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Design Thinking: A Practical Method for Designing Stress Management Application Interfaces Using a Biomicroscopy Approach

Ernianti Hasibuan[1*], Karin Rehulina[2], Evans Winanda Wirga[3]
Faculty of Computer Science and Information Technology[1], Information Systems, Gunadarma University, Indonesia
Faculty of Industrial Technology, Informatics, Gunadarma University, Indonesia

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Corresponding author*:
ernianti@staff.gunadarma.ac.id

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Abstract: Academic stress is a significant challenge frequently faced by final-year students and can negatively impact their mental health and academic performance. This study aims to design a user interface for a stress management application using Design Thinking methods and a biomimicry approach, an approach that mimics natural patterns and principles to create more intuitive and effective design solutions. The research process involved in-depth interviews and usability testing with final-year students as the primary respondents. The results showed that the application of biomimicry principles in interface design can create an atmosphere resembling a natural environment that supports relaxation and provides a calming effect for users. Testing using the System Usability Scale (SUS) yielded an average score of 89.38, which falls into the Acceptable and Excellent categories based on the Adjective Rating scale. These findings indicate a very good level of acceptance and a satisfactory user experience. The implementation of the Design Thinking method, starting from the empathize stage to the prototype and test, combined with the biomimicry approach, successfully produced an interface design that is not only aesthetically pleasing and functional but also effective in helping students cope with academic stress.

Keywords: Biomimicry, User Interface Design, User Experience, Stress Management, Academic Stress, Design Thinking.

INTRODUCTION

Academic stress is a common condition experienced by final-year students, especially in stressful academic environments. This condition can significantly impact students' mental health and academic performance (Barbayannis, 2022; Misra & McKean, 2000). Symptoms of academic stress include physical and emotional complaints, such as headaches, anxiety, and sleep disturbances. Contributing factors include high academic demands, expectations from lecturers and parents, and pressure to complete assignments on time (Tasalim, 2021; Gadzella, 1991).

Efforts to help students cope with stress have also attracted widespread attention through various programs and activities. In line with this, technological advances have led to the emergence of various stress management apps as one such effort. While these apps offer features such as meditation, mood monitoring, and breathing exercises, many of them are still less than optimal in terms of personalization and relevance to their users (Lokmic-Tomkins, 2023; Bakker et al., 2016). A more humanistic user interface (UI) and user experience (UX) design approach, oriented toward natural human needs, is needed.

One promising approach is biomimicry, a design method inspired by nature to create solutions to human problems. By imitating patterns and principles found in nature, UI/UX designs can be more intuitive, adaptive, and effective in supporting users' mental health (Benyus, 2002; Vincent et al., 2006).

This research aims to explore the application of biomimicry principles in the UI/UX design of a stress management application, evaluate user interaction and response to the resulting design, and develop a functional and visually appealing prototype. Through this approach, it is hoped that a holistic and humane solution will be created to support the mental well-being of students experiencing academic stress.

RESEARCH METHOD

Types of research

This research is development research focused on the application of biomimicry principles in user interface (UI) and user experience (UX) design for a stress management application. This development research involved several stages, including concept exploration, prototype design, and iterative evaluation to ensure that the resulting design was not only innovative but also met user needs. The method used was Design Thinking, which involves a deep understanding of user problems, brainstorming creative solutions, and testing ideas in the form of prototypes that are accessible to users. Design Thinking was chosen because this method prioritizes users at the center of the design process, allowing researchers to directly respond to the needs and challenges faced by final-year students who are the target users of the application. The principles of biomimicry, which adopt patterns and strategies found in nature to be applied in design, were used to create an intuitive and efficient interface in reducing academic stress. This approach also allows for the development of a more holistic and sustainable solution, capable of supporting the overall mental health of users.

