

APPLICATION PROGRAM FOR RESEARCH STANDARD APPLIED: A CASE STUDY OF KING MONGKUT'S INSTITUTE OF TECHNOLOGY LADKRABANG

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Received: February 01, 2024; Revised: March 26, 2024; Accepted: April 02, 2024

Abstract

Conducting research or experiments on humans and creatures has contributed to advancement in science and modern healthcare, and that definitely enables us to have a better life quality. Considering the research standard as the key guidelines and criteria for a single standard research system management, the present research that was carried out at King Mongkut's Institute of Technology Ladkrabang, Thailand, aimed to understand the operation of the research standard and research ethics of educational institutions and to design an application program on a smartphone to follow up the aforementioned research standard and research ethics. This research consisted of three different stages; that is, Stage One involved surveying the operation of the research standard and research ethics of educational institutions; Stage Two focused on designing an application program on a smartphone to follow up the research standard and research ethics; and Stage Three was the pilot study and evaluation for an efficacy of the application program. The research findings were greatly essential for stakeholders in gaining more knowledge about ethical research practices in humans and promoting information about the operation in the research standard and research ethics of educational institutions in order to keep the research procedures secured and conduct research underlying the ethical and appropriate academic practice.

Keywords: Educational institution material; mobile application program; research ethics applied; research standard operation

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DOI: <https://doi.org/10.55766/sujst-2024-03-e05610>

Suranaree J. Sci. Technol. 31(3):030193(1-14)

Introduction

Nowadays, it is widely accepted that research studies or experiments on humans and living creatures have contributed to scientific advancement, especially in the fields of medicine, creating knowledge regarding epidemiology, disease occurrence, disease pathophysiology, diagnosis, prevention, and treatments. This is to confirm the effectiveness and drug safety, which leads to modern and advanced methods of diagnosis, prevention, treatments, and health care (Sueblinwong *et al.*, 2007), resulting in a better quality of life.

The National Research and Innovation Policy Council has appointed a subcommittee to improve the laws and regulations to reform the country's research and innovation system with three operational principles and guidelines: improving the laws and regulations, adjusting the structure of agencies in the research and innovation system, and developing various enabling factors such as standard systems, and mechanisms for managing research and innovation. In order to drive the Council's missions, the National Research Council of Thailand, together with the National Science Technology and Innovation Policy Office, has established the policy directions, and strategies, and improved the country's research and innovation system with one important mission, which is to establish the research standards to be used as the guidelines and criteria for managing the research system to have the same standards and to establish the research standards at the research unit level.

At present, the National Research Council of Thailand has continuously and systematically developed Thailand's research standards by promoting the application of the research standards in both science and social science research processes (Phusing, 2008). This helps elevate the quality of research in the country so that the research results are accepted both nationally and internationally. Important research standards are set and used as a mechanism for supervision, inspection, and certification, as well as for maintaining the standards in the research process. The standards include the standards for human research, the standards for laboratory animals, the standards for laboratory safety, the standards for biosafety, ethical standards for evaluators for research projects, academic works, and research works (Taocharee, 2011), and the standards for publication of academic and research works, as well as research integrity, etc.

Creating a system for developing and monitoring the research standards and ethics in

higher educational institutions to promote the ability and safety performance as desired with better efficiency, following the design concept of a mobile phone application based on the standards and ethics of research in higher educational institutions, will contribute to the development of the research system and the research standards and ethics.

Focusing on setting the criteria and measures for carrying out research based on the appropriate ethics and academic principles (National Research Council of Thailand, 1998; Cook *et al.*, 2008), this research, An Application for Operation of Research Standards for Higher Educational Institutions: A Case Study of King Mongkut's Institute of Technology Ladkrabang (KMITL), aims to study the operation of the research standards and ethics at higher educational institutions, leading to the design of a mobile phone application to monitor the research standards and ethics in higher educational institutions, and, subsequently, the evaluation of the application for monitoring the research standards and ethics in higher educational institutions.

