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Research Article

Persuading Students to Overcome Mild Bad Habits with 'Indomitable'

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Abstract

Mild bad habits, while they may not seem critical at first, can become serious issues over time. If left unchecked, this habit can pose a major threat to individual well-being, public health, and economic stability in modern society. Smartphone and internet use, which is increasingly important, also contributes to the increase in behavioural addictions such as gaming, social media, and internet use disorders. It also facilitates substance abuse, including alcohol. Modern lifestyles are often the cause of bad habits such as excessive consumption of fast food and lack of physical activity. This, in turn, contributes to chronic health problems and mental stress. The project aims to develop a mobile application, 'Indomitable', which helps users face and control their bad habits. This app not only helps users to be free from bad habits but also empowers them to take control of their lives. 'Indomitable' uses persuasive techniques to overcome the issue of bad habits among students. One of the main issues among students in their attempts is the difficulty in monitoring their progress and the lack of motivation during the process of controlling bad habits. This application provides tools to track progress and use persuasive elements to increase motivation. The development methodology used the Waterfall Model, involving requirements analysis, design, development, implementation, integration and testing. By leveraging the widespread use of smartphones and the growing understanding of habit formation, 'Indomitable' provides important functions to address concerns about bad habits, and also provides persuasive elements to increase student motivation.

Keywords: mild bad habits, behavioural addictions, persuasive technology, habit formation, student motivation

INTRODUCTION

The rise of smartphone and internet usage has increased behavioural addictions, including gaming, social media, and internet use disorders, which can also facilitate substance abuse such as alcohol consumption. Students, in particular, are vulnerable to developing these bad habits due to the demands of academic life, social pressures, and the pervasive use of technology. Modern lifestyles often lead to excessive consumption of fast food and a lack of physical activity, contributing to serious health problems and mental stress (Ravichandran & Keikhosrokiani, 2022). Addressing these habits early is crucial for fostering a healthier and more productive society (Herdiansyah et al., 2021).

Despite the awareness of the negative impacts of mild bad habits, many students struggle to escape from them. Traditional methods of intervention, such as educational campaigns and counselling, have had limited success in effectively changing behaviours (Aida et al., 2010). One of the primary challenges is the difficulty students face in monitoring their progress and maintaining motivation during the process of

overcoming bad habits (Dewi et al., 2022). There is a pressing need for innovative solutions that can empower students to take control of their lives and make positive changes.
In today's educational landscape, fostering students' personal growth and development extends beyond academic instruction, encompassing the nurturing of positive habits and behaviours. Many students struggle with mild bad habits that, while not immediately detrimental, can impede their long-term success and well-being (Hammill et al., 2020). These habits may include procrastination, disorganization, excessive screen time, or neglecting physical health (Ibrahim et al., 2021; Mohamed et al., 2023). Addressing these issues requires innovative strategies that not only highlight the importance of positive habits but also empower and persuade students to make sustainable changes.

A comprehensive approach to this challenge involves leveraging a combination of psychological insights, motivational techniques, and practical tools (Salleh et al., 2022). The goal is to inspire students to recognize and overcome their mild bad habits through a structured and supportive framework. By incorporating elements such as goal-setting, self-monitoring, positive reinforcement, and peer support, an effective program can create an environment where students feel motivated and equipped to make lasting improvements in their daily routines (Ferrer et al., 2020; Mohamed et al., 2022).

The core objective of such a program is to empower students with the skills and mindset needed to take control of their habits and, by extension, their futures (Vaithilingam et al., 2019). Through targeted interventions, workshops, and continuous support, the program emphasizes the importance of self-efficacy and personal responsibility. By fostering a culture of resilience and determination, the initiative not only addresses the immediate challenges posed by mild bad habits but also instils a lifelong capacity for self-improvement and adaptability, ultimately contributing to the holistic development of students.

This paper introduces empowerment and persuasion elements in a mobile application designed to help students overcome and control their bad habits. The objectives of this study are to develop an application called 'Indomitable' that aids users in tracking and managing their bad habits and to employ persuasive techniques within the application to enhance user motivation and engagement. The significance of this study lies in its potential to provide a practical and accessible tool for students to manage their bad habits. By leveraging the widespread use of smartphones and incorporating persuasive elements, 'Indomitable' aims to offer a comprehensive solution that not only monitors progress but also motivates users to persist in their efforts.

This study focuses on the development and evaluation of the 'Indomitable' application specifically for students from high school to university level. The scope includes the identification of common mild bad habits among students, the design of persuasive features within the application, and the assessment of its usability and effectiveness. The study also explores the broader implications of using technology to address behavioural issues in modern society.

To guide this study, the following research questions have been formulated: What are the most prevalent mild bad habits among students? How can persuasive techniques be effectively integrated into a mobile application to help control bad habits? What are the usability and effectiveness outcomes of the 'Indomitable' application in helping students overcome their bad habits? How can the application be optimized to ensure sustained user engagement and habit change?