Population and Sample

The population in this study were final-year university students, who are vulnerable to academic stress due to the increasing burden of final assignments. This study focused on a population consisting of students in their final semester of study, with the primary target being women. The sample selection based on this criterion was based on previous research showing that women tend to be more vulnerable to stress than men, especially in academic contexts. Furthermore, women often face additional pressures, such as greater social and emotional demands, making them an important group to focus on in studies on stress management. The sample in this study was selected purposively, involving willing students who met certain criteria, such as age, perceived stress level, and experience using stress management applications. This purposive sampling method allowed researchers to obtain more relevant and representative data from the target population, thus making the research results more effective in achieving the stated objectives.

Data Collection Techniques

The data in this study were collected through several methods designed to gain in-depth insights into user needs and experiences. The primary method used was in-depth interviews with a selected sample to identify the key issues faced by final-year students related to academic stress. These interviews were conducted in a structured manner using a pre-developed interview guide to ensure that all relevant aspects were comprehensively explored. In addition to the interviews, data collection was also conducted through usability testing, where users were asked to use a prototype of the application and provide feedback on their experience. This usability testing was conducted in several iterations to ensure that all feedback could be effectively implemented in the application's development. Direct observation during usability testing was also used to record user behavior while interacting with the interface, providing additional information about aspects that may not have been revealed in the interviews. This combination of methods enabled the researchers to obtain rich and diverse data, which can be used to refine the application's design.

Data Analysis Techniques

The collected data was analyzed using qualitative and quantitative analysis techniques. Qualitative analysis was used to explore the findings from in-depth interviews and observations during usability testing, where the data was processed through a coding

process to identify key themes and patterns that emerged from respondents. These themes were then used to develop design concepts that better align with user needs. Meanwhile, quantitative data from usability testing, such as task completion times and user satisfaction scores, were analyzed using descriptive statistics to measure the effectiveness and efficiency of the designed interface. This analysis involved calculating the mean, median, and standard deviation to identify areas requiring further improvement. Quantitative data was also analyzed by comparing results before and after implementing changes based on user feedback, to assess the extent to which the improvements have improved the overall user experience. The results of these qualitative and quantitative analyses were then combined to provide a comprehensive picture of the application's success in meeting its stated objectives.

Research Procedures

Procedures This research procedure consists of several stages carried out sequentially and systematically. The first stage is a literature study and identification of user needs, where researchers conducted a literature review related to biomimicry, academic stress, and UI/UX design to obtain a strong theoretical foundation. After that, in-depth interviews were conducted to gain direct insight from target users regarding their experiences and challenges in managing stress. Based on the interview results, researchers then brainstormed to generate creative ideas that could be applied in a prototype design. The next stage was the development of an initial prototype that implemented the identified biomimicry principles. This prototype was then tested through usability testing involving a selected sample, where users were asked to complete a series of tasks within the application. Feedback from the usability testing was used to refine and refine the prototype design. This procedure was repeated until satisfactory results were achieved, with each iteration providing significant improvements to the user experience. The study concluded with data analysis and the preparation of a research report, which presented key findings and recommendations for further development.

DESIGN THINKING METHOD

Empathize

At the level *Empathize*The main focus was on deeply understanding the needs, desires, and challenges faced by users. Face-to-face interviews with four different users were

conducted to gather relevant data from the student group. The results of the interviews were followed up with the development of a*user persona*Ariana is a 22-year-old student living in Depok who is experiencing high levels of stress due to her academic workload. Ariana represents users who are looking for solutions to manage stress with a more natural and effective approach *human centric*. *User persona*This not only describes the demographics of the users, but also reflects the goals, motivations, and challenges that Ariana faces in her daily life.*user persona*This helps research to focus on how the application design to be developed can meet the actual needs and preferences of users.

