An Extreme Programming Approach to Streamlining Thesis Writing

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***Abstract*—Thesis writing is a significant challenge for many university students, often leading to substantial stress, confusion, and distress. Despite numerous studies to reduce academic stress, a specific solution for thesis writing has yet to be identified. This study introduces Penamasy, a thesis writing management system designed to address this issue. Penamasy was developed using the Extreme Programming (XP) methodology, effectively addressing the rapidly changing demands of university students in an academic environment. The result was a user-friendly app delivered promptly and met the needs of students. The study consisted of three research cycles, including user requirements, release planning, and acceptance tests, followed by an extended user acceptance test with students and promoters from three universities. Results indicated a positive response, with 79.6% of respondents expecting a more systematic and fuller online thesis writing experience, enabling them to complete their theses promptly. In conclusion, Penamasy provides a solution for university students facing the stress and difficulties of thesis writing. By streamlining the process and offering a systematic approach, students can focus on their research with confidence in the control of their writing process. Nevertheless, this study can be used as a guide in resolving students' academic stress and many other pragmatic problems that occur, especially in an educational environment. Future studies should involve users choosing UI component libraries, performance evaluation, and possible workflows.**

***Keywords*—Extreme programming; academic stress; thesis writing.**

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I. INTRODUCTION

For many years, it was considered that the student was the least experienced with stress [1]. However, stress affects everyone, regardless of their developmental level [2]–[6]. Many Western countries have extensively researched student stress and its implications [7], [8]. Academic stress occurs when students are overwhelmed by the knowledge required to grasp the materials and when substantial tasks are due [9].

Master students devote most of their second year of postgraduate study to writing a thesis. This term refers to a formal academic document that a student develops and submits to fulfill the requirements of the master's degree qualifications. Writing a thesis is daunting for most students [10] because it demands them to have multiple complex abilities, such as preparing, conducting research, and logical analysis. Thus, they must struggle with and may face a substantial amount of obstacles [11]–[13] that lead to anxiety [14]–[16], confusion, and distress [17]–[20].

Over the last decade, digitalization has transformed the global educational structure [21]–[23], with practitioners, researchers, and policymakers focusing on educational advancement. Through education collaboration, digital technologies are growing beyond new and less traditional methods of teaching and learning [24]–[27]. These changes demonstrate that technology is crucial to education 4.0 [28]. Technological innovations enable educators to comprehend and employ technology in educational activities to create a progressive educational experience [29], [30].

Many previous studies [31]–[33] have been conducted to reduce academic stress. This study utilized counseling and mediating approaches to reduce academic stress. However, these studies did not provide a specific solution for reducing academic stress during thesis writing. This study aimed to develop a full-online system to help university students decrease academic stress during thesis writing, especially caused by environmental obstacles (distance, traffic, and weather). This study intended to design and develop a Penamasy, a thesis writing journal system. This study also determines whether extreme programming methodology suits rapidly changing users' demands, especially in an academic environment. This study contributed to the decrease in students' academic stress at Indonesian Islamic State University. Besides that, this study also has practical

implications to help developers gain an overview when developing software for rapidly changing demand, especially in an academic environment. Last but not least, this study has limitations: the final evaluation was conducted two months after delivery and focused on students' perspectives. Nevertheless, this study can be used as a guide in resolving students' academic stress and many other pragmatic problems that occur, especially in an academic environment.

This study is structured into four main sections. The second section is the methodology section, which describes this study's system architecture, design, development, and evaluation. The third section is the results and discussion section, which presents the findings, categorization, and analysis. Finally, the conclusion section describes the conclusion, implications, and limitations and offers critical recommendations for future research.

II. Materials and Methods

A. System Architecture

The system architecture implemented in this study is illustrated in Figure 1. The Penamasy web application's final version is deployed on Firebase. Whenever the web app is opened, it prompts a username and password; the username is connected to a particular role (student or promotor). This study uses Firestore as a database, Firebase hosting as a hosting platform, and Appscrips as a serverless function to interact with Google's service (Automated Gmail). The promotor dashboard displays a list of its students and their details. It can advise the submitted thesis paper draft, add a custom thesis writing-related guidance link, and approve the draft so students can go to the next section. The students' dashboard displays its thesis writing journal history, submit draft function, and gives comments on the promotors' advice. Every time a student or a promoter adds a journal entry, the system will email the related person.