The introduction provides an overview of the background, problem statement, objectives, significance, scope, and research questions of the study. The literature review explores existing research on bad habits, behavioural addictions, and the use of technology in habit control, highlighting gaps and opportunities. The methodology details the research design, data collection methods, and analytical approaches used in

the study. The development of 'Indomitable' describes the development process of the application, including design, implementation, and testing. The results and discussion present the findings of the study and provide an in-depth analysis of the data collected. The conclusion and recommendations summarize the main findings, discuss their implications, and offer recommendations for future research and practice.

ADDRESSING MILD BAD HABITS WITH PERSUASIVE TECHNOLOGY

In today's fast-paced digital era, students are increasingly susceptible to developing mild bad habits such as staying up late, maintaining an unbalanced diet, and excessive use of smartphones. These habits, while often overlooked as minor issues, can accumulate and lead to significant challenges, affecting both mental and physical health (Aw et al., 2023). The advent of technology has made it easier for students to fall into these habits, often without realizing the long-term consequences. Recognizing and addressing these issues early is crucial for ensuring students' overall well-being and academic success.

Mild bad habits, although often dismissed as inconsequential, can accumulate over time, leading to significant negative outcomes for individuals and society (Herdiansyah et al., 2021). These habits may include behaviours such as excessive screen time, procrastination, frequent consumption of fast food, and lack of physical activity. While these actions may not appear harmful initially, they can gradually erode mental and physical health, contributing to chronic issues like obesity, anxiety, and decreased cognitive function. For example, consistent overindulgence in fast food can lead to poor nutrition, which in turn worsens health problems such as diabetes and heart disease. Moreover, mild bad habits often have a compounding effect, where one negative behaviour reinforces another, creating a cycle that is difficult to break without intentional intervention (Polus et al., 2025; Ravichandran & Keikhosrokiani, 2022).

The seemingly benign nature of mild bad habits makes them particularly insidious, as they often escape the immediate notice and concern of the individuals affected. However, the cumulative impact of these behaviours can undermine productivity, strain relationships, and reduce overall quality of life. The rise in smartphone and internet use has further complicated the landscape of mild bad habits, as digital addictions such as social media overuse or compulsive gaming are increasingly prevalent. These behaviours not only detract from time spent on more productive activities but also contribute to mental health issues like depression and social isolation. Addressing these mild bad habits through innovative tools, which focus on both awareness and behaviour modification, is crucial for preventing their escalation into more serious problems (Gaines, 2021; Mohamed et al., 2024).

Behavioural addictions, such as excessive use of smartphones and internet-related activities, have become increasingly prevalent. Research has shown that these addictions can have serious implications for mental health, leading to issues such as anxiety, depression, and social withdrawal. The connection between behavioural addictions and neurological pathways shows how addiction can alter brain function, which in turn influences motivation and decision-making (Bezençon et al., 2023).

The use of persuasive applications is an appropriate step to help students overcome their bad habits. The approach appears to be suitable to overcome the problem for three reasons. First, the approach may provide tailored support and guidance (Dolhalit et al., 2015). Persuasive applications like 'Indomitable' can provide personalized support and guidance to students in overcoming their bad habits. These apps can tailor their features to suit individual needs, allowing users to set specific goals, track their progress, and receive targeted feedback. By offering personalized assistance, persuasive applications can address the unique challenges and motivations of each student, increasing the likelihood of behaviour change (Can et al., 2025).

Secondly, continuous motivation and engagement in the approach (Abdessettar et al., 2016). One of the key challenges in breaking bad habits is maintaining motivation and engagement over time. Persuasive applications can help address this issue by providing continuous motivation and reinforcement. Through features such as reminders, progress tracking, and rewards, these apps keep users engaged and motivated to stick to their goals (Munif et al., 2021). By consistently reinforcing positive behaviours, persuasive applications can help students stay on track and overcome their bad habits more effectively.

Thirdly, behavioural modification techniques could be involved in the approach (Widyasari et al., 2019). Persuasive applications leverage behavioural modification techniques to encourage positive behaviour change. These techniques, rooted in psychology and behavioural economics, are designed to influence users' attitudes and behaviours. By incorporating elements such as goal setting, social support, and feedback, persuasive applications can effectively guide students towards healthier habits. Additionally, features like gamification and habit tracking make the process of behaviour change more engaging and enjoyable, increasing the likelihood of success. Overall, the use of persuasive applications provides a systematic and evidence-based approach to helping students overcome their bad habits.

The use of persuasive applications has been proven to be effective in helping overcome bad habits (Orji et al., 2019). One effective approach to combating these habits is through the use of mobile applications designed to track and modify behaviour. The feature aims to help students monitor their habits and make positive changes. By leveraging persuasive technology, the platform provides users with the tools to set goals, track progress, and receive continuous motivation. The application’s design focuses on user engagement and empowerment, making it easier for students to stay committed to their goals (Annamalai et al., 2014).

The use of persuasive techniques is central to the effectiveness of 'Indomitable'. These techniques include goal setting, progress tracking, and providing motivational feedback (Devincenzi et al., 2017). By integrating these elements, the application helps students maintain their focus and motivation, which are often the most significant barriers to overcoming bad habits (Johan et al., 2021). The application also incorporates elements of gamification, such as rewards and challenges, to keep users engaged and motivated. This approach not only makes the process of breaking bad habits more manageable but also more enjoyable.

