

Usability, User Experience and Self-Determination Theory Motivation Analysis of Pregnancy Application for Antenatal Care Support Information System Requirements

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Abstract—One of the information technology uses in the health sector is to improve antenatal care, which can reduce early pregnancy complications the risk of stillbirths. Antenatal care (ANC) information system should be personal because pregnancy is unique for every woman. This research proposed a non-technical approach to make the system closer and personal to users by integrating user experience, in this case using the usability approach and self-determination theory motivation. This approach is expecting to improve the quality of existing application and system by understanding response and satisfaction about the system and psychological needs of pregnant women as users and to fulfill the requirements of the proposed antenatal care system called Zena. The proposal of Zena system done by compared existing pregnancy applications and then integrated modules that had good usability and self-determination theory aspect to design a better antenatal care system. This research conducted through questionnaires and interviews given to pregnant women who used smartphone pregnancy application and assessment by using a Likert scale. The analysis discovered that self-determination theory aspects are more significant than usability aspects and dominant aspects of it can be integrated into the Zena system to suggest making it more compatible with pregnant women.

Keywords—*Usability, Pregnancy Application, Antenatal Care*

I. INTRODUCTION

Indonesia has experienced high maternal mortality throughout the period, even in 2015 Indonesia was the second-highest Maternal Mortality Rate (MMR) in Southeast Asia [1,2]. However, based on the Indonesia Statistics data, estimated that Indonesia MMR in 2015 was 305 per 100,000 live birth [2]. One target of The Sustainable Development Goals (SDGs) in 2030 is to reduce the global Maternal Mortality Rate (MMR) in 70 per 100,000 [3], which means deaths due to complications from pregnancy or childbirth should less than 70 deaths per 10,000 live births. The major causes for maternal mortality are diverse as, younger aged married, lack of skilled birth attendance and short of access to excellent quality health care. There was a gap of skilled birth

attendance coverage between area, while in Java-Bali Island was 52% but in other areas was only 42% [2].

In the era of technology, pregnant women and health professional can use mobile or smartphone application (app) and social media to increase promote health result [4]. The technology used in health care can improve the quality of health care for mothers and infants. Advances in technology today allows one to be able to maximize the functions of a cell phone or smartphone with apps that can be easier to provide information to users. Pregnant women can advantage from mobile apps that could monitor, present information, and link to health professionals or caregivers, even that could connect with fellow pregnant women [5]. There are 40% of pregnant women used at least one pregnancy app in their smartphone and some respondents argue it is more pertinent and helpful than other forms of health communication but often bored with them immediately [6].

Therefore, this study proposes a non-technical approach to make the pregnancy-related mobile app an ANC support system closer and more personal to users. An intervention designed to not only provides users satisfaction with the system but also understand the motivation, personality and psychological needs of the pregnant women as a user by using usability and Self-Determination Theory (SDT) analysis. SDT is mainly relevant to health care because it has the aspect of autonomy that can be probed using empirical methods [7]. This study is part of the design of a system that will propose namely an ANC support system called Zena.

II. BACKGROUND

Pregnancy is a unique period with various physical and psychological changes [8] that affect women's lives, therefore a good pregnancy support app and the system should be personal to each woman. Mobile phone significantly increased the rate of women receiving the recommended four ANC visits during pregnancy and there was a trend towards more women receiving preventive health services in Zanzibar [9] Pregnancy support systems can be in the form of a smartphone-based

app that can be used by pregnant women as a personal pregnancy monitor to be more aware of their pregnancy, provide pregnancy information and make it easier for a maternal health worker to provide antenatal services.

Several studies have been successfully conducted concerning mobile and smartphone prenatal and antenatal. There was a mobile app by Maitra and Kuntagod called mHealth to help maternal healthcare and pregnant women in the rural region to provide information, monitoring, data collecting with an expert system that advises maternal health workers in multiphase of maternal care also assuring a continuum of maternal care [10]. Khanum et al. designed a Pregnancy Care Network (PCN) that provide information and education about pregnancy, also connect pregnant women with maternal health care provider [11].

