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Progressıve Web Apps : A Development And Acceptance Study Among College Students In Indonesıa Usıng Scrum Framework And Utaut Model

Herman[1], Frederick[2]
Email of author correspondence : herman@uib.ac.id[1], 1931163.frederick@uib.edu[2]

[1] Information System, Universitas Internasional Batam, Batam, Indonesia
[2] Information System, Universitas Internasional Batam, Batam, Indonesia

Abstract

Currently, the usage of mobile applications and the total activity on mobile phones through web browsing or native applications is very high. But both have limitations. In web applications, the user experience that users receive is not that great compared to native applications, and on mobile native applications, it requires higher development costs to ensure the app is able to be accessed across multiple platforms. To solve this problem, Google launched the progressive web apps as an alternative, where progressive web apps can be accessed through various different platforms, saving development costs but still providing a user experience that is almost the same as native apps. The focus of this research is to develop a progressive web app with React.js using the scrum method, and also to do research about user acceptance of progressive web apps through qualitative methods/interviews based on the UTAUT research model to students and lecturers of computer science in general. The result of this research, which is based on UTAUT points, shows responses toward the acceptance of progressive web apps that are represented in the form of affinity diagram. With this research, it is hoped that it can bring benefits to the decision to use the progressive web apps, become a reference for the next research, and increase the knowledge of the public and readers about the progressive web apps.

Keywords: Progressive web app, Scrum, UTAUT, React.js, Mobile application.

Introduction

Currently, around 60% of users worldwide use smartphone, and the total activity on mobile via web browsing or native applications is close to 67% identified in a recent survey. Most users use native mobile apps to browse specific industry content. Another way is through a web browser. But both have limitations. In web browsing, the appearance of most websites is not automatically responsive in a web browser when accessing using a mobile phone which

cause users to feel unhappy and less satisfying experience for users. (Mhaske et al., 2018). In native mobile applications, with the rapid development of technology, companies need to ensure that the applications developed can be accessed on any device, be it a mobile phone, computer, tablet, or other devices, regardless of the operating system, screen size, or device conditions. Therefore it requires more expensive and high development costs. To overcome this limitation problem, Google launched a progressive web app as an alternative, where progressive web app can be accessed on various devices regardless of the operating system, screen size, and device conditions, without the need to develop several applications specifically on different platforms. Even for developers that develop apps for iOS and Android only, this indicates a huge time saving and effort in developing an app. In addition, progressive web app offer a very similar user experience to native apps (Rajesh N & John Jacob, 2020).

Progressive Web App (PWA) is a new technology designed and developed by Google in June 2015 to overcome the limitations of mobile browsers and native apps. Progressive web app use modern web capabilities that describe a collection of technologies, design concepts, and web APIs that work together to deliver an user experience like a native app (Nurwanto, 2019). The progressive web app can be accessed by mobile users because they can be accessed via the home screen and work without an internet connection. The progressive web app also offers features such as camera access, data storage, GPS, motion sensors and push notifications, which are similar to the experience that native apps give. There is also a study that shows that progressive web app require less memory storage and have faster launch times than hybrid apps. Due to the unique features and experiences similar to native apps, progressive web app are believed to provide the same user experience as native apps (Sedkowska & Kiunsi, 2020).

Scrum is a lightweight framework that enables teams to overcome complex adaptive challenges for the development and delivery of high-value products by enhancing collaboration, creativity, and productivity. Scrum was invented by Jeff Sutherland and Ken Schwaber in 1993 (Bhavsar et al., 2020). Recognizing that the technology industry is showing interest and investing in progressive web app to study the progress and future improvements, it is found the lack of academic research on how is the user acceptance of progressive web app. (Sharma et al., 2019).

Based on the background above, this research focuses on developing a progressive web app with React.js using the scrum method, as well as providing research results on the user acceptance of progressive web app both for mobile users and desktop users through interviews with students and lecturers of computer science in general. With this research, it is hoped that it can bring benefits to the decision to use the progressive web apps, become a reference for the next research, and increase the knowledge of the public and readers about the progressive web apps.