Likewise, persuasive principles address the need for early intervention (Aziz et al., 2018). By identifying and targeting mild bad habits before they escalate, the application helps prevent the development of more severe issues. This proactive approach is essential in promoting long-term health and well-being among students. The ability to track progress and see tangible improvements can be a powerful motivator, encouraging students to continue their efforts and develop healthier habits over time.

The success of persuasive techniques lies in their comprehensive approach to habit formation. By combining technology with behavioural psychology, the application offers a robust solution to the problem of mild bad habits among students (Nurul Ulfa et al., 2017). Its user-friendly interface, coupled with effective persuasive techniques, makes it an invaluable tool for students striving to improve their habits and overall quality of life. As technology continues to evolve, applications like 'Indomitable' have the potential to play a significant role in promoting healthier lifestyles and enhancing student well-being.

In the context of habit formation, persuasive technology can be leveraged to support individuals in developing and maintaining positive habits while addressing less severe or mild habits that may impact their well-being. By utilizing techniques such as personalized feedback, goal setting, and motivational reminders, persuasive technology can effectively encourage users to adopt healthier behaviours and

sustain them over time (Alqahtani et al., 2023). For instance, mobile applications that track progress and provide rewards for achieving small milestones can foster a sense of accomplishment and reinforce the desired habits.

Habit formation is a critical aspect of behavioural change, particularly when addressing mild habits that may be detrimental if left unchecked. Research in this area suggests that habits are formed through repeated actions that become automatic over time (Hammill et al., 2020). Persuasive technology can facilitate this process by creating environments that support consistency and reinforce positive behaviours. For example, integrating features such as daily prompts, progress tracking, and social support within an application can help users stay engaged and committed to their habit-forming goals. By focusing on gradual improvements and providing timely encouragement, persuasive technology can play a significant role in helping individuals overcome mild habits and achieve long-term behavioural change.

In the context of persuasive technology and its function in mobile applications, mobile applications have the potential to influence user behaviour and induce positive health (Orji & Moffatt, 2018). They also found that by integrating persuasive features, the app can effectively motivate users to make changes in health behaviours. This study also identified four main persuasive features that often exist in persuasive applications, namely main task support, dialogue support, social support, and system credibility support.

In persuasive technology, key tasks to support intervention functions may involve, such as self-monitoring (Johan et al., 2021). Self-monitoring allows users to see their progress, while dialogue support provides reminders, rewards, and encouragement. Additionally, social support allows users to engage in the community, while system credibility support gives users confidence in the reliability of the application. For example, the persuasive application 'Indomitable' can provide a community feature that enables interaction between users, sharing achievements, and providing support to fellow users. In addition, the system's credibility support feature can provide confidence to users through verification from health experts or recognition certificates from authoritative organizations. Overall, this study provides effective and relevant insights in identifying persuasive features that can be used in mobile applications to help 'Indomitable' users control their mild bad habits.

Persuasive technology plays a pivotal role in addressing mild bad habits by subtly guiding users toward positive behavioural changes. This technology leverages psychological principles such as reinforcement, feedback, and social influence to encourage users to adopt healthier habits (Idrees et al., 2024; Junker et al., 2024). For instance, mobile applications designed to reduce screen time or promote physical activity often use persuasive elements like personalized reminders, goal-setting features, and reward systems. These strategies are effective because they provide immediate feedback and a sense of achievement, which are critical for sustaining behaviour change (Takami et al., 2022).

Moreover, the integration of interaction within persuasive technology to allow users to earn points, badges, or rewards for meeting their goals has been shown to significantly enhance user engagement and adherence to desired behaviours (Henkemans et al., 2017). By making the process of breaking bad habits more engaging and rewarding, persuasive technology can transform a potentially difficult and mundane task into a more enjoyable and motivating experience (Liu & Hsu, 2022).

Student motivation, particularly in the context of self-regulation and habit formation, is crucial for the success of interventions aimed at reducing mild bad habits. Students are more likely to commit to behaviour change when they are intrinsically motivated (Alyana & Soomra, 2023). Driven by personal goals and a sense of autonomy, motivation could be achieved better rather than by external pressures. Persuasive technology can enhance this intrinsic motivation by aligning the intervention with the user's

values and goals, making the process of overcoming bad habits more meaningful and relevant (Aura et al., 2022). Additionally, features like progress tracking and personalized feedback in apps can boost a student's sense of competence and self-efficacy, which are key drivers of sustained motivation. By empowering students to take control of their habits and see tangible progress, these technologies foster a more proactive approach to self-improvement, ultimately leading to more successful and lasting behaviour change (Dorrah & McCabe, 2023).

APPLICATION DESIGN AND DEVELOPMENT

The methodology used in the design and development of Indomitable Application is the waterfall methodology. The Waterfall model is particularly suitable for this project due to its structured approach, which aligns with the sequential nature of application development and allows for clear documentation and evaluation at each phase (De Lope et al., 2015). The Waterfall model works as a traditional and linear approach to system development and offers several advantages that can be beneficial in specific project contexts.

