank you for your feedback!

APPENDIX B – Questionary for Jury



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