A. User Experience and Usability

User Experience (UX) according to ISO 9241-210 is the response and perception of the user resulting from the use of a product, system or service. UX covers all aspects of user interaction with the product, app or system and can be used to measure a metric that can measure values in the performance of an app even habits and behavior of users [12]. UX consists of four elements, there are: 1) Usability, and the user can easily perform the desired tasks from the product. 2) Valuable, which is a feature on the product must be by user needs. 3) Adoptability, which is a product easy to obtain, easy to purchase and easy to download, finally 4) Desirability, which is associated with emotional appeal [13]. Usability is part of User Experience (UX) and refers to how easily users to learn and use a product to achieve their goals and how satisfied the process is doing it. UX is influenced by several factors that include the product or system, users and the environment [14] some of the specifications to achieve good usability are: a) learnability; b) efficiency, memorability, and c) error [15].

B. Self-determination theory of motivation

Introduce three basic psychological human needs: a) competence are needs to be able to control the outcome and the desire to master a certain skill; b) relatedness refers to interact, relate and care for each other and c) autonomy, refers the need to integrate the actions performed freely with the personal self without being bound or gained control of another person [7].

C. Self-determination theory of motivation approach in technology

Various pregnancy-related app by many developers can discover on the internet such as Apple Store and Play Store with a diversity of features and sophistication and them already familiar with the importance of usability and usability in their app yet of them perhaps un-mindful of SDT about psychological needs of pregnant women as users. We expected to improve the quality of existing app and system by understand response and satisfaction about the system and motivational of users to fulfill the requirement of novel antenatal care with integrating learnability, efficiency, memorability and error in usability aspects with competence, relatedness, and autonomy in SDT aspects.

III. METHOD

In this research, we conducted three surveys and one usability test to women aged 20-37 years old who had been pregnant and user of the pregnant-related app as the sample, the surveys are: firstly, survey to obtain information about the behavior and needs of pregnant women which was distributed to 35 women. Secondly, a survey to gathering information about pregnant women's need for pregnancy app, based on usability and SDT aspect, distributed to 50 women. Thirdly, usability testing, UX testing, and SDT motivation analysis to conducted on 12 women have been used the InfoBunda and Pregnancy+ app. Finally, expert judgment by 3 people who midwife, obstetrician and IT practitioner. Data gathering methods using a questionnaire or interview measurement of variables by using a Likert scale with a semi-structured question for extract data about views and insights terms of usability aspects, whereas with a closed-question are to get opinions and feelings inflicted by technology. Components of the questions consist of behavior about technology, motivation, reason users, obstacles, etc. The quantitative questionnaire with multiple-choice, qualitative with open-ended questions to produce two types of data, also there are some multiple response surveys. The parameter to be measured is the ease of use of the app, how easily users find the information they need, how good users can understand the content, how comfortable the user is using the app and how personal pregnancy health awareness after the use of a pregnancy-related app. The stages carried out in this study are: a) Determine the participants; b) Conduct users requirement and behavior survey; c) Conduct users requirement survey based on usability and SDT from existing pregnancy app; d) conduct interview to validate usability, UX and SDT aspects on two existing pregnancy app; e) Conduct expert judgment survey; e) Analyze responses of surveys and f) Design recommendations for improving existing pregnancy-related by proposing an ANC support system. We argue that to understand what is needed by pregnant women in a mobile app is not enough with user requirements analysis but also there should be aspects of usability, UX and SDT analysis.

IV. RESULT

A. User requirement and behavior

We found that 42% of respondents prefer to get pregnancy-related information through health workers such as doctors, midwives or nurses, 24.6% participants from a computer or smartphone and the rest is through books, media, people around and community-based maternal and child health service (e.g. Posyandu, Polindes, Poskesdes). All women in the present study had used social media to look for pregnancy-related information with 40% social media used such as the blog, 23% wiki, 16% chatting app, and 14.3% used Facebook and only 2.6% used website same as Instagram. The problems that are often found in the use of social media are 31.7% because the intervention of advertisement in the app, 30% information regarding pregnancy that cannot be

trusted and 16.7% of the information presented is not relevant.