The waterfall model emphasizes gathering and documenting requirements before moving on to design and implementation (Arslan, 2021). These thorough requirements analysis helps in creating a detailed and accurate project scope, reducing the risk of scope creep. By defining requirements early and adhering to them throughout the development process, the Waterfall model minimizes the likelihood of significant changes during later stages, which can be disruptive and costly.

The Waterfall model originates from the manufacturing and construction industries. Adapted for software engineering by Winston W. Royce in 1970, the Waterfall model divides the development process into five distinct phases: Requirements, Design, Implementation, Testing, Deployment, and Maintenance. Each phase must be completed before moving on to the next, ensuring a structured and systematic approach to software development (Royce, 2021). This linear progression facilitates clear milestones and deliverables at each stage, providing a well-defined roadmap for the project (Hygerth, 2016).

The Requirements phase involves gathering and documenting all the necessary specifications and requirements for the software project. This phase is crucial as it sets the foundation for all subsequent phases. By clearly defining what the software needs to achieve, the project team can create a detailed requirements specification document. Early and comprehensive requirements gathering is vital for project success, as it minimizes the risk of scope creep and ensures that stakeholder needs are accurately captured and addressed.

Following the requirements gathering, the Design phase focuses on creating detailed design documents that outline how the software will meet the specified requirements. This phase includes architectural design, data models, and interface design. Thorough design documentation during this phase helps in visualizing the system’s architecture and user interactions, leading to more effective implementation and fewer design-related issues during later stages. This phase ensures that the software’s blueprint aligns with the initial requirements.

The Implementation phase is where the actual coding and development of the software occur. Developers translate the design documents into functional code, adhering to the specifications outlined in the previous phases. The Waterfall model’s structured approach helps in maintaining code quality and consistency. Each coding task in the implementation is guided by predefined design documents and requirements. This phase also includes the integration of various components and preparation for testing.

Once the software is developed, the Testing phase begins, focusing on identifying and fixing defects. The Waterfall model schedules testing only after the implementation is complete, which allows for a thorough and systematic evaluation of the software against the initial requirements. The testing phase is critical for ensuring software quality, as it provides an opportunity to detect and resolve issues before deployment. The comprehensive nature of testing in the Waterfall model helps in validating that the software meets all specified criteria.

The final phases are Deployment and Maintenance. During Deployment, the software is delivered to users and put into production. The Maintenance phase involves ongoing support and updates to address any issues that arise post-deployment. While the Waterfall model provides clear guidance through these phases, it may face challenges in adapting to changes once the software is in use. The model's rigidity can make it difficult to incorporate feedback or modifications without revisiting earlier phases, which can be a drawback in dynamic or evolving project environments.

The architecture for this application is presented in Figure 1. The Model View Controller describes the components responsible for managing data and processing logic. In the context of system development, the Model clearly shows data processing.

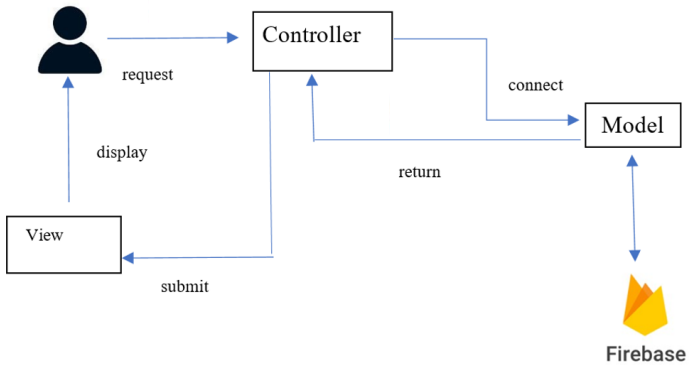

Figure 1: Model View Controller Architecture

The development of the Persuasive Indomitable application has been carried out carefully according to the requirements and model design. In the development process, Android Studio acts as the main Integrated Development Environment (IDE). The Kotlin programming language was chosen to support the development of this application. Google Firebase was chosen as the database management system, providing several important functions such as Firebase Authentication and Firestore. Firebase Authentication provides a secure and user-friendly authentication system, while Firestore provides easily accessible data storage and supports features such as automatic synchronization and real-time updates, making it an ideal choice for applications that require data management that is efficient and effective.

INTERFACE AND IMPLEMENTATION OF INDOMITABLE APPLICATION

Indomitable's persuasive application leverages Google Firebase, specifically Firebase Authentication, to provide a secure and effective registration and login system. In this application, users will be asked to provide their personal information, such as their email address and password, for the registration process. Firebase Authentication will handle user authentication by securely storing and managing their credentials. When users want to log in to the application, they need to enter their previously registered email address and password. Firebase Authentication will verify this information and grant access to authorized users. This system ensures that only registered users with valid credentials can access the

application, guaranteeing security. Figure 2 shows a screen display of the login interface using the Google method.