The results of the interviews conducted showed several*pain points*Ariana experienced this. She felt that many stress management apps on the market had overly complicated and confusing interfaces, so instead of reducing stress, they actually increased her mental burden. Ariana also felt that these apps lacked personalization tailored to her needs and preferences. Furthermore, the frequent ads in these apps were very intrusive and actually exacerbated her stress. The visual experience presented by some apps was also considered less than calming, thus failing to achieve the goal of creating calm and relaxation. Identifying these pain points is crucial because it helps ensure that the app design truly addresses the issues faced by users like Ariana.

Design needs to be attempted to remain focused on user needs, for that reason*user story*developed based on the results of interviews and analysis of Ariana.*User story*This illustrates Ariana's hopes and needs for the application she is designing. Among them is that busy female students generally want an easy-to-use application that allows them to manage stress without increasing their mental burden. The application needed is one with an attractive visual appearance.

Relax and be free from ad distractions, so you can focus more on the relaxation process. *User story*This serves as an important guide in developing application features and interfaces, ensuring that every design decision taken is always centered on user needs.

Visualization*user journey*, a detailed description of the user's journey through the app. This journey begins with the initial recognition of a need for a stress-relief solution, ultimately leading to the discovery of an app that offers a natural and intuitive approach. After considering various options, the user decides to try the app, which is specifically designed to address the issues they identified. A simple onboarding process and user-friendly guide introduce the user to the app's key features, designed to help reduce stress levels. The app includes features to aid stress management, such as the 4-7-8 breathing

exercise and listening to nature sounds. The user stated during the interview that she felt the benefits of the app and felt calmer and more prepared to face her academic challenges. *User journey*This provides important insights into how users interact with the application and helps researchers to identify areas that can be improved to enhance the overall user experience.

Define

After understanding user needs and problems through the stages*Empathize*, the next step is*Define*At this stage, the core problems that need to be solved in the application design are formulated. Based on data collected from interviews and analysis*pain points*, can be formulated*problem statement*which became the main focus in the application development. The identified problem was how to design an intuitive and easy-to-use stress management application, inspired by natural elements, to create a calming user experience and support the user's mental health.*Problem statement*This reflects the user needs described in*User Persona*and other similar users. These users are looking for a stress management solution that is not only functional but also provides a pleasant and distraction-free experience.*Problem statement*This is the basis for developing the concept and features of the application that will be designed in the next stage.

Ideation

Level *Ideation*is the phase in which various ideas and concepts to solve previously defined problems can be developed. This process involves creative and innovative exploration aimed at finding the best solution that can meet user needs. One important step in this stage is conducting*competitive audit*, an analysis of similar apps already on the market. Several popular stress management apps were reviewed to understand their strengths and weaknesses. This analysis revealed that many existing apps suffer from overly complex interfaces, intrusive ads, and a lack of personalization. These findings suggest a significant opportunity to create simpler apps, focus more on natural elements, and offer a more personalized user experience.

The brainstorming session is the next stage carried out in design thinking using techniques. *How Might We* (HMW). This technique helps formulate questions that encourage creative and innovative ideas. Some questions asked include how to create a simple and intuitive user interface, how to use natural elements to create a more relaxing

experience, and how to reduce in-app advertising distractions. These questions help identify broader, innovative solutions that can then be evaluated and further developed.

The application's feature development phase utilizes a biomimicry approach, which mimics the forms, functions, and patterns of nature to create efficient and harmonious solutions. Some of the features developed include: Calm Breath 4-7-8, inspired by the breathing mechanism of fish; Nature Sounds, which uses sounds from nature to create a calming atmosphere; Daily Journal, inspired by tree growth rings; and Self-Transformation, which adopts the concept of metamorphosis in nature. This biomimicry approach not only offers effective solutions but also enriches the user experience with touches inspired by the beauty and intelligence of nature.

Prototype Making

The prototyping stage is a critical phase in application development, where previously formulated ideas begin to be realized into concrete forms. At this stage, translating user needs identified through various previous research methods is crucial and plays a role in the creation of the application.*user persona*, *user story*, And *user journey map*, into a functional and testable design. Prototyping aims to provide an initial overview of the workflow and user interaction with the application, as well as to identify and fix potential issues before entering the final development phase.