Conceptual Framework

The conceptual framework for the research standards functions as the guidelines and criteria for managing the research system to meet the same standards as well as to establish the research standards to raise the quality of research in the country so that the research results are accepted both nationally and internationally (Kusumawalee, 2011). The following research standards, used as the mechanism for supervision, inspection, and certification, and for maintaining the standards in the research process, are established: the standards for human research, the standards for laboratory animals, the standards for laboratory safety, the standards for biosafety (Guerrero and Urbano, 2010), and the ethical standards for evaluators for research projects, academic works, and research works (Taocharee, 2011), as displayed in Figure 1.

The conceptual framework for developing the application adopts the System Development Life Cycle (SDLC), consisting of seven steps (Srinutpong, 2007), which explain the search for work system projects needed to be developed and the consideration of the projects that will bring the organization the most returns. It describes the logical process of developing an information system to solve health service problems for the elderly and meet the needs of users. This may start with developing a new system or improving an existing system (National Research Council of Thailand, 2016a; 2016b). The steps in the SDLC enable

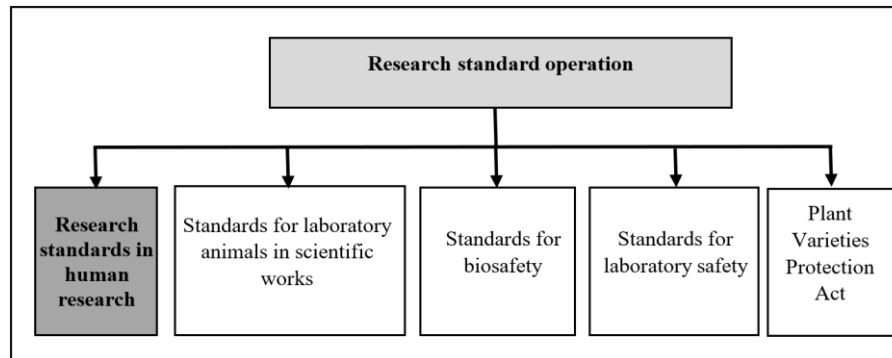


Figure 1. KMITL operation of research standards

system analysts to follow the guidelines step-by-step and control the duration and budget for the performance of the system development projects. This cycle covers every step from the beginning, is workable, and requires the system analysts to fully understand the function and the operation in each step (National Research Council of Thailand, 2017). Based on the cycle, the conceptual framework of this research consists of seven steps as follows:

- 1) Project Identification and Selection
- 2) Project Initiation and Planning
- 3) System Analysis
- 4) Logical Design
- 5) Physical Design
- 6) System Implementation
- 7) System Maintenance

The following needs to be considered when designing and developing a mobile phone application: the usage patterns of people according to their age, the on-screen image, and the components in the computer system, leading to securing the data reception and transmission (Kirby *et al.*, 2011; Di Ciccio *et al.*, 2022).

Research Area

The research area of this study was King Mongkut's Institute of Technology Ladkrabang (KMITL). Established with the assistance of the Government of Japan, KMITL is a public university that emphasizes science and technology instruction, located in Ladkrabang District in Bangkok at the following address: 1 Soi Chalongkrung 1, Ladkrabang Subdistrict, Ladkrabang District, Bangkok 10520.

Materials and Methods

Population

The population in this study was KMITL staff, consisting of 2,140 staff members.

Research Sampling

In this qualitative research study, the data were collected from the samples within the research area and the experts outside the area, following the research plan, which is divided into three activities based on the research objective as follows:

Activity 1: Study the operation of research standards and ethics at higher educational institutions. The sample consisted of 24 experts on the operation of research standards and ethics at higher educational institutions and the operation of the research standards in human research, the standards for laboratory animals, the standards for laboratory safety, the standards for biosafety, and the Plant Protection Act.

Activity 2: Design a mobile phone application to monitor research standards and ethics at higher educational institutions. The design was based on the information from the experts on information technology and mobile phone application development. The experts were divided into two groups, six experts for each group, in accordance with their qualifications as follows:

1. Six experts on information technology from the public sector and non-profit organizations, and
2. Six experts on mobile phone application development from the public sector and non-profit organizations.

Activity 3: Evaluate the application for monitoring the research standards and ethics at higher educational institutions. The sample consisted of 30 subjects, divided into two groups as follows:

1. 15 researchers and staff members who conducted research at KMITL, and
2. 15 staff members working at the Research Standards and Ethics Department at other higher educational institutions.