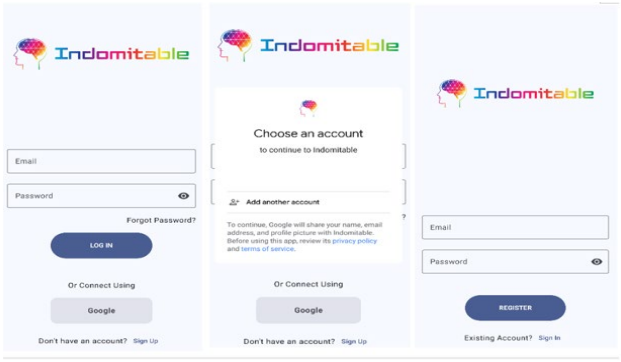

Figure 2: Indomitable login

Figure 3 shows the introduction screen interface designed to describe all the functions in this application. Briefly, this facility explains the existing functions found in Indomitable's persuasive application, including goal-setting, progress tracking, personalized feedback, habit formation tips, motivational quotes, and peer support features.

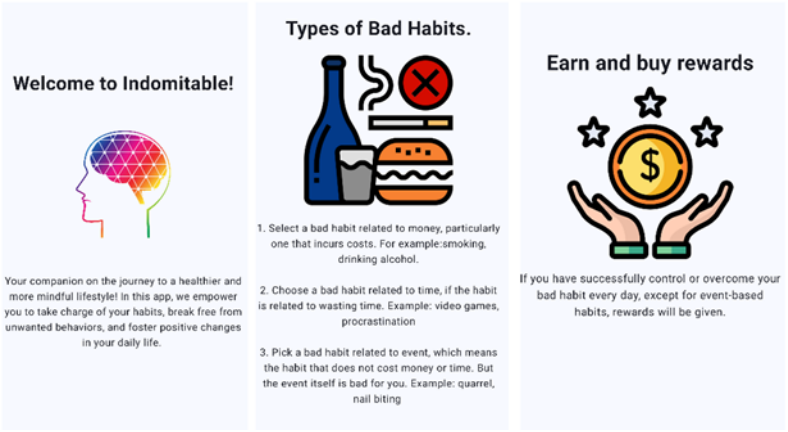

Figure 3: Description of functions

Goal setting function (in figure 4) allows users to view the list of all bad habits being declared in the selected category: time, money and event. The function also allows user to see their progress in controlling bad habits. To monitor the overall progress of bad habits during a certain period, the user will be able to define the starting point and period of the review. To add the progress record, the user can list how much money they've saved on a daily, weekly, and monthly basis. The system will also show how many times the user managed not to do the bad habit. In addition, there is also an add and edit note/journal button for users to record important feelings or events throughout the process of controlling the bad habit.

The goal-setting function in Indomitable is a core feature designed to help students identify, plan, and achieve their personal development targets, specifically related to overcoming mild bad habits. This function facilitates a structured approach to habit formation, ensuring that students have clear, actionable objectives and the tools they need to succeed.

The goal-setting function has the following important features. Initial Assessment is the starting point where students identify the mild bad habits they wish to change. This may involve answering questions

about their current behaviours, challenges they face, and areas they want to improve. The SMART (Specific, Measurable, Achievable, Relevant, Time-bound) Goals Framework is used to help students create effective goals. The application guides students in defining specific objectives that are clear and actionable, ensuring that each goal is realistic and relevant to their personal growth.

Customization and Personalization allow students to adapt their goals based on their individual needs and preferences. This includes setting the parameters for what they aim to achieve, how they will measure success, and the timeframe within which they plan to accomplish their goals. Action Plans assist students in developing detailed action plans. These plans break down each goal into smaller, manageable tasks or steps, providing a clear roadmap for students to follow. Action plans include daily or weekly tasks that contribute to the larger objective.

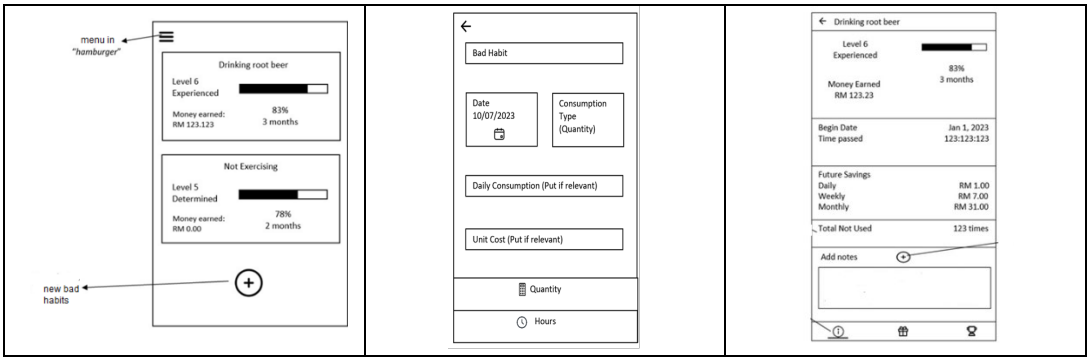

Figure 4: Goal-setting functions

The reward function in Indomitable, as presented in Figure 5, is designed to incentivize and reinforce positive behavior changes among students by providing tangible and intangible rewards for achieving their goals. This function operates on a point-based system where students earn points for completing tasks, reaching milestones, and demonstrating consistent effort in overcoming their mild bad habits.