Literature Review

1. **Information System**
   Information systems are elements contained in an organization which consists of a group of people, media, technology, procedures and controls that can be used to communicate, transact, and provide information in making a decision (Rahmawati & Bachtiar, 2018).
2. **Progressive Web App**
   Progressive Web App (PWA) is a technology designed and developed by Google in June 2015 to overcome the limitations of mobile browsers and native apps. Progressive web apps use modern web capabilities that describe a collection of Web technologies, design concepts, and APIs that work together to deliver a native app-like user experience. Progressive web apps can be accessed by mobile users because they can be accessed via the home screen and work regardless of an internet connection. Progressive web apps also offer features such as camera access, data storage, GPS, motion sensors and push notifications, which are similar to the experience of native apps (Nurwanto, 2019).
3. **Scrum**
   Scrum is a lightweight framework that enables teams to overcome complex adaptive challenges for the development and delivery of high-value products by enhancing collaboration, creativity, and productivity. Scrum was invented by Jeff Sutherland and Ken Schwaber in 1993 (Bhavsar et al., 2020). Recognizing that the technology industry is showing interest and investing in progressive web app to study the progress and future improvements, it is found the lack of academic research on how is the user acceptance of progressive web app. (Sharma et al., 2019).
4. **React.js**
   React.js is a Javascript library developed by Facebook that is used to develop the appearance of applications to users, especially for single-page applications. React.js is used to handle multiple layers of application views utilizing a variety of reusable components. Apps developed using React.js can make changes to data in the viewport without reloading the entire page itself. This makes React.js very popular among modern web and app developers (Singh Timalsina, 2019).
5. **UTAUT**
   UTAUT (Unified Theory of Acceptance and Use of Technology) model is an integrated model developed by Venkatesh et al based on cognitive social theory with a combination of eight leading research models regarding technology acceptance. The UTAUT model has proven successful out of the other eight theories of technology acceptance in explaining up to 70% of user variance. The UTAUT model has four key constructs, namely: performance expectancy, effort expectancy, social influence, and facilitating conditions which have an influence on behavioral intentions to use technology (Rahi & Abd.Ghani, 2019).

Research Methods

The research begins by formulating the problem based on the topic raised for the title of this research, then developing a progressive web app using React.js technology with the scrum method. Then determine the parameters or scope of measurement, followed by designing interview questions or qualitative instruments based on the UTAUT research model,

then the interview results that are obtained will go through an analysis process from the author. and at the end, the author will make a conclusion from this research. The following is an outline illustration of the research flow in Figure 1.

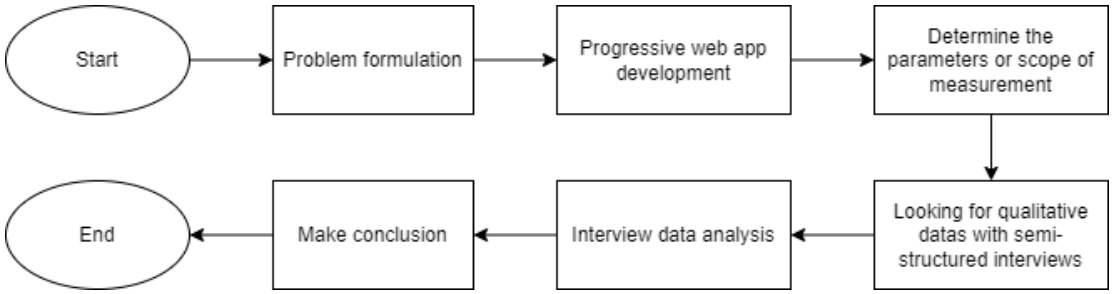

Figure 1. Research Flow

In the development of progressive web app using React.js technology and the scrum method, in this research, the development team will be played by the author. Then the product owner & scrum master will be played by the author's supervisor. The details of the scrum process in this research are the following :