The prototypes were designed with biomimicry principles in mind, serving not only as an aesthetic guide but also as a source of functional inspiration. For example, the "Calm Breath" feature is inspired by fish's respiratory adaptations to stress, a concept developed based on scientific research on the respiratory control mechanisms in fish during stressful conditions or intense physical activity. By adopting the 4-7-8 breathing technique, the app offers a solution that helps users manage stress more effectively, combining the benefits of nature with the needs of modern humans.

Making process *goal statement*at this stage is also based on*problem statement*which has been formulated previously, where the main problem faced by users, especially students, is the high level of stress they experience.*Goal statement*This set the primary goal of developing an app that was not only intuitive and easy to use, but also free from distractions like ads and complicated account creation. Support for Indonesian and a clean, organized interface were key aspects of the app's design, considering the primary user preferences identified in the user personas.

The navigation structure of the "Peace" app is designed with a hierarchical approach, allowing users to navigate the app easily and efficiently. This begins with the opening page, which is designed to provide a warm welcome to users and direct them to initial steps such as login or registration. From the homepage, users can access four main features designed to support their stress management: Calm Breathing, Nature Sounds, Daily Journal, and Self-Transformation. Each of these features is not only designed to meet the user's functional needs but also integrates biomimicry elements that provide a more immersive and calming experience. For example, the Nature Sounds feature offers a variety of sounds from the outdoors, aiming to create a relaxing atmosphere similar to the experience of being in a natural environment.

Making*storyboard*In this stage it plays an important role as a visual guide to show how the concept of biomimicry is applied in the application.*Storyboard*This illustrates the steps of user interaction with the application, from opening the application, selecting a feature, to using the feature.*storyboard*, user interactions can be visualized along the user journey within the application and ensure that every design element supports the ultimate goal of the application, which is to provide an effective and intuitive stress management solution.

Brand Board

*Brand Board*This app was designed with a biomimicry approach in mind, integrating natural elements into the visual and functional aspects of the stress management app. The chosen color palette is inspired by natural elements, with the goal of creating a calming atmosphere and supporting a comfortable user experience. These colors were chosen not only for aesthetics but also to reinforce the app's goal of helping users manage stress.

The app's logo design reflects the balance between technology and nature, which is the essence of the biomimicry approach. The logo was designed to clearly and effectively communicate the app's identity, with the hope that users will feel connected to the philosophy behind the app.

The typography used in this application was chosen because the characters are simple and easy to read, in accordance with the design principles that*human-centric*The fonts used support the overall clean and harmonious aesthetic, allowing users to feel comfortable interacting with the app. The brand's inspiration is drawn from natural elements that evoke a sense of calm and comfort, aligning with the app's mission to help users manage stress.

All elements, from the color palette to the typography, are designed to create a strong visual identity and support an optimal user experience.

Style Guide

The app's Style Guide is designed to ensure visual and functional consistency in line with the biomimicry approach, creating a harmonious and intuitive user experience. Typography guidelines govern the use of various font sizes and types, selected to maintain readability and consistency across platforms. The fonts used are not only aesthetically pleasing but also functional, ensuring that in-app text is always easy to read and blends seamlessly with the overall design.

The color palette guide explains the use of colors in various user interface (UI) elements, maintaining visual cohesion that supports the app's natural theme. Each color was chosen to reflect elements of nature and create a calming atmosphere, in keeping with the app's mission of stress management.

The app's iconography is designed to be intuitive and recognizable, supporting efficient navigation and a pleasant user experience. Each icon is designed with the goal of allowing users to easily identify its function without confusion, increasing the effectiveness of interactions with the app. UI components such as buttons, forms, and menus are designed with a focus on optimal user experience. The design of each component takes into account ease of navigation and use, ensuring that users can interact with the app smoothly and intuitively.