The reward function works using the following principles. Task Completion allows students to earn points each time they complete a designated task related to their habit-forming goals. For example, if a student sets a goal to study for an hour each day, they earn points each day they successfully meet this target. Milestone Achievement gives additional points for reaching significant milestones. These milestones can be predefined within the application, such as studying consistently for a week or reducing screen time by 30% over a month.

Consistency Bonuses are given to encourage sustained effort, students receive bonus points for maintaining streaks of positive behaviour. For instance, completing a task daily for a consecutive number of days will result in higher rewards. Feedback and Encouragement provide personalized feedback and encouraging messages. When students achieve certain goals, they receive congratulatory notes that reinforce their efforts and motivate them to continue.

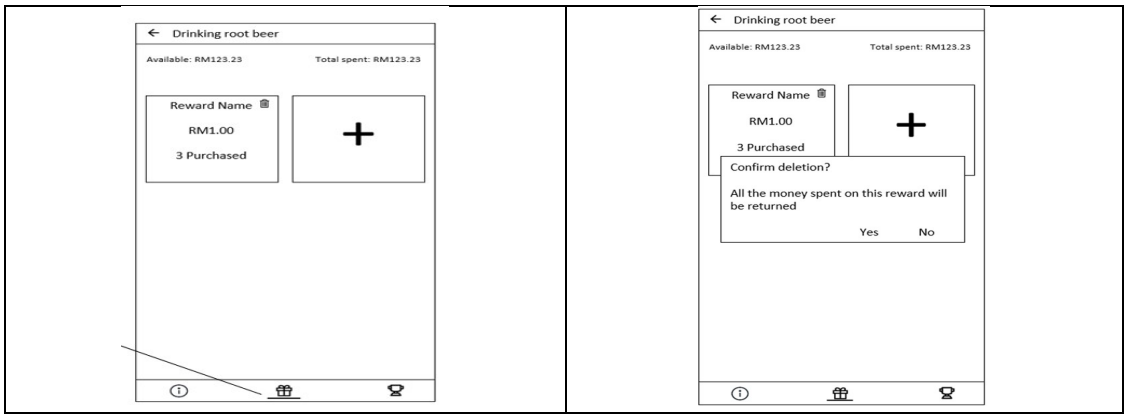

Figure 5: Reward function

The achievement display function, such as Figure 6, plays an important role in rewarding users who achieve or overcome bad habits within a certain period. For example, if the user manages to control or overcome their bad habits within a set number of days, the user will be given a " Success Badge " as recognition. This badge marks the achievements and positive efforts of users in improving themselves. The use of this kind of achievement display can provide additional encouragement to users to continue practising healthier habits or building positive habits. This function also acts as an incentive that gives satisfaction and recognition to users, encouraging them to continue to work towards achieving their health and well-being goals.

The achievement function in Indomitable is designed to recognize and celebrate students' progress and accomplishments as they work towards overcoming their mild bad habits. This function helps to maintain motivation and a sense of accomplishment by marking significant milestones and achievements along their journey. There are a few important features in the function. Setting Achievement allows users to define a series of achievements that correspond to various stages and aspects of habit formation. These achievements are tailored to different types of habits and levels of difficulty, ensuring that students have attainable goals to work towards. Tracking Progress allows users to continuously track their progress. This tracking system records data such as task completion rates, consistency streaks, and overall improvements in behaviour.

Milestone Recognition occurs when students reach specific milestones, such as completing a task for a set number of consecutive days or achieving a predefined goal. The achievement function triggers a recognition event. This could involve awarding digital badges, certificates, or unlocking new levels within the application.

Notifications in the Indomitable Persuasive app (as in Figure 7) include motivational words and reminders to control bad habits when users are inactive. These notifications serve as gentle nudges to re-engage users with their personal development goals, helping to maintain their focus and commitment. By delivering timely and encouraging messages, the app reinforces positive behaviours and supports users in overcoming challenges related to habit formation. Additionally, these notifications can be customized based on individual user preferences and progress, ensuring that the reminders are relevant and impactful. This feature is crucial in sustaining user engagement and fostering a supportive environment for continuous self-improvement.

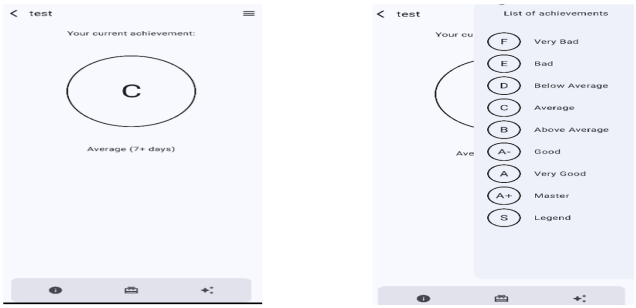

Figure 6: Achievement display

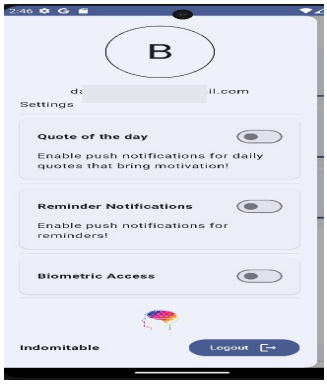

Figure 7: Notification display

The testing phase of the Indomitable project plays an important role in ensuring the entire development is successful. The testing process, especially in the context of unit testing and user acceptance testing, will be described here. The testing process begins with mutual unit testing, where each part of the application is tested individually to ensure the system works smoothly. Additionally, testing with target users provides a holistic view of the real user experience. Responses and feedback from target users become an important starting point for further improvements.