The product backlog list are the following :

a. Setup Development Environments & Sourcecode
b. Build UI + Responsive UI Developments
c. Build Functionalities
    1) Search Functionality + Reset Search Keywords
    2) Integrate Weather API & Get Details for Every Fetch
    3) Error Handlings
    4) Display Background Based on Weather Condition Result
d. PWA Developments + Lighthouse Testing
e. Testings & Bug Fixes
f. App Deployment

In this study, a sprint will last 2 weeks. The plan for designing the application is with 2 sprints which have tasks that are divided according to the following :

Sprint Backlog 1

a. Setup Development Environments & Sourcecode
b. Build UI + Responsive UI Developments
c. Build Functionalities

Sprint Backlog 2

a. PWA Developments + Lighthouse Testing
b. Testings & Bug Fixes
c. App Deployment

Upon going through the sprint process/stages in the scrum, the author also conducts a daily scrum with the product owner & scrum master, then after the expiration of a sprint or 2 weeks, the author conducts a sprint review and sprint retrospective with the author's

supervisor. Then because there are no additional features and the development process runs smoothly, the sprint continues as usual. Until the end of the 2nd sprint, the development process resulted with a progressive web app that has been deployed to a third-party provider with the name of Netlify and can be accessed by the public online. Here is an illustration of the scrum by (Mihajlović Milićević et al., 2019) in Figure 2 :

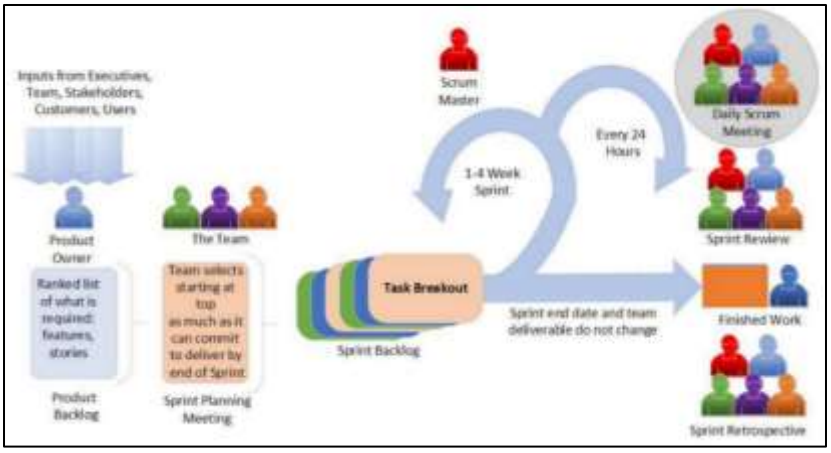

Figure 2. Scrum Illustration

After completing the development of the progressive web app, the author collected data by using the qualitative method or interviews with the concept of semi-structured based on the UTAUT model to computer science lecturers/students in general, with a total of 30 based of references from (Vasileiou et al., 2018). UTAUT has 4 key model constructions namely: performance expectancy, effort expectancy, social influence, and facilitating conditions which influence behavioral intention to use technology (Rahi & Abd.Ghani, 2019). The following is an illustration of the UTAUT model in Figure 3.