In app use, 48.6% of participants used app pregnancy with 29.4% of participants used the app to get easier information, 23.5% to get the latest information about fetuses' development, and 11.7% to attend online forums. From the study, there were 51.4 % who did not use the app for various reasons, among them: 33.3% had not installed the app, 16.7% of the information presented was not trusted and felt unnecessary, 11.1% due to gadget limitations and did not know of a pregnancy app, 5.6% other reasons. Problems that are usually encountered when using apps are 31.2% participant argues that information presented is incomplete, 27.1% large memory, 18% of information is incomprehensible. The expectation of pregnant women as users of an app is 47.9% complete information, 29.8% lightweight app, 19% attractive user interface. Additional functions or features needed by pregnant women are 31.9% chatting, 24% nutritional information, 23.4% drug or supplement information, 15.1% reminder for ANC schedule. The use of the app it is expected that 32.7% can get information about pregnancy, 26.5% can monitor fetal development, 22.4% can monitor maternal health, and 18% to increase awareness of pregnant women in maintaining their pregnancy. Based on the results of the questionnaire, it can be concluded that the needs of users are as follows. 1) Users prefer to search for information using blogs and websites because of the ease of access; 2) Users need media information that can be justified; 3) Users want media without interrupting by advertisements; 4) Users want apps that present information in comprehensive and 5) Users need a pregnancy app with small file size.

B. User requirement with usability and SDT aspects

This study, using a Likert scale that turns into the average interval in the value of respondents' responses which 1.00-2.59 are strongly disagreed and disagree, 2.60-3.39 undecided, 3.40-4.19 agree and 4.20-5.00 are strongly agreed. Based on the learnability requirement regarding ease of understanding and using the app, an average value is 4.41. In the aspect of efficiency that app efficiency, results are found with a value 4.31. In the aspect of memorability regarding easy to remember and as a reminder with result 4.60. Aspects of error with the handling if there are errors with a value of 2.21 that means disagree. In the aspect of satisfaction with questions regarding safety, comfort and satisfaction in the use of the app found a value of 4.57, here the highest value among others. Furthermore, aspects of SDT are competence, relatedness, and autonomy. Competence aspect about competency information regarding the availability of a pregnancy journal or diary feature worth 4.47, relatedness about the features of the forum and chat to share information with other pregnant women and health workers valued at 4.37, autonomy by asking questions about information independently at any time and pregnancy advisory is 4.41. All aspects of the SDT are valued above at intervals of 4.20-5.00 which means that they strongly agree.

TABLE I. USABILITY AND SELF-DETERMINATION VALUE OF PREGNANCY APPLICATION REQUIREMENTS

(a)

Num.	Usability aspects	Value
1.	Learnability	4.41
2.	Efficiency	4.31
3.	Memorability	4.60
4.	Error	2.21
5.	Satisfaction	4.57

(b)

No.	SDT Aspects	Value
1.	Competence	4.47
2.	Relatedness	4.37
3.	Autonomy	4.41

C. Validation from expert judgment

Based on the results of interviews conducted with experts who have three roles, a mother, health practitioner and IT and app users, it is produced that the average percentage of total justification is 90%, which means that they strongly agree so that it can be stated that pregnancy app is a matter which can help pregnant women to do self-care and monitoring on the health of their pregnancy can also help medical staff in conveying pregnancy information to pregnant women.

D. Testing with usability, UX and SDT aspect

The object of testing conducted in this study is not the design of the antenatal care information system, but rather the testing of aspects of usability, UX and SDT in existing apps to propose a better ANC system. Comparative pregnancy apps are Pregnancy+ [16] and InfoBunda [17]. The average interval of response values is divided into 3 namely 1.00-1.65 disagree, 1.66-2.31 undecided and 2.32-3.00 agree. In the Pregnancy + app, the usability and UX aspects have a value of 1.70 which means that the respondent judges undecided that the Pregnancy + app fulfills aspects of good usability, whereas, from the interpretation of the percentage, it is known that 60.93% of respondents disagree if this app has aspects that have good and rate that the Pregnancy + app still needs improvements in its usability aspects. In the aspect of SDT, the assessment is 2.00. The average score is entered at an undecided interval, the respondents assess neutral that the app of Pregnancy + has met the aspects in a good SDT. However, based on the interpretation of the percentage, it is known that 50% of respondents disagree and 50% agree if this app has the appropriate SDT aspects.