Proper use of whitespace is maintained to create a clean, uncluttered design, which is essential for providing visual comfort and preventing eye fatigue. Strategic placement of whitespace also helps highlight important information and effectively guide visual flow.

The vectors used in the app depict natural elements adapted from the concept of biomimicry, providing an aesthetic that aligns with the app's theme. These vector elements not only enrich the visual appearance but also reinforce the natural message the app aims to convey. This Style Guide ensures that every aspect of the design works synergistically to create a maximal user experience.

High-Fidelity

After prototype development*low-fidelity*, the next stage in the application design process***"Peace"***is the creation of a prototype*high-fidelity*, which offers a more detailed and

realistic representation of the application interface. Prototype*high-fidelity*This design includes richer visual elements, such as color, typography, iconography, and other details that reflect the app's final look. This design was developed specifically for the app's four main features: 4-7-8 Calm Breathing, Nature Sounds, Daily Journaling, and Self-Transformation.

Calm Breathing 4-7-8 is a feature designed to help users practice breathing techniques to reduce stress.*high-fidelity*This feature features a clean interface with a calming color palette, combining light green and soft pink to create a relaxing atmosphere. Furthermore, visual animations synchronized with the 4-7-8 breathing pattern guide users through effective breathing exercises. Users can also choose nature sounds as background music, adding depth to their relaxation experience.

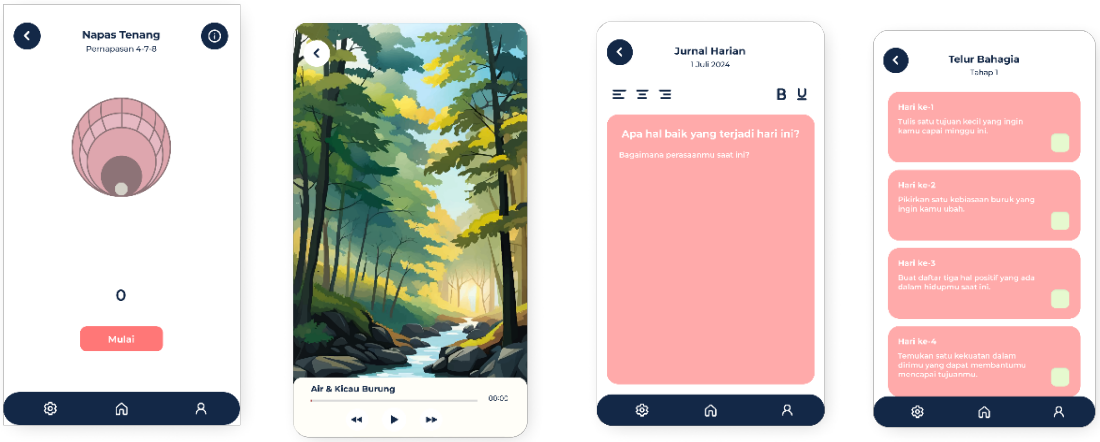

Figure 1. Calm Breath Feature, Nature Sound Feature, Daily Journal Feature, Self Transformation Feature (Left to Right)

Nature Sounds Feature offers a selection of natural sounds, such as flowing water, chirping birds, and gentle breezes, designed to create a calming atmosphere. The feature's high-fidelity design displays these sounds as interactive cards with corresponding illustrations, providing a strong visual association with the sounds being played. The intuitive interface allows users to easily play, pause, or change sounds as desired.

Daily Journal offers users the ability to record and track their emotional state daily. This high-fidelity design incorporates the concept of tree growth rings, where each journal entry is displayed as a circle that evolves over time. The design uses soft colors to create a reflective and calming atmosphere and provides emotion icons to help users express their

feelings. Users can also track their emotional development through simple yet informative visualizations.