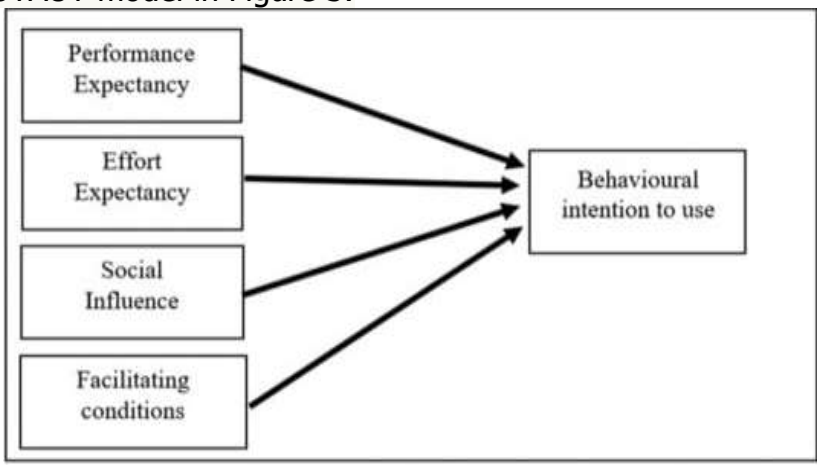

Figure 3. UTAUT Model

With UTAUT and its 4 key model constructions, the author compiled a list of interview questions based on references from (Sedkowska & Kiunsi, 2020) and (Khoirunnisak, 2016) such as the following.

Table 1. List of Interview Questions

Variable	Interview Question
Performance Expectancy	1. Does the user experience the same experience as when using the other native apps when accessing this progressive web app? 2. Does the user feel comfortable / accept this progressive web app? 3. Does progressive web app provide flexible choices for users to access this app from the website or directly from the home screen?
Effort Expectancy	1. Does using a progressive web app feels more practical when compared to a native app that is installed from Playstore or is installed directly to the desktop? 2. Does the user feel any uncomfortable feeling or rejection towards this progressive web app?
Social Influence	1. How big does the user agree with the statement that people who influence user behavior or those closest to user, think/suggest that user should access all applications directly from the home screen without using the website, just like when using native apps/desktop apps?
Facilitating Conditions	1. How smooth is user's device upon using this progressive web app? 2. Does user know that the website that is a progressive web app, has a download button, which when pressed, can add the progressive web app to the home screen?
Behavioral intention to use progressive web app	1. How interested are you in trying and doing activity in another progressive web app that can be accessed from website or directly from the home screen, that suits your needs?

Source: Author

The results of the interviews will be analyzed using the descriptive exploratory method by conveying the results of the interviews in general.

Results and Discussion

Here are some result snapshots of the progressive web app that has been developed with React.js and the scrum method :

In Figure 4, shows the appearance of a progressive web app that is being accessed through Google Chrome browser on the desktop, which has the option to install on the desktop.