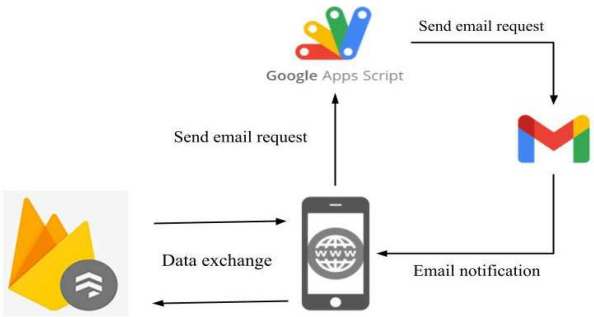

Fig. 1 System Architecture of the Penamasy

B. Design, Development, and Evaluation of the Penamasy

The development process, as shown in Figure 2, used Extreme Programming (XP) methodology [34]–[36] after comparing it with other methodologies [37]. Three research cycles of user requirements, release planning, and Acceptance test were conducted before the app release. Finally, after the app was released, we conducted an extended user acceptance test with students and promotors from three universities.

C. User requirement

We conducted a Focused Group Discussion (FGD) with students and the promotor to discuss their needs [38]. We discussed this in a high-level way so that the users could express their thoughts without prior technical knowledge. The result of this FGD was that the web application (app) must be/ have (1) a Simple User Interface (UI); (2) Mobile Optimized; (3) Record all the thesis writing activities; and (4) Email notifications.

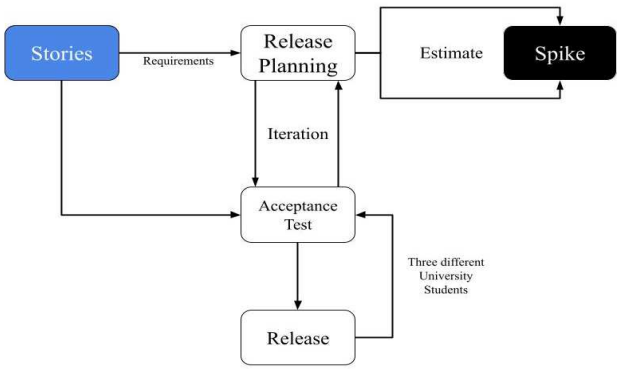

Fig. 2 Design, development, and evaluation process of the Penamasy

D. Release Planning

The User Interface (UI) of the Penamasy web prototype was developed using VueJs, an approachable, performant, and versatile framework for building web user interfaces, by referring to related research [39]–[41]. The app was developed with a persistent state that the user just needs to log in first. With the analytical interaction component, the users can add all the information related to thesis writing. Promotors could also add/ remove students based on a "promotor decision letter" from the faculty. As for the search UI component library, we refer to related UI components used in other studies, such as [42]–[44]. In the search for an email notification solution, we found from other research [45]–[47] that Google AppScript can interact with all of googles' services Application Programming Interface (API)

For the apps' database, by referring to other research [48], [49], Google's Firebase Firestore was used to store the data. Google Cloud Firestore is a Not Only Structured Query Language (NoSQL), document-based cloud-host, auto-scale database solution. Each document is organized into collections and may be linked to other subcollections. It has queries that are significantly faster and more efficient than Firebase Real-Time Database, as well as improved scalability and its speed advantage over Firebase Real-Time Database [50], Which means that the database will scale automatically based on client requests.

E. User Acceptance Test

Thirty-four university students and promotors evaluated the User Interface (UI) and functionality of the Penamasy. The Penamasy prototype was presented to the participants so that they could explore the prototype. Participants were then interviewed with questionnaires to evaluate and canvass comments from the participants concerning the UI and functionality of the prototype. The questions were established to evaluate the general UI design, the landing page, the dashboard panel, the students' journal history, notifications, and the analytical interaction of the prototype. Participants' remarks and recommendations were composed and evaluated to determine whether they call for further refinement of the UI design in the next iteration. Remarks and

recommendations that were simple and feasible within a short period were considered in the next release planning iteration. On the other hand, remarks and recommendations that required extensive effort and a significant revision of the application were regarded as a recommendation for further research.

F. Final Acceptance Test

The final version of Penamasy was built after three iterative project development cycles. One hundred and three university students and promotors from three Universities were chosen randomly to evaluate the efficacy of using the Penamasy in a simulated scenario. Twenty-five different tasks were Categorized into UI, functionality, and academic stress. Finally, based on their assumptions, the participant was asked if there were any differences in the pressure/ stress when using the application during Thesis writing. The participants were made to log in, add journal entries, comment on journal entries, add the Thesis draft, approve the draft, and check email notifications. Successful tasks that participants could accomplish were calculated for the Penamasy app's effectiveness. As for the UI test, participants were requested to evaluate the menu, buttons, colors, and layout and adopted the Likert rating method by referring to a related scaling study [51]–[53]. A central tendencies statistical tool was used to determine if there is a substantial distinction between utilizing and not utilizing the Penamasy on lessening students' anxiety/ stress during Thesis writing.