Self Transformation is a feature that takes users through four stages of self-development, illustrated as an egg, larva, chrysalis, and butterfly. The high-fidelity design for this feature uses a soft pink color, creating a harmonious feel with the overall aesthetic of the app. Each stage is displayed as a card with an illustration depicting that phase. Users receive a motivational message each time they complete a stage, and transitions between stages are accompanied by smooth animations that reinforce the sense of ongoing transformation.

RESULT AND DISCUSSION

In the testing stage carried out in this research, *Usability Testing*is a key component in evaluating the extent to which this stress management application prototype can meet user needs. This testing involved four respondents who had previously participated in in-depth interviews. Using the same respondents aimed to obtain more consistent and relevant results, given that they already had a prior understanding of the application's purpose and function. The testing process focused on completing several specific tasks within the application, designed to reflect everyday use. Direct observations were conducted to note any difficulties users might encounter and to measure the time required to complete each task. Below are some of the testing results.

Table 1. Feature Test Results with Two Scenarios

Skenario 2 - Menggunakan Fitur "Napas 4-7-8"					
Tugas	Tujuan	Responden 1	Responden 2	Responden 3	Responden 4
Pengguna diminta untuk memulai dan mengikuti panduan teknik pernapasan "Napas 4-7-8."	Menilai kefungsio-nalan dan efektivitas fitur ini dalam membantu pengguna mengelola stres.	Panduan napas mudah diikuti dan memberik-an rasa relaksasi. Elemen visual dan animasi membantu, ikon informasi bermanfaat, navigasi mudah, dan teks jelas. Tidak ada saran tambahan.	Panduan napas mudah diikuti dan mene-nangkan. Visual dan animasi mendu-kung, ikon informasi jelas, navigasi mudah digunakan, dan teks mudah dipahami. Tidak ada masukan tambahan.	Panduan napas mudah diikuti, namun waktu 4 detik terasa terlalu lama, dan tidak mem-berikan efek tenang. Elemen visual dan animasi baik, tetapi informasi sebaiknya disajikan setelah memilih menu. Navigasi dan teks sudah jelas.	Panduan napas mudah diikuti, memberik-an rasa tenang dan senang. Visual, animasi, dan ikon informasi membantu. Navigasi mudah dan teks jelas. Tidak ada saran tambahan.

Skenario 3 - Mengakses dan Menggunakan Fitur "Suara Alam"					
Tugas	Tujuan	Responden 1	Responden 2	Responden 3	Responden 4
Pengguna diminta untuk membuka fitur "Suara Alam," memilih suara yang mereka suka.	Menilai seberapa intuitif fitur ini untuk digunakan dan apakah pengguna merasa lebih rileks setelah mengguna-kannya.	Menemukan suara favorit mudah, tampilan menarik, navigasi mudah, dan teks jelas. Tidak ada saran tambahan.	Suara favorit mudah ditemukan, visual menarik, navigasi intuitif, dan teks mudah dipahami. Tidak ada masukan lebih lanjut.	Fitur me-mudahkan dalam me-nemukan suara alam, elemen visual menarik, navigasi mudah, dan teks jelas. Tidak ada saran tambahan.	Mudah me-nemukan suara favorit, tampilan menarik, navigasi mudah, dan teks jelas. Tidak ada masukan tambahan.

Based on the testing results of all scenarios, the author concluded positive and negative feedback.

Positive feedback:

a. The application is easy to understand and use.
b. Intuitive registration process with attractive visual layout.
c. The Breath Guide feature provides a real relaxation effect, supported by visual elements, effective animations, and information icons that clarify breathing techniques.
d. The Nature Sounds feature makes it easy for users to find their favorite sounds with intuitive navigation and an engaging visual display.
e. The Daily Journal feature inspires users to write journals with easy-to-understand text and supporting visual elements.
f. The Self-Transformation feature provides motivation to get to know yourself more deeply and move on to the next stage, with engaging visual elements and easy-to-use navigation.
g. The Exit App option is easy to access, with a good visual display and a smooth process.