Research Instruments

The details on the research instruments for collecting the qualitative data based on the three research activities are as follows:

Activity 1 research instrument was a structured interview in which the data were collected from 24 experts on the operation of the research standards and ethics at higher educational institutions. The structured interview covered the following issues:

- The research standards in human research,
- The standards for laboratory animals in scientific works,
- The standards for biosafety,
- The standards for laboratory safety, and
- The Plant Protection Act.

Activity 2 research instruments were two structured interviews. In the first interview, the data were collected from six experts on information technology, covering the following issues:

- 1) The use of mobile phone applications appropriate to the groups of users,
- 2) The user-friendly screen design,
- 3) The functions of the applications that are easy to operate and not complex, and
- 4) The directions for program development for users in specific areas.

The second interview was conducted with six experts on mobile phone application development from the public sector and non-profit organizations, covering the issues that can lead to the development of the applications based on the information provided by the experts.

Activity 3 research instruments comprised a prototype application for monitoring the research

standards and ethics at higher educational institutions and an evaluation form for the application trial. The data were collected from 30 subjects consisting of 15 researchers and staff members who conducted research at KMITL, and 15 staff members working at the Research Standards and Ethics Department at higher educational institutions. The data collected from both sample groups were linked.

The components of the application were evaluated with the overall trial of the mobile phone application, as follows:

- Mobile Application is an application designed for mobile devices such as mobile phones and tablets. The application responds to the user's needs.
- Web Server functions as the information provider to the clients or any computers that request services in the multimedia format.
- HOSxP is a software application for organizations.
- Content Management System (CMS) is the system used to create and manage the application.

Incorporated with the research area, the sampling groups, and the research instruments, Figure 2 displays the development of a prototype application tool for monitoring the research standards and ethics at higher educational institutions.

Figure 2 Flowchart of application for monitoring research standards and ethics. This research model can be used to verify the performance by evaluating the application for

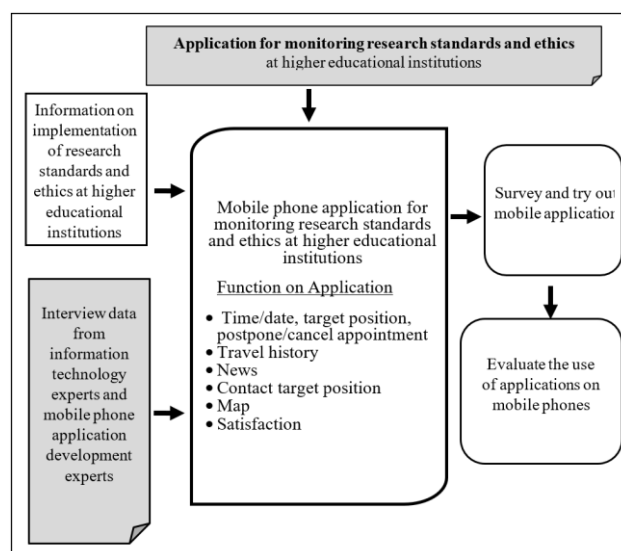


Figure 2. Flowchart of application for monitoring research standards and ethics

monitoring the research standards and ethics at higher educational institutions (Etzkowit, 2004).

Data Analysis

The data analysis for developing an application to monitor research standards and ethics at higher educational institutions: A case study of King Mongkut's Institute of Technology Ladkrabang consisted of the following steps:

1. The qualitative data from the structured interviews regarding the operation of the research standards and ethics at higher educational institutions and the interviews with the information technology experts and the experts in mobile phone application development were analyzed and processed using content analysis with related computer programs e.g. Photoshop, Microsoft Excel, and 3D AutoCAD.
2. The qualitative data collected from the mobile application prototype tool monitoring the research standards and ethics at higher educational institutions were analyzed using descriptive statistics, estimating the value of problems according to BEST's criteria.
3. An analysis was conducted on the use of mobile phone application formats to monitor the research standards and ethics

at higher educational institutions for further implementation.

This research on the mobile phone application monitoring the research standards and ethics at higher educational institutions was qualitative; therefore, an analysis according to the situation model was employed in order to draw conclusions and, subsequently, carry out the evaluation.

