Interaction Design of Fertility Tracking Application Using User-Centered Design

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Abstract*—Fertility tracking application (FTA) is a type of digital health product in the form of a digital tracker that helps women manage their menstruation. Given that every woman has different menstrual characteristics, FTA has the potential to alienate certain groups of users. Thus, the aim of this research is to create an interaction design that can accommodate both normal and outlier users of FTA. The design methodology is user-centered design so that the iteration of design process is driven by feedbacks from existing user groups. Based on the user research, it is found that current FTAs, including but not limited to Flo and MyCalendar, have following problems: lack of ways for users to set up their preferred period tracking, lack of personalization, features with low visibility, and lack of explanation of unfamiliar medical terminologies in the application. Thus, an interaction is designed to address these problems. The solution allows each user to personalize various aspects of menstrual tracking. Usability goals of the interaction design solution are effective to use and easy to learn with helpful as user experience goals. The results of the interaction design evaluation using usability testing show that the solution is usable with a Single Ease Question score of 6.84 out of 7, a System Usability Score of 92 (Grade A/Excellent) out of 100, and an NPS score of +60 out of +100. Usability goal effective to use is achieved with 100% task completion and easy to learn is achieved with a score of 4.6 out of 5. Finally, helpful as user experience goal is achieved with a score of 5 out of 5.

Keywords: Interaction design, fertility tracking application, user-centered design

I. INTRODUCTION

Fertility tracking application (FTA) is a type of digital health product in the form of a mobile digital tracker [1][2]. FTA helps women manage their menstruation by providing functionalities to track menstrual cycles and symptoms [1][2]. The issues surrounding FTAs are in line with issues that also exist in the healthcare domain in general: the ability to accommodate all user groups. Equality in the healthcare is important to ensure that each patient's differences are respected [3]. FTA has a great potential to alienate certain groups of users that possess menstrual cycles that are unlike majority of women [4]. As a result, these outlier users are unable to use FTA with as much as ease as users with normal, regular cycles. Hence, a study is necessary to identify interaction design problems faced by FTA users, including normal users and extreme users who have unique menstruation pattern such as irregular menstrual cycles and/or certain medical conditions that affect their menstruation in one or more ways [4][5].

This study aims to create an interaction design solution for FTA that can accommodate all user groups. The problem statements for this study are (1) What are the requirements and interaction design solution of FTA using user-centered design approach? (2) What are the results of the evaluation of FTA interaction design solution?

II. METHODOLOGY

This study's methodology is user-centered design (UCD) based on ISO 9241-210 [6]. The methodology justification is that users' feedbacks in requirements gathering, design process, and design evaluation are important to build interaction designs that can provide value for each user group. This methodology also focuses on task, which is suitable for products with defined user journeys such as FTA [7]. The stages of UCD are as follows [6].

1) Understand and specify the context of use, conducted by existing FTA analysis and online questionnaire followed by online interview

2) Specify the user requirements, conducted by narrowing down UCD stage (1) result into requirements that can solve commonly faced and urgent problems i.e., problems that directly hinder the achievement of their goals

3) Produce design solutions to meet user requirements, conducted iteratively by prototyping both in low and high fidelities using Figma tool

4) Evaluate the designs against requirements, conducted by User Testing [12]

III. FERTILITY TRACKING APPLICATION REQUIREMENTS ANALYSIS

This section contains two UCD stages: understanding context of use and specifying user requirements.

A. Understand and specify the context of use

To understand and define the context of use, FTA is divided into five major user journeys or tasks [7], which are onboarding, data logging, prediction, exploration, and data export. Three activities were carried out to formulate interaction design problems in FTA: (1) analysis of the current FTA interfaces, (2) quantitative user research using questionnaires, and (3) qualitative user research using interviews.

The first activity is interface analysis by referring to existing FTAs which have the highest number of downloads in PlayStore: Flo [15] and MyCalendar [16]. The problems found from the two applications are then referred to as questions for user research to validate these problems.