In the aspects of usability and UX, 2.35 value means that respondents agree that the InfoBunda app has good aspects of usability and UX and 63.33% of respondents agree that InfoBunda has good in UX aspects. While in SDT aspects, the value was 2.44, this score is included in the interval, of agree, that means the respondents agree that InfoBunda app has fulfilled good SDT aspect and based on the percentage, it is 72.22% of respondents rated agree this app has basic needs according to aspects of learnability, autonomy, satisfaction, efficiency and relatedness of pregnant women.

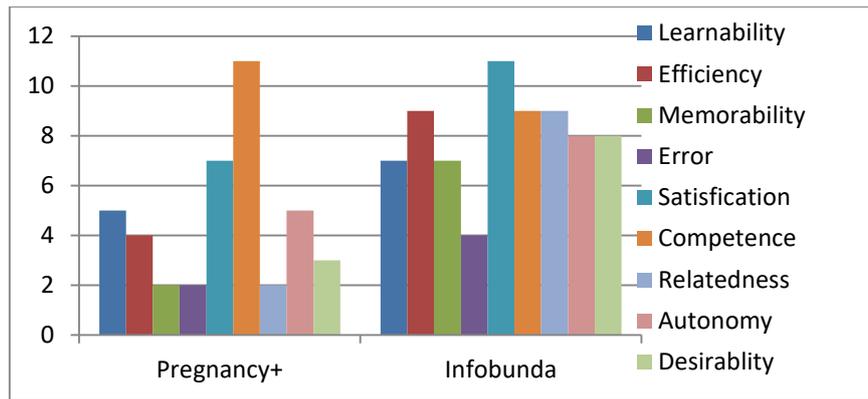


Fig. 1. Comparison Pregnancy + with InfoBunda of usability, UX and SDT aspects.

Based on the comparison results, it can be seen that in the SDT aspect the Pregnancy + app is higher in the competence aspect, ie this app is considered to present information on pregnancy and childbirth that is more relevant and interesting because of the illustration of fetal development. While the InfoBunda app has the highest UX value in the aspect of satisfaction, the user feels

comfortable and satisfied in using the InfoBunda app. Zena's components based on an extract of Pregnancy+ and InfoBunda aspects. In the aspect of error and satisfaction are considered to have equality. However, in other aspects, Infobunda is higher. The following Zena components are obtained from the results of completing the Pregnancy + and InfoBunda app.

TABLE 2. THE COMPONENTS OF ZENA ADAPTATION FROM THE HIGHER ASPECTS OF EXISTING PREGNANCY APP

Usability, UX and SDT Aspects	Feature in Zena
Competence ^a	Fetal development, Interesting illustration, attractive colors and images
Learnability ^b	Using Bahasa and simpler displays
Efficiency ^b	Ease of accessing features Used and smaller file size
Memorability ^b	Simpler user interface
Error ^{a,b}	Have handling of error
Satisfaction ^a	Displays pregnancy information that is quite satisfying
Desirability ^b	Practical, easy and complete features
Relatedness ^b	Pregnant women forum and QnA with medical personnel
Autonomy ^b	Fetal information every week and fertility calculator
a Pregnancy+ aspects adoption	
b InfoBunda aspects adoption	

V. CONCLUSION

Usability need has an average value in 4.02 which means that respondents agree and want to use a pregnancy app that is easy, efficient, easy to remember, can handle mistakes and can provide satisfaction to its users. While the average value of SDT motivation need is 4.41, then respondents strongly agree on the existence of SDT aspects in the pregnancy app. This proves that basic human psychological needs such as competence, connectedness, and independence are important aspects of an ANC system. Based on the analysis of UX and SDT, a pregnancy app system design that meets the aspects of UX and SDT is proposed by completing and integrating the previous app to produce an app that encompasses elements of experience and complete human needs called the Zena ANC support information system. From the results of the study note that the usability and UX satisfaction aspects from the InfoBunda app and SDT competence aspects from the Pregnancy + app will be

integrated into the component of the Zena ANC support system design.

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