Result

The present study on the mobile phone application for compliance with the research standards for higher educational institutions started by examining the operation of research standards and ethics at higher educational institutions, followed by designing the mobile phone application for monitoring the research standards and ethics in higher educational institutions based on the evaluation on such application.

Research Standard Operation Format

The information on the services and activities on the research standards in human research consisted of five parts based on the information on the research standards and ethics in human research in higher educational institutions. The survey issues consist of the following:

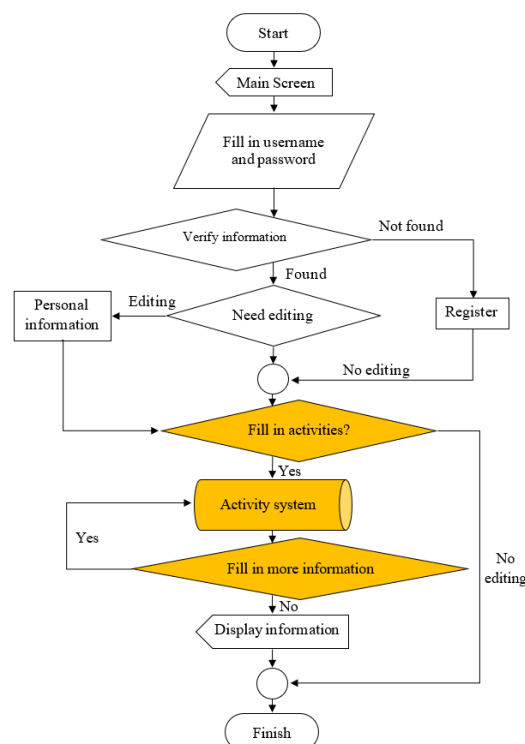


Figure 3. Steps for operating the application on the iOS system

The components of service providers and service recipients, the online technology for providing the research standard services, the media system for publishing news about the standards for conducting research, the channels for news notification of the research standards, and the safety of the research data, are presented in Table 1 Survey information on research standard operation. Figure 3 illustrates the design of the operation of the research standards application on the IOS system.

According to Figure 4, the design of the operation of the research standards application on the Android system, the functional design of the

application is described using the standardized symbols, the keywords describing the resulting data, the commands, and the selections for each step in the application on both the Android and iOS operating systems, linked by the arrow lines indicating the direction from the beginning to the end.

The organization of the application continues from the design and development of the data movement by defining the display groups according to the goals and the needs of the application users, as shown in Figure 5, Organization of the structure of the application.

Table 1. Experts' evaluation on the application

Expert	1. The information in the application meets the needs.	2. The speed of response to use	3. The ability to display results accurately and realistically	4. Ease of use of various commands in the menu	5. Preparation of sufficient information for use	6. Application installation process	7. The screen layout	8. Ease of/Difficulty in understanding	9. Positioning of components and menus
A	100	80	80	80	80	100	80	80	80
B	80	100	80	100	80	80	80	100	100
C	80	100	100	80	100	100	80	80	80
D	60	100	80	60	80	40	80	80	80
E	80	80	80	80	80	80	60	60	60
Average	80	90	83	77	80	77	77	80	80