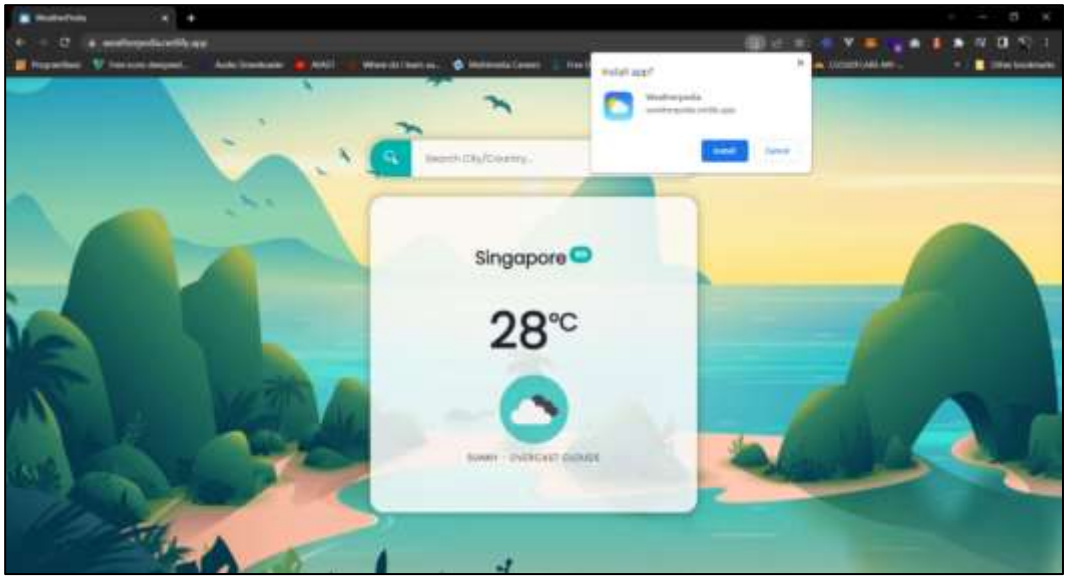

Figure 4. Appearance on Desktop

In Figure 5, shows the appearance of a progressive web app that is being accessed through Google Chrome browser on the desktop, which has the option to install on the desktop.

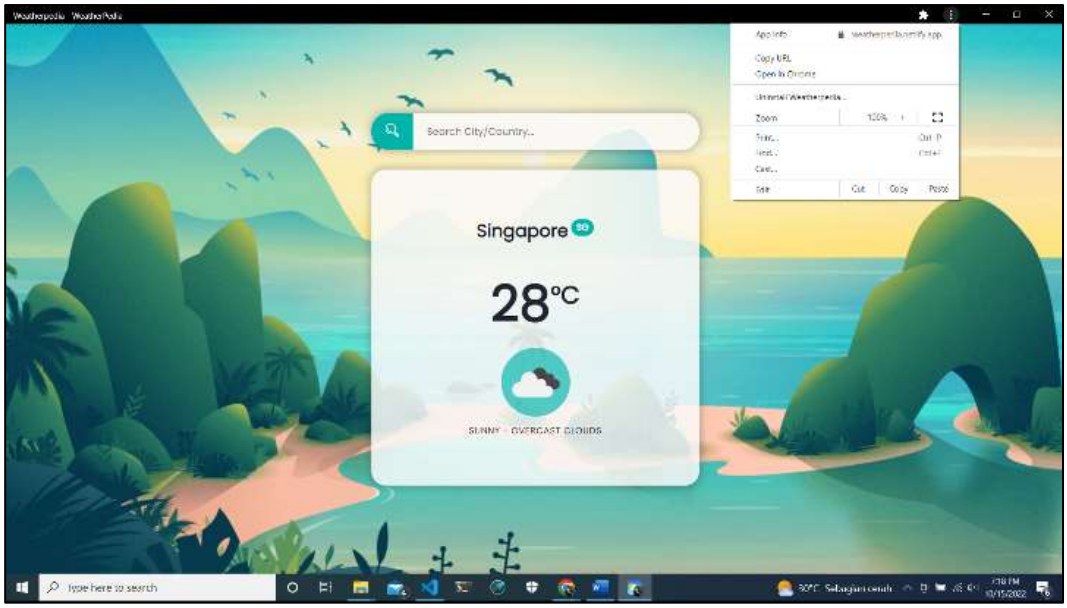

Figure 5. Appearance on Desktop

In Figures 6 and 7, shows the appearance of a progressive web app that is accessed through Google Chrome browser on mobile phones that have the option to install on mobile.

Figure 6. Appearance on Mobile Phone

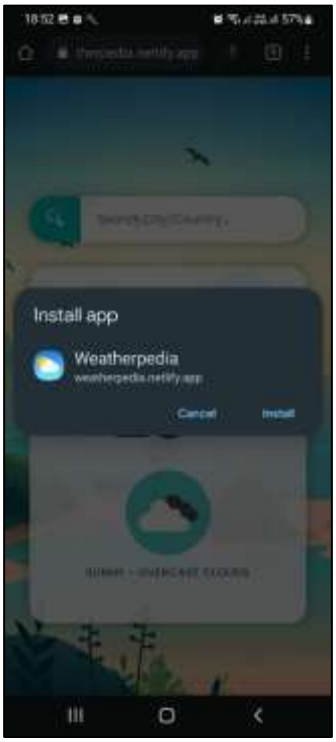

Figure 7. Appearance on Mobile Phone

In Figures 8 and 9, shows the appearance of a progressive web app that is installed on mobile or home screen and can be used similar to like a native mobile app.