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The quantitative user research is targeted towards current and past users of any FTAs who live in Indonesia. This study targets past users as well to understand their experiences that eventually led to app uninstallation. The questionnaire reached 253 respondents. From these numbers, five individuals that have different experiences from one another are chosen for online interview. The following are the characteristics of the five users.

1) User A, current user, had experienced irregular cycle in the past but current cycle is regular, categorized as normal user that perviously had been an extreme user

2) User B, current user, has a chronic medical condition that causes irregular cycle, on medication, categorized as extreme user

3) User C, past user, cycle is normal with terrible cramps in the past that has disappeared, categorized as normal user

4) User D, current user, has PCOS (polycystic ovarian syndorme) that causes irregular cycle, categorized as extreme user

5) User E, current user, cycle is extremely regular, occassional mild pain, categorized as normal user

The equal distribution between normal/extreme users for the interview is to gain equal insights from both sides on FTA interaction problems. The following are the key findings obtained from interface analysis and user research.

- The most common goals for FTA usage are (1) to observe one's menstrual cycle and (2) to recognize the symptoms experienced during menstruation. Meanwhile, the problems that most users face are (1) lack of accurate menstrual cycles prediction and (2) limited symptom tracking data provided by the app. These two problems directly hinder the achievement of the two most common goals because they are interrelated.
- Respondents who have stopped using FTA have the following most common reasons: (1) the menstrual cycle prediction is inaccurate, (2) the application is not personalized, and (3) the respondents do not understand the benefit of tracking certain symptoms data. At the same time, 90.1% of these respondentsare willing to return to using FTAs if there are FTAs that can meet their needs.
- Some respondents have never used certain main features because they are not aware that this feature exists in the application. Hence, in general, the current learnability for main features of FTA is not good.

Looking at the key findings, interaction problems commonly faced by FTA users are related with main features that are not able to support users to achieve their goals and low learnability. Hence, the usability goals formulated for the solution are "effective to use" and "easy to learn" with user experience goal "helpful". Usability goal "effective to use" aim to reach a goal where the product can support users' achievement of their goals – in this case, goals to observe menstrual cycle and recognize menstrual symptoms. Coupled with "easy to learn" whose aim is that the product should require minimum effort to learn, the FTA end product can address the commonly found users' concerns.

B. Specify the user requirements

First of all, a gap analysis is carried out to understand the gap between the existing FTAs and the ideal FTA which will be the final product of this study.

- Onboarding
  - Initial questions for users do not acquire comprehensive information, illustrated by the lack of questions, especially regarding user's condition (medical condition, use of birth control, etc.) and users' menstrual cycle and/or duration fluctuations (if applicable)
  - Menstrual symptoms tracker setup is not executed right after completion of initial questions, even though the setup can take advantage of users' answers to generate data tracker recommendations that match their profile
  - There is no app tutorial for users, even though some features have entry points that are not on the main screen (have low visibility)
- Data logging
  - Symptoms tracker is not flexible, hence not providing easy way for users to record non-default symptoms
  - There is no explanation about the data/symptoms being tracked such as the benefits of tracking and its relevance to the user profile, so the user must guess which data is relevant to them according to his own understanding
- Exploration
  - Symptoms/cycles report does not provide an explanation on what is considered normal/not normal so users cannot easily interpret the data. For example, there is no explanation on the threshold for regular menstrual cycle
  - Symptoms/cycles report does not have data filters to enable easy way for users to focus on the data that are relevant for them
- Prediction

  There is no user task that encourages users to independently observe symptoms that they experience during menstruation and make predictions independently assisted by alerts. In fact, this task is essential for extreme users with irregular cycles that cannot be accurately predicted by the application.

The gaps specified above are then translated into user requirements (Table I) where each requirement is mapped to problems it ought to solve.