After the testing process, target users will be asked to fill out a questionnaire. The feedback from this questionnaire becomes a valuable source of information for planning improvements. This is a proactive step to ensure that the application meets the needs and expectations of users better. The testing process is the final phase in development, where the entire application is tested to ensure optimal usability. All aspects of the application, from design specifications to test case specifications, are given special attention. Errors are identified and corrected to ensure the application works properly and without problems.

In Android application development, the test plan plays an important role in ensuring the effectiveness, usability, and overall quality of the application. A test plan is a systematic step designed to identify, review, and correct potential errors or weaknesses in software throughout the development process. Android application development involves many complex components and aspects, and a test plan is a guide to ensure that each aspect is working as it should. This process includes unit testing, integration testing & functional testing, and improvement suggestions.

The test plan is not only focused on error detection but also on ensuring optimal user experience and overall application performance. By planning and implementing a comprehensive test plan, Android application development can be done effectively, minimize the risk of errors, increase user satisfaction, and provide stable and quality applications. With that, the introduction of a test plan becomes an important foundation in the Android application development process.

Test Function Items list the 11 functions that will be tested for the application. For example, the K011 function labels send messages privately to test that messages can be sent to other users successfully in private. Next, the Functional Test Case Specification highlights the test cases based on the K011 function, as presented in Table 1.

The test plan procedure gives some opportunity for the system developer to enhance the system in future. Suggestions for improvement are as follows.

1. Increased Platform Availability: Expanding Indomitable app support to platforms such as iOS and Windows is an important step to reach more users. The development of versions of the application compatible with other operating systems will expand the user base of the application.
2. Time Management Improvement: Overcome time constraint issues by using efficient project management methods. The use of planning and scheduling tools can help in reducing time pressure and improving the quality of the final result of the project.
3. Alignment with Technology Updates: Alignment of applications with the latest technology updates is essential in application development. By researching and integrating the latest technologies, especially those related to data storage, applications can remain competitive and relevant.
4. Wider Data Storage Options: Provide users with more diverse data storage options, such as different cloud storage or additional subscription offerings. This method can help overcome storage constraints on the free version of Google Firebase.

Table 1: Specifications for testing confidential messages

No	Procedure	Decision
1	The user presses the add button	The system displays an interface setting
2	The user fills in the name, password, and encryption	The system displays a conversation-type interface encrypted
3	The user selects the " *Local Area Network* " option	The system takes the user to the interface to set up a confidential conversation
4	The user provides the destination address of the second party	The system takes the user to a confidential conversation interface
5	The user types a few words and hits the send icon	The system records and displays the message, and sends it to the second party
6	The user selects the "*Self-test*" option.	The system takes the user to a confidential conversation interface.
7	The user types a few words and hits the send icon	The system successfully records the message and displays the message
8	The user selects the " *External Output test*" option	The system displays a notification to activate the SMS feature and to fill in the phone number of the second party.
9	The user selects the " *Yes* " option and fills in the phone number	The system takes the user to a confidential conversation interface
10	The user types a few words and hits the send icon	The system successfully records the message and displays the message

Usability testing evaluates a product's effectiveness and user-friendliness by observing real users in action. It identifies issues, insights, and preferences, helping developers refine the design for a seamless user experience and improved performance (Kuhnel et al., 2018).

The results of the user questionnaire are a valuable reflection on the development and improvement of the system. This questionnaire provides a platform for users to share their views, experiences, and opinions related to the use of this application. By evaluating the feedback received, the project can understand the needs and expectations of users, work as improvement measures, and ensure that the application continues to meet their satisfaction and usability.

In a comprehensive usability test involving 57 respondents, valuable insights were gathered to assess the user experience and effectiveness of the system. The diverse group of participants, representing various demographics of students, provided a broad perspective on how the design performs in real-world scenarios. Through this large sample size, the usability test was able to identify common patterns, usability issues, and areas where the system excelled or fell short. The feedback from the respondents highlighted both strengths and weaknesses, offering actionable data that will guide the refinement process to improve overall user satisfaction and functionality.

The result of the usability test is presented in Table 2. The usability test conducted with 53 respondents yielded highly positive results, with the average scores ranging between 4.33 and 4.65 on a 5-point scale. These scores indicate a strong overall user satisfaction with the system, suggesting that the application meets user needs effectively while maintaining a high level of usability. The consistently high ratings across various aspects of the system reflect its intuitive design, ease of use, and functionality. The results underscore the system's ability to deliver a user-friendly experience, with only minor areas for improvement identified, ensuring that it aligns well with user expectations.