III. Results and Discussions

A. First Iteration Result

The prototype app was designed and developed by the developer using XP methodology [34], [35], [54] and had basic UI and functionality. When the app is opened, the welcome screen is displayed initially. The user is prompted to enter a username and password once the "Log in" button is tapped/ clicked. After successfully logging in, the dashboard screen opens. The main dashboard consists of the students' list, which has added/ removed students, and the situated information, which contains the details of related students' thesis writing journals. Add a student button, which is located on the bottom right.

After the Penamasy prototype had been initially released, the UI design was assessed by twelve university students and promoters. Most participants stated that the app was generally beneficial, especially for those living out of town. For general accessibility, the participant found the app nicely displayed on a laptop or mobile phone. According to participant feedback, many believe adding the University logo on the landing page was necessary. For the edit button on the edit profile form, the participants suggested that the button be moved to the top left of the screen so that users do not need to scroll down. Promoter participants suggested that there should be a student contracts upload feature in which students can upload their commitment contracts.

B. Second Iteration Result

The second iteration's design analysis considered remarks and recommendations from the first assessment. The following modifications to the design were made: the university logo was added, the edit button was moved to the top left of the screen, and the student's commitment contract upload feature was added. Once the second Penamasy prototype had been developed, the application was reevaluated by another group of twelve university students and promoters. According to the participants' feedback, the general navigation of the application is easy to use. Numerous participants thought the UI design was appealing, vibrant, and visually pleasing. Promotors found the username and password system cumbersome. They have to ask students to email and send the generated password. For the promotor dashboard, participants thought adding or deleting students was necessary. The participant suggested that there must be an upload feature regarding any file related to thesis writing.

C. Third Iteration Result

Remarks and recommendations from the second assessment were considered in the design analysis of the third iteration. The following modifications to the design were made: the username and password system changed to a token system so that the promotor only needs to generate a new token and then send it to a related student; the delete students' function was also added; the file related to thesis writing upload feature was added. Once the third prototype had been developed, the application was reevaluated by another group of twelve university students and promoters. According to the participants' feedback, the general aspect of the prototype was excellent and beneficial in the thesis writing process, especially for the students who lived out of town. Overall, the navigation was deemed intuitive and easy to comprehend. There was a suggestion that an About page should be added, which explained the app briefly. The participant also suggests that there should be a change password feature. Even though the app is simple, many participants suggested that there should be a user manual.

D. Final Evaluation Result

Remarks and recommendations from the third evaluation were considered in the final release's design analysis. The following modifications to the design were made: a simple about page was added, which explain the app detail and philosophy; the change password feature was added so that promotor can change their given password; the user manual was added to the landing page, which explains all possible workflow of the app. In evaluating the effectiveness attribute, 25 questionnaires were given to 103 participants from three universities after using the app for two months. The questionnaires were categorized into UI, functionality, and academic stress. The questionnaire was composed with a Likert scale (1-5) for its rating. The result can be seen in Figure 3.

The decreased stress category was divided into three groups: thesis writing speed, Increased motivation, and Academic stress decrease. The UI was rated 4.32/5.00 by participants, which is surprisingly good; the functionality was rated 4.43/5.00, which is relatively high also, and the decrease in academic stress was rated 4.30/5.00, which is the main of this study to decrease academic stress. The decreased academic stress category was divided into three groups and shown in Figure 4: thesis writing speed, rated 4.38/5.00;

increase motivation, rated 4.28/5.00; and Academic stress, rated 4.25/5.00.

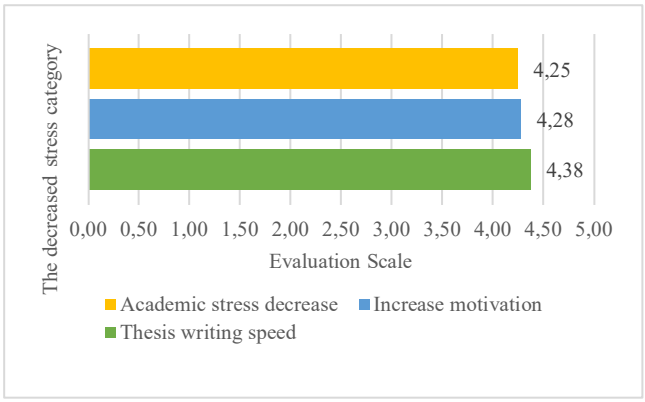

Fig. 3 Final evaluation results

More specifically, the respondents were asked what the app features were most influential and least influential in reducing their academic stress. The result shows that 57.5% of respondents believe that the most noteworthy feature was the 'Appointment feature' and the least noteworthy feature was the 'OJS-like workflow feature' with only 26.5% votes, illustrated in Figure 5. Furthermore, they asked what the respondents expected after using the Penamasy app when writing a thesis. The result shows that 79.6% of respondents expected that thesis writing would be more systematic and could be done fully online so that the students would finish it sooner.