TABLE I USER REQUIREMENTS

Require-ment-ID	User Requirement
R-1	FTA provides ways for users to self-regulate their menstrual cycle observations according to their conditions and needs
R-2	FTA prioritizes personalization
R-3	FTA provides information that supports users' learning
R-4	FTA displays relevant menstrual information for both normal and extreme users
R-5	FTA contains five main stages of FTA: onboarding, data logging, exploration, prediction, and data export as well as basic FTA functionalities such as registration, log in, etc

IV. Fertility Tracking Application Interaction Design Solution

After specifying user requirements, the third UCD process that is to produce design solutions is carried out. The design solution is made using Figma tool and is divided into two types of prototypes: low-fidelity prototype visualizing rough solution designs and high-fidelity prototype visualizing the interaction and actual application design. The fourth UCD process that is to evaluate design solutions will also be described in this section.

A. Low-Fidelity Prototype

Low-fidelity prototyping results in 46 screens designs. The base idea on what kind of interactions will present in the final product and how they are placed in the interface is laid out in this phase. The following are highlights of new interaction design ideas that do not exist within the existing FTAs.

1) Comprehensive user data acquisition, which aims to help achieve better app personalization. Comprehensive answer options such as providing ways for users to tell the app that they have fluctuating menstrual cycles as well as comprehensive questions such as users' medical conditions and lifestyle can help app understand users more holistically. The interaction design principle this solution follows is constraint, meaning users need to complete each question before being granted access to other features.

2) App tutorial, an interaction to enhance app learnbility. The tutorial is short and it briefly explains the buttons on the main screen. Its interaction design principle is consistency, meaning that every feature that is being introduced to users is highlighted in the same manner.This is so that users can intuitively follow the tutorial process.

3) Symptoms tracker recommendation, that enables users to connect initial user data acquisition to which symptoms/data are relevant to them. The task gives recommendations on which symptoms too track for their period tracking activities. Each recommended symptoms/data are accompanied by explanation on (1) the definition of the data and (2) the benefits of tracking the data. The interaction design principle is feedback because processing initial questions into symptoms tracker recommendations takes time.

4) Flexible symptoms tracker, where users can (1) add answer options to an existing tracker, and (2) add a new symptoms tracker themselves. With the possibility of adding new data to the tracker, users can determine for themselves what data they want to track without limits. The interaction design principle of this solution is affordable. This is because a flexible symptoms tracker is something new that does not exist in other FTAs, hence the buttons to perform the task must have intuitive design.

5) Interactive tooltip, to assist users inn understanding uncommon terminologies used in the app. Contents that have tooltips are information on normal cycle length and period duration and symptoms/data definition. The interaction design principle for the help tool is visibility, by making interactions related to explanatory information easily accessible and placed near the item being described so that it is easy for users to find.

6) Symptoms report filter, to make it easier for users to focus on important data. The interaction design principle is feedback, i.e., the filter can provide feedback in the form of filtered data or feedback stating that the data they are looking for does not exist because it has never been recorded before.

7) Self-regulated cycles prediction, which will be helpful to users who receive late menstruation notification. Being late in menstrual cycle can mean two things: (1) the user is a normal user with regular cycle who happens to experience an abnormality in the cycle due to certain factors i.e., stress or change in lifestyle, or (2) the user is an extreme user with irregular cycle which is difficult to predict accurately by FTA. In this case, there will be an interaction that offers the user to start tracking symptoms during the time in which they are late and will be alerted if there is certain symptoms/pattern that is often recorded by the user. T he interaction design principle of this solution is affordance, meaning the buttons to complete tasks easily accessible and the flow to complete the task is intuitive.

Low-fidelity prototype evaluation is conducted using usability testing (UT) [12]. UT participants are randomly selected from questionnaire respondents who dropped their contact information. The purpose of UT is to determine whether the low-fidelity prototype has a usable user flow without considering the aesthetic aspects and the completeness of the interaction on each design component. Tests were carried out using Single Ease Questions (SEQ) [9][10] and System Usability Scale (SUS) [11][13]. The choice of metrics was based on the need to test individual tasks to find bottlenecks through SEQ and also the need to test the entire interaction design through SUS. UT respondents amounted to five people.