Table 2: Usability test results

No	Item	Mean
1	I am satisfied with how easy it is to use the application	4.33
2	The application is easy to manage from one activity to another	4.54
3	I can complete the given task quickly and easily using this application	4.46
4	I feel comfortable using the application	4.50
5	The application is easy to learn.	4.54
6	I believe I am faster and more productive by using the application.	4.45
7	This application gives a clear error message	4.46
8	Whenever I make a mistake in the application, I can solve it easily.	4.54
9	The information provided in the application is clear.	4.54
10	The information I needed was easy to find.	4.65
11	The information is effective in helping me complete the task.	4.38
12	The order of information in the application screen is clear.	4.48
13	The interface in the application is attractive	4.63
14	I like to use between application page	4.59
15	The application has all the functions and capabilities I expect.	4.39
16	Overall, I am satisfied with this application.	4.64

DISCUSSION AND CONCLUSIONS

Mild bad habits, such as excessive use of smartphones, have a serious impact on students' health and mental stability. By using the persuasive app 'Indomitable', users can see progress and get support to change their bad habits. Literature highlights show that persuasive applications have proven to be effective in helping overcome bad habits. The study also identified persuasive features used in mobile applications to help users control their mild bad habits.

Indomitable Persuasive application has a core feature of goal-setting function, which allows users to identify, plan, and achieve personal development targets, particularly related to overcoming bad habits. This function provides a structured approach to habit formation, enabling users to define specific objectives, track progress, and adjust their plans based on individual needs. By allowing users to monitor their progress, record savings, and document important events, this feature supports continuous improvement and accountability in habit management.

In addition to goal setting, the reward function plays a pivotal role in motivating users by providing tangible and intangible incentives. The system awards points for task completion, milestone achievements, and consistent effort, fostering sustained positive behaviour. Personalized feedback and encouraging messages further enhance motivation, making the journey towards habit change more rewarding and engaging (Narciss et al., 2014). By recognizing effort and milestones, the reward function helps maintain user interest and commitment to their goals.

The achievement display celebrates users' progress by awarding success badges for overcoming bad habits within specified timeframes. This recognition system not only provides a sense of accomplishment but also encourages continued efforts towards healthier habits. By tracking progress and marking significant milestones, the achievement function helps users visualize their journey and stay motivated. The satisfaction and recognition from achieving these milestones reinforce positive behaviour changes, contributing to long-term personal development and well-being (Cho et al., 2022).

Indomitable has demonstrated the application of persuasive principles to empower students to overcome mild bad habits. Its multifaceted features, including goal setting, progress tracking, personalized feedback, reward mechanisms, and achievement displays, collectively foster a supportive environment for users aiming to overcome bad habits and achieve personal development goals. The use of motivational notifications and reminders further enhances user engagement by providing timely encouragement and guidance, ensuring continuous progress and commitment.

While Indomitable demonstrates significant potential, several weaknesses in the study should be addressed. Firstly, the reliance on self-reported data for tracking progress and habit formation can introduce bias and inaccuracies. Users may overestimate their compliance or underestimate their lapses, leading to skewed data that affects the app's feedback and effectiveness. To mitigate this, future studies could incorporate more objective measures, such as integrating wearable technology to provide real-time data on user behaviour (Nasir et al., 2021).

Additionally, the study may not adequately account for the diversity of user needs and preferences (Grant & Grace, 2019). The effectiveness of motivational notifications, reward systems, and personalized feedback can vary significantly across different user demographics. Factors such as age, cultural background, personality traits, and specific habit challenges can influence how users interact with and benefit from the app. A more segmented analysis could provide deeper insights into how to tailor the app's features to cater to diverse user groups, ensuring broader applicability and effectiveness. Addressing these

weaknesses through more robust methodologies and comprehensive evaluations will be crucial for the ongoing development and refinement of the Indomitable Persuasive app.

Looking ahead, the potential for integrating advanced technologies and conducting comprehensive research offers exciting opportunities to enhance the study. Future research may study the long-term effectiveness of the reward and achievement systems within the app. Longitudinal studies could examine how sustained use of point-based rewards, milestone recognitions, and success badges influences user motivation and behaviour change over time. Understanding the psychological impact of these incentives on different demographics, such as age, gender, and personality traits, could lead to more inclusive and effective design strategies. Furthermore, exploring the potential for integrating social features, such as peer support and community challenges, may reveal additional ways to enhance user engagement and accountability.

Research could also investigate the potential benefits and challenges of incorporating biofeedback and wearable technology into the Indomitable. By integrating data from fitness trackers, heart rate monitors, and other wearable devices, the app could provide more comprehensive insights into users' physical and emotional states. This integration could enable more holistic support for habit formation, addressing both mental and physical health aspects. However, it would be important to examine the ethical implications, data privacy concerns, and user acceptance of such technologies. Overall, these research directions could significantly advance the app's capabilities and effectiveness in promoting long-term positive behaviour change.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Foo Han Lin: Conceptualization, Original draft preparation, **Hairulliza Mohamad Judi**: Writing-Original draft preparation, Reviewing, Editing.

DECLARATION OF GENERATIVE AI

During the preparation of this work, the authors used ChatGPT to enhance the clarity of the writing. After using ChatGPT, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

DATA AVAILABILITY STATEMENT

Data is available within the article or its supplementary materials.

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