Figure 8. Appearance on Mobile Phone

Figure 9. Appearance on Mobile Phone

The results of interviews with 31 people regarding progressive web app are represented using an affinity diagram. Affinity diagrams were chosen because it makes it possible to group repetitive patterns in the data, add structure and gain clarity of the problem efficiently. In addition, the affinity diagram technique is also recommended in this journal to analyze data collected during interviews, focus group discussions, and field studies (Sedkowska & Kiunsi, 2020). The following is an affinity diagram that has been categorized based on UTAUT points.

Table 2. Performance Expectancy Affinity Diagram

Performance Expectancy
"…I think the application is already very similar to the other native apps."
"…I have used progressive web app before, for me, this progressive web app feels comfortable and practical."
"…for me, the progressive web app is very flexible, because I can access it from the website/home screen. If I need to quickly access the progressive web app, this progressive web app is very useful because we can add it to the home screen."

Source: Author

In terms of performance expectancy, average people answered that the experience from progressive web app felt the same as native apps, they felt comfortable using the progressive web app, and also felt that the progressive web app was flexible because it could be accessed from the website or home screen.

Table 3. Effort Expectancy Affinity Diagram

Effort Expectancy
"…progressive web app feels practical to me, overall it's also similar to native apps."
"…yes! I feel that the progressive web app is practical, the progressive web app that we are witnessing is very pleasing to the eye, but it's just nicer because it can be accessed from the home screen or a browser."
"…for me, there is no discomfort/rejection towards progressive web app."

Source: Author

In terms of effort expectancy, average people answered that progressive web app is practical for them, and there is no discomfort or rejection towards progressive web app.

Table 4. Social Influence Affinity Diagram

Social Influence
"…in my opinion, there are pluses and minuses, for the home screen we need to download that takes some space, if from a website you need to have internet access to open. So I'm neutral."
"…for me, I prefer the home screen because for websites we need to open a browser and fill in the URL or something, so I prefer the home screen."
"…I don't agree with accessing all applications directly from the home screen without using the website because not all device has enough storage, so using the website may help."

Source: Author

In terms of social influence, average people answered that they agree with the opinion of accessing most applications from the home screen, due to factors such as convenience, ease, etc. There were also several people who answered that they did not agree/neutral to this opinion.

Table 5. Facilitating Conditions Affinity

Facilitating Conditions
"…my device is very smooth in using this progressive web app."
"…quite smooth because the application is also light."
"…I know the location for the download button on a progressive web app, usually on Google Chrome on mobile, it's at the bottom with words like add to home screen."

Source: Author

In terms of facilitating conditions, average people answered that accessing the progressive web app felt very smooth for them, then there was no any problem, and they knew the location and how to download the progressive web app to their home screen.

Table 6. Behavioral Intention to Use Affinity Diagram

Behavioral Intention to Use
"…for me, I'm same as my friends, quite attracted, quite interested too."
"…after seeing the weather app uses progressive web app, and it looks more practical, I'm definitely very interested to see another progressive web app."
"…interest or not in trying other progressive web app depends on my needs, if the application fits my needs of course I will try it."

Source: Author

In terms of behavioral intention to use Progressive Web App, average people answered that they were attracted and interested in trying and accessing the other progressive web app.

Conclusions

In this research, Scrum & React.js is proven to be able to be used to develop progressive web app. The research results that is obtained using qualitative method represented in affinity diagram form that is categorized based on UTAUT points, shows positive response towards the acceptance of progressive web apps. With the rapid developments of web and browsers, progressive web app will have a promising future to potentially replace native apps (Sedek, 2019).

For future work, analyzing from a wider group of users and security, would make the research about progressive web app to be more comprehensive and complete.

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