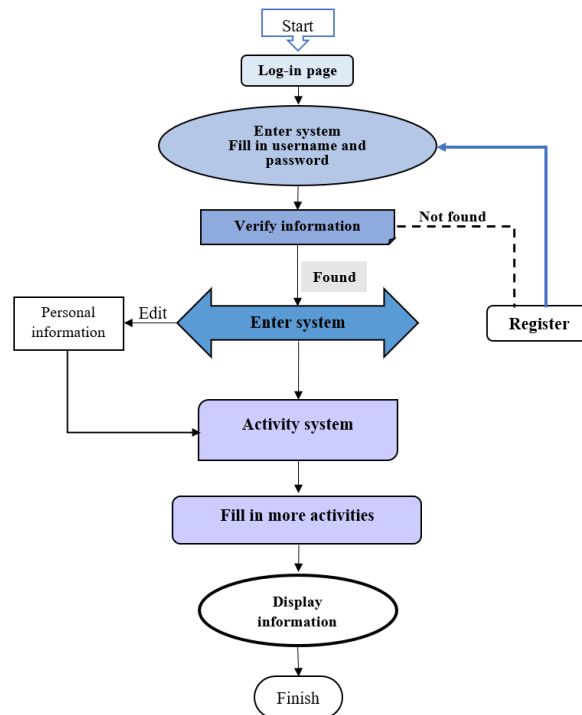


Figure 4. Steps for operating the application on the Android system

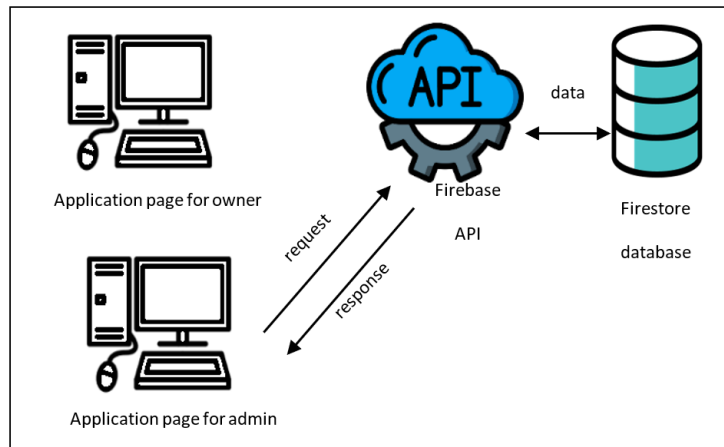


Figure 5. Organization of structure of application



Figure 6. Shows the application screen design results, linking the information in the application

The data management on the research compliance application requires login by registering before saving and editing the information with Google Authenticator so that the data management is systematic and safe.

For the application page link, when designing, each page of the application must be arranged according to the layout and the activities needed to be presented and display the search results according to the commands. As shown in Figure 6, this follows the study model of developing and designing the information page links on the applications for both Android and iOS operating systems.

There is an operational format based on sending and receiving the commands from the registered users and the specified information based on the personal data security framework.

Evaluation of the Application

The application was tested and evaluated by the experts at King Mongkut's Institute of Technology Ladkrabang. Table 1 illustrates the experts' evaluation of the application.

From the evaluation, the researchers prepare to develop the use of various commands on the menu and the layout of the screen as the priority to suit the application user groups.

Application Evaluation by Research Standard Service Providers

The application evaluation by the research standard service providers at KMITL, comprising research coordinating staff from every school with experience in providing information on the research standards, is presented in Table 2.

Table 2. Experts' evaluation on the application

No.	1. The information in the application meets the needs.	2. The speed of response to use	3. The ability to display results accurately and realistically	4. Ease of use of various commands in the menu	5. Preparation of sufficient information for use	6. Safety in using the application	7. The screen layout	8. Ease of/Difficulty in understanding	9. Positioning of components and menus
1.	80	80	80	60	60	60	80	80	80
2.	100	80	100	80	80	100	80	100	100
3.	100	100	100	100	100	100	100	80	100
4.	100	80	100	100	100	100	80	100	100
5.	80	80	80	60	60	60	80	80	80
6.	100	80	100	80	80	100	80	100	100
7.	100	100	100	100	100	100	100	80	100
8.	100	80	100	100	100	100	80	100	100
Average	95	85	95	85	85	90	85	90	95

The evaluation of the application by the research coordinator from KMITL Research and Innovation Services or KRIS, King Mongkut's Institute of Technology Ladkrabang's research support unit, was analyzed, in which the researchers will employ the results for further development of precision in responding to the commands on the menu as well as the screen layout as the priority, making it convenient to the users of the application.

Application Trial By the Service Recipients

The application trial was conducted with the service recipients at KMITL, some of which were part of the sampling group previously surveyed on the research standard activities prior to the application design and those who were the new group of subjects. The details of the trial are as follows:

According to Figure 7, developing the research standard services using the application for the service recipients needs to meet the recipients' needs, which are unique according to their society and culture. The service providers must investigate and create activities in compliance with the needs.

Therefore, the development of the application for compliance with research standards for higher educational institutions, which, in this research, is KMITL, is the way in which the messages from the service providers and recipients can be conveyed via online media, making it more flexible and effectively reducing the time when contacting.