The result of UT is that the SEQ score reached 6.58 out of 7 (minimum threshold: 5.5 [10]) and the SUS score is 79 out of 100 (minimum threshold: 68 [13]). Thus, the low-fidelity prototype solution is proven usable. Even so, there are several key findings that can be considered for improvement for the next iteration as follows.

B. High-Fidelity Prototype

High-fidelity prototype is built using Figma tool. The design theme for the prototype is as follows: (1) it is dominated with a pink color palette like most existing FTAs are, and (2) uses the Roboto font. The high-fidelity prototyping is conducted in two iterations with the second iteration done to improve the interaction based on users' feedbacks. This iterative process is in line with UCD methodology.

In general, high-fidelity prototype has the same components and structure as low-fidelity prototype, except that the former is colored and consider aesthetic aspects into the design. In addition, the tasks that received feedbacks on low-fidelity UT are also improved. Thus, the interaction design principles that have been applied to the low-fidelity prototype are also reflected in the high-fidelity prototype.

1) Comprehensive user data acquisition

This sample on Fig. I provides a scenario where questions about cycle length is accompanied by tick box on length fluctuation. The same tick box is also provided on period duration question. The goal is to understand users holistically so that the app can provide suitable recommendations to them.

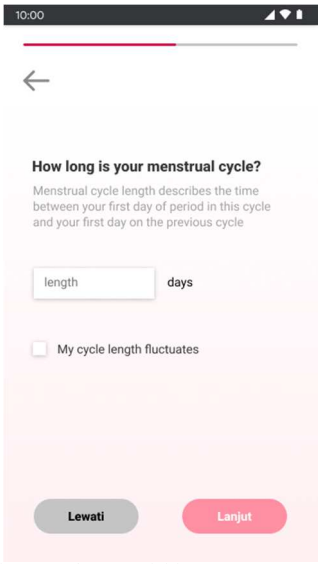

Fig. I. Comprehensive user data acquisition

2) App tutorial

Tutorial represented in Fig. II ensures that users have learnt each important entry points.

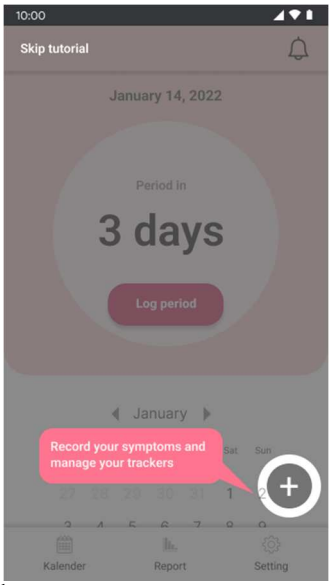

Fig. II. App tutorial

3) Symptoms tracker recommendation

Symptoms tracker in Fig. III Allows users to see what their answers to data acquisition generate and learn more about each symptom's relevance too their profile.

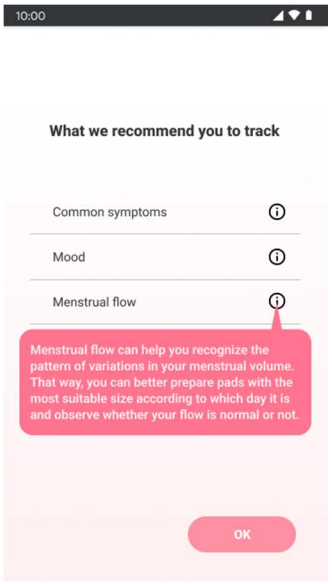

Fig. III. Symptoms tracker recommendation

4) Flexible symptoms tracker

This solution gives flexibility to users to add symptoms by themselves as shown in Fig. IV And Fig. V. This will help users that have uncommon period symptoms, especially extreme users, to track them with ease, as opposed to existing method through "Notes" which requires manual typing.