Negative feedback:

a. Icon colors should be aligned with menu colors for a harmonious appearance.
b. The 4 second duration on the Breath Guide Feature is considered too long.
c. Information on the Breath Guide Feature should be presented after the menu is selected for better usage flow.
d. The white text color on the Self Transformation Feature looks faint and needs to be fixed.
e. The term "how to use" in the Daily Journal Feature should be replaced with a more appropriate phrase such as "steps".

A comprehensive evaluation of this application was conducted through five main aspects. *usability*, that is *Learnability, Efficiency, Memorability, Error*, And *Satisfaction*. *Learnability*refers to the user's ability to learn how to use the application quickly. Test results show that this application has a high level of*learnability*high, with most basic tasks

being able to be completed in a short time. *Efficiency* is measured by the speed and efficiency with which users achieve their goals using the application. The time required to complete key tasks indicates that the application is designed with user efficiency in mind. *Memorability* focuses on how easily users can remember how to use an app after not using it for some time. The app scored positively in terms of*memorability*, which means that users do not experience significant difficulty in remembering the application's functions. *Error* User satisfaction refers to the number of errors that occur and the user's ability to resolve them. Users report that they rarely encounter errors while using the app, and when errors do occur, they can easily fix them. User satisfaction is measured by how satisfied users are with the app's design and performance. While the app received positive feedback overall, there are still some aspects of the visuals and information flow that need improvement to improve user satisfaction.

*System Usability Scale*The Usability Test (SUS) is used as a standard measurement tool to assess application usability. The SUS calculation based on the answers from four respondents showed that the application achieved an average score of 89.38. This score indicates that the application is not only well-received by users but also of excellent quality. The Acceptable category for this application indicates that overall, the application has met the expected usability standards. *Grade* from this application get*Grade*B, which is approaching*grade* A, and in scale *Adjectives Rating*, this score is classified as*Excellent*This shows that this application provides a very satisfying user experience and can compete with other applications in the same category.

CONCLUSION

The application of biomimicry principles in user interface and user experience (UI/UX) design has proven effective in developing a stress management app that is not only functional but also comfortable to use. The biomimicry approach, inspired by natural processes and structures, has improved the quality of user interaction with the app, particularly in terms of aesthetics, navigation, and responsiveness.

Method*Design Thinking*The methods used also play a crucial role in achieving satisfactory results. Application design takes user needs into account; this method allows application designers to iteratively design, develop, and test prototypes until optimal results are achieved. This result is reflected in the System Usability Scale (SUS) score, which averaged 89.38, placing this application in the "*Acceptable*" with *Grade B*, and is classified

as "*Excellent*" on a scale*Adjectives Rating*. This score indicates that the application not only meets user expectations but also exceeds standards *usability* in general, offers a very positive and satisfying experience.

While the app has performed very well, there are several areas for improvement to further enhance the quality and user experience. First, visual alignment could be improved to create a more consistent and aesthetically pleasing interface. Second, adjusting the duration of therapeutic features or self-control exercises should be considered, as some users found the current duration too long and suggested adjusting it for greater comfort. The presentation of important information after selecting a menu item needs attention to ensure users understand the steps before starting. Other improvements are needed, particularly in terms of text readability. Finally, terminology should be adjusted to make it easier to understand and more user-friendly, particularly in the instructions section, to make them clearer and more understandable.

The evaluation results of this stress management application are expected to improve the application to a better level, increase usability and user satisfaction, and provide a greater positive impact in helping users, especially final year students, manage academic stress more effectively. The use of the Design Thinking method, although simple and not too resource-intensive, can be used to approach problems in application design, especially interface design, in order to focus on the needs of application users. The role of Biomimicry in interface design adds a positive experience or UX factor for users in using the application more comfortably.

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