Guidelines for Developing an Application for Research Standard Services

The application can be used to share information on the research standards with higher educational institutions. It is an online supporting

tool for managing the research standards for researchers and those interested. The trial was conducted among the service providers and recipients at KMITL. The suggestions given after the trial are as follows:

- 1) Problems regarding using the application
 - The system is rather complicated e.g. after registration, the process is repeated, starting from the beginning, and there is no exit or return button.
 - Filling in information is problematic e.g. the user cannot return to the previous page to edit any information; if editing is needed, the user is required to fill in all the information again. In addition, the information regarding affiliations and equipment is rather limited.
- 2) Font size
 - When zooming, the picture is blurred and unreadable.
 - The font is unclear e.g. in the Plant Variety Protection Act section.

Based on the suggestions, the researchers have developed the website of the community products, so that the use is more effective and suitable for the target groups. The details of the development are presented in Figure 8.

In this study, the researchers conducted the trial of the application after the improvement, as shown in Figure 8, with a group of service recipients at KMITL, as displayed in Figure 9.

The survey and the development of the application for providing the research standard services need to be conducted continuously in order to create a communication application between the provider and the recipient, which is up-to-date and suitable for the changing technology.

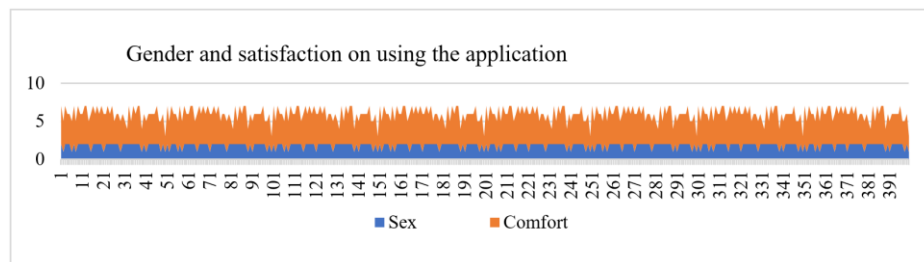


Figure 7. Users' satisfaction on the application

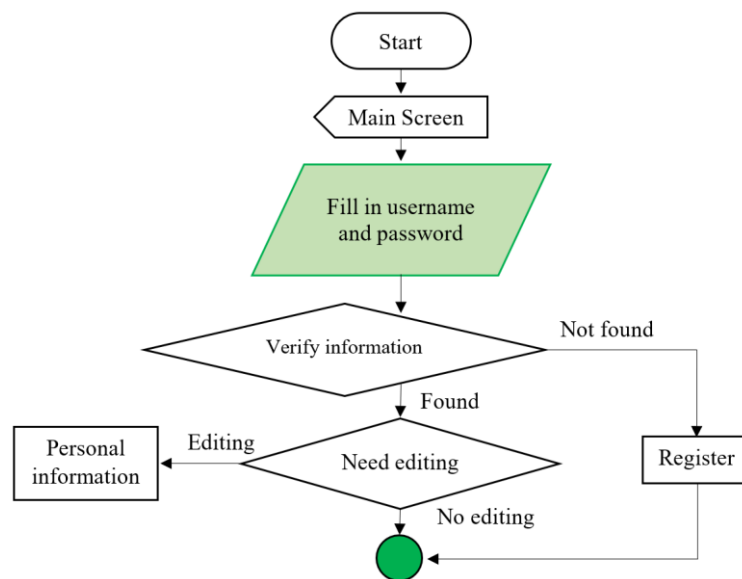


Figure 8. Improved structure of application

Conclusions

This research began with a study of the operation of the research standards and ethics at higher educational institutions, leading to the design of a mobile phone application following the research standards and ethics at higher educational institutions based on the evaluation of the application.

Format of Activities in Compliance with Research Standards

The development of the application monitoring the research standards consisted of three steps, linking the innovation management, respectively. The steps include the following:

- 1) Investigate the operation of the research standards and ethics at higher educational institutions, and
- 2) Design a mobile phone application for monitoring the research standards and

ethics at higher educational institutions and evaluate the application.