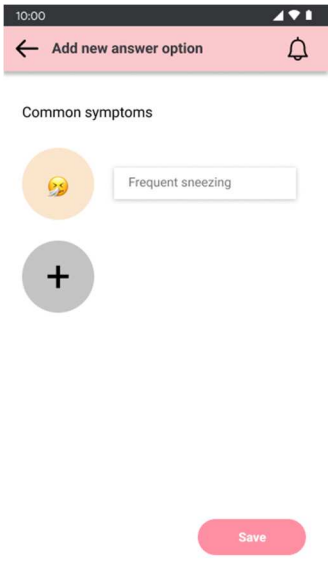

Fig. IV. Flexible tracker – add new answer option

On Fig. V, it shows that the newly-added option now exists within the tracker. Users can now click it whenever the symptom occurs.

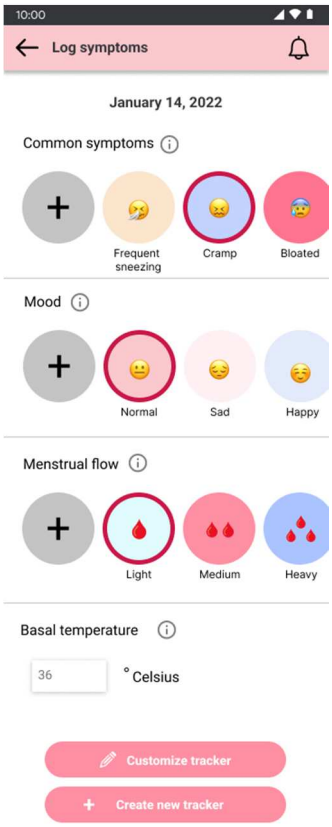

Fig. V. Flexible tracker – new answer option is reflected

5) Interactive tooltip

Tooltip helps users understand definitions better, especially those related with medical terminologies. Sample interface for interactive tooltip interaction is shown above on Fig. III.

6) Symptoms report filter

Overcrowded symptoms report makes it harder for users to focus on important information that they want to focus on, such as shown in Fig. VI The filters are divided into two: time filter and symptoms filter.

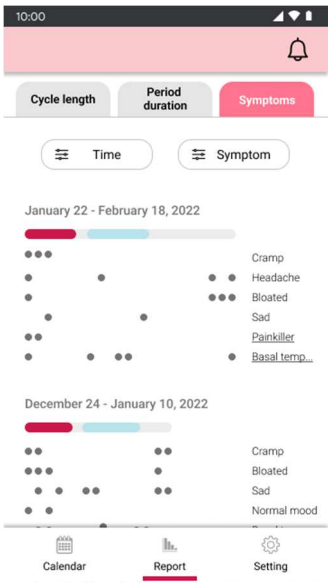

Fig. VI. Symptoms tracker before filter

The filter enables less data shown and more whitespace that helps with focus, represented in Fig. VII.

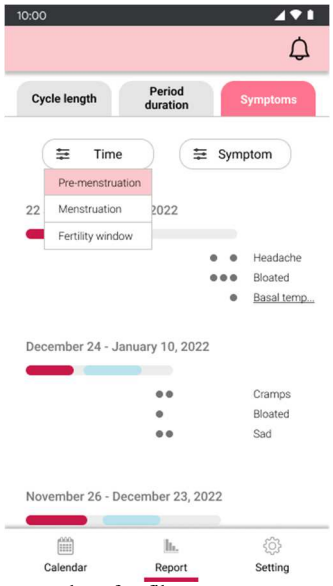

Fig. VII. Symptoms tracker after filter

7) Self-regulated cycle prediction

This interaction is especially helpful to users who experience late period or inaccurate prediction due to their irregular cycle – hence, to extreme users. This works by a pop-up as shown in Fig. VIII to encourage users to start tracking their symptoms and activating notification for repeated symptoms logging.