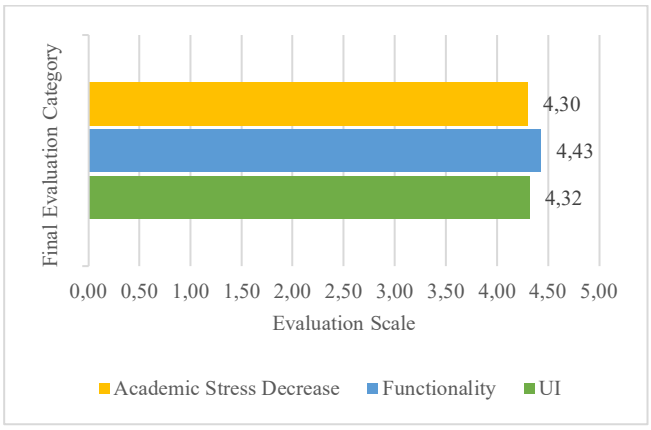

Fig. 4 The decreased stress category results

The evaluation results of the Penamasy app are quite promising, with participants rating the app highly in terms of its user interface, functionality, and ability to reduce academic stress. The iterative design process, incorporating feedback from university students and promoters, made several improvements to the app, including adding a university logo, a student contracts upload feature, and a token system for logging in. The final evaluation, which consisted of a questionnaire given to 103 participants, showed that the app was rated highly in terms of UI and functionality and that its main goal of reducing academic stress was also achieved, with participants rating the decrease in academic stress at 4.30/5.00.

Regarding the most influential and least influential features, the results showed that the appointment feature was deemed the most noteworthy by 57.5% of respondents. In contrast, the least noteworthy feature was the OJSlike workflow feature, with only 26.5% of votes. Additionally, 79.6% of respondents expected the Penamasy app to make thesis writing more systematic and to allow for full online completion, further reinforcing the idea that technology can enhance the quality of education.

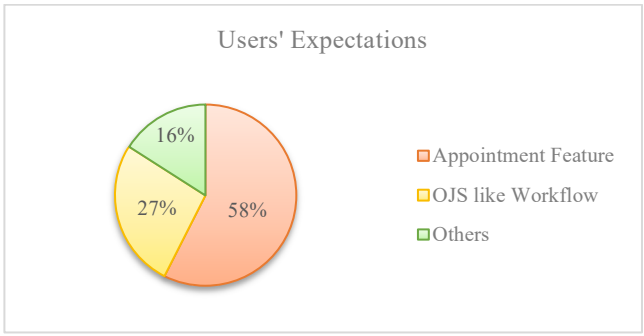

Fig. 5 Users' Expectations

In conclusion, the results indicate that the Penamasy app has the potential to be a valuable tool for students, particularly those who live out of town, to manage their thesis writing process and reduce academic stress. The iterative design process, incorporating user feedback, highlights the importance of user-centered design in developing educational technology. The results of this study also align with previous research [55]–[57], which suggests that technology can play a significant role in enhancing the quality of education.

IV. Conclusion

This study aims to decrease academic stress by developing a thesis writing management system. The result shows that utilizing extreme programming methodology in a rapidly changed request can result in a fast delivery time. Three cycles of release planning were conducted to get the best development result to satisfy users' demands. Finally, The UI was rated 4.32/5.00 by participants, which is surprisingly good; the functionality was rated 4.43/5.00, which is relatively high also, and the decrease in academic stress was rated 4.30/5.00, which is the main reason for this study to decrease academic stress. The decreased academic stress category was divided into three groups: Increased thesis writing speed, which rated 4.38/5.00; increased motivation, which rated 4.28/5.00; and decreased academic stress, which rated 4.25/5.00.

The result shows that 57.5% of respondents believe that the most influential feature in decreasing students' academic stress was the 'Appointment feature' and the least noteworthy feature was the 'OJSlike workflow feature' with only 26.5% votes. Finally, 79.6% of respondents expected that the thesis writing would be more systematic and could be done fully online so that the students would finish the thesis writing sooner. This result could be concluded that the Penamasy thesis writing management system works great in decreasing students' academic stress and contributes to decreasing students' academic stress at Indonesian Islamic State University. Besides that, this study also has practical

implications to help developers gain an overview when developing software for rapidly changing demand, especially in an academic environment.

Finally, this study has limitations: the final evaluation was conducted two months after delivery and focused on students' perspectives. Nevertheless, this study can be used as a guide in resolving students' academic stress and many other pragmatic problems that occur, especially in an academic environment. Future studies should involve users in choosing UI component libraries and possible workflows.

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