For the development of the application in the respective sequence as mentioned above, it took the researchers one year to survey the research area, design the application that promotes the research practice in compliance with the research standards, and evaluate the application via an online platform, in which the researchers appreciated the kind cooperation from the service providers and the service recipients and from the sample groups.

In order to link the data between the application and the KRIS Website, the findings obtained from an analysis of the users' needs and participation in the research standard monitoring activities were incorporated in the design of the interface between the two platforms for the continuation of the activities, as illustrated in Figure 10.

An interface of information between the application and the KRIS Website is the data center

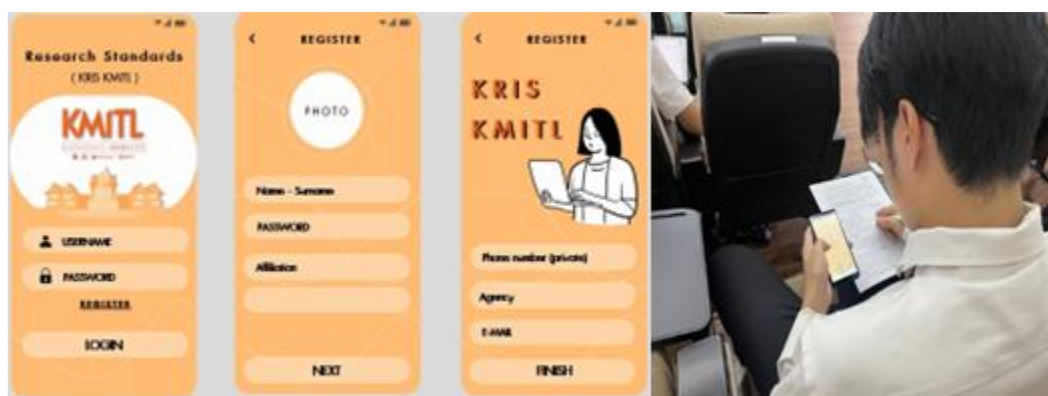


Figure 9. Evaluation of application after improvement

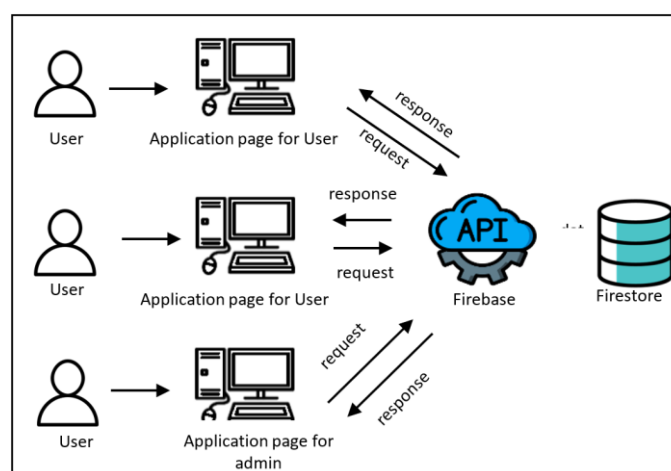


Figure 10. Interface between the application and KRIS Website

with an innovative structure using the data management model from the online platforms (East, 2014). This data management was evaluated after the trial at KMITL, as shown in Figure 11.

The application evaluation results contribute to the study and the analysis of implementing the research standards to effectively create creative collaboration in the research community. The survey on satisfaction with using the application for monitoring the research standards among the sample groups who use smartphones daily (Satty and Vargas, 2012) leads to the use of the innovative application for monitoring the research standards and further enhancing the research activities.

Conclusion on the Research Standard Application Design

This study aimed to develop an application for monitoring the research standards at higher educational institutions. Those who engaged in the application trial were mostly the research standard

service providers and recipients who received the services in terms of receiving and forwarding news as well as making appointments to improve the project according to the recommendation. The findings are discussed below.

Recognition of Research Standard Compliance Activities

The activities in compliance with the research standards to promote research at higher educational institutions were published via basic recommendations posted on the KRIS Website.

It can be seen that the recognition of the basic recommendations posted on the KRIS Website,

especially via online channels complying with the WHO Operational Guidelines for Ethics Committee (That Review Biomedical Research, 200), effectively helps promote the recognition of the activities. In addition, the development of the application for monitoring the research standards