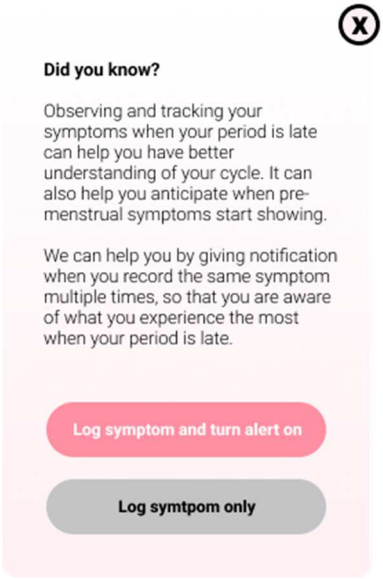

Fig. VIII. Self-regulated cycle prediction

The evaluations for the first and second iteration of high-fidelity prototype are carried out using UT with the same tasks and instruments as in the first iteration. Evaluation for the first iteration results in a high score, and comments such as “easy to use” and “I see helpful features that do not exist in other FTAs” are frequently found. However, there are feedbacks that touch the interaction goals, hence second iteration is conducted to address said feedbacks.

The evaluation for the second high-fidelity iteration is conducted to achieve following parameters: (1) SEQ for tasks that undergo changes achieve scores above 5.5 [10], (2) The

SEQ as a whole has a consistent score against the SEQ score for the first iteration, which is 6.94. (3) SUS has a consistent score against the SUS score for the first iteration which is 93, and (4) NPS has a consistent score against the NPS score for the first iteration, which is +80. The following is the test results obtained.

- SEQ score for improved tasks 6.8, 7, dan 6.6 out of 7 (accepted)
- SEQ score: 6.84 (-0.1) out of 7 (accepted)
- SUS score: 92 (-1) out of 100 (Grade A, accepted)
- NPS score: +60 (-20) out of +100 (accepted)

Although all metrics have decreased slightly, they still show high scores that are consistent with the previous iteration's scores. That is, both evaluation objectives to prove usability and maintain high scores are achieved. It also received a lot of comments saying "helpful". The goals of the interaction design are also achieved with the following descriptions.

- Usability goal "effective to use" is achieved with 100% task completion and "easy to learn" is achieved with SUS number 7 getting a score of 4.6 out of 5, the same as in the previous iteration
- User experience goal "helpful" is achieved with SUS number 1 getting a score of 5 out of 5, an 0.2 increase from the previous iteration score

The evaluation received two feedbacks from respondents but the two feedbacks are not crucial and/or there are alternative features that tackle these feedbacks within the current solution. Thus, based on the scores of the three metrics and the achievement of testing objectives, the design process iteration is complete.

V. CONCLUSION

The interaction design solution for FTA using UCD approach results in an interaction design that considers the needs of FTA from the perspective of both normal and extreme users. These needs are: (a) FTA provides ways for users to self-regulate their menstrual cycle observations according to their conditions and needs, which can help extreme users whose cycles are often not accurately predicted by algorithm, (b) prioritizes personalization, (c) provides information that supports the users' learning, (d) displays relevant menstrual information for both normal users and extreme users. , and (e) contains the five main stages of FTA, namely onboarding, data logging, exploration, prediction, and data export as well as basic FTA functionalities. FTA also has usability goals that are "effective to use" and "easy to learn" as well as "helpful" user experience goals. (2) Based on the evaluation results of the final prototype, namely the second iteration high-fidelity prototype, it is found that the interaction design solution of usable FTA achieves following scores: SEQ score of 6.84 out of 7, SUS score of 92 (Grade A/Excellent) of 100, and NPS score of +60 out of +100. The SUS and SEQ indicators also prove that the interaction design is able to achieve usability goals "effective to use" and "easy to learn", as well as user experience goals "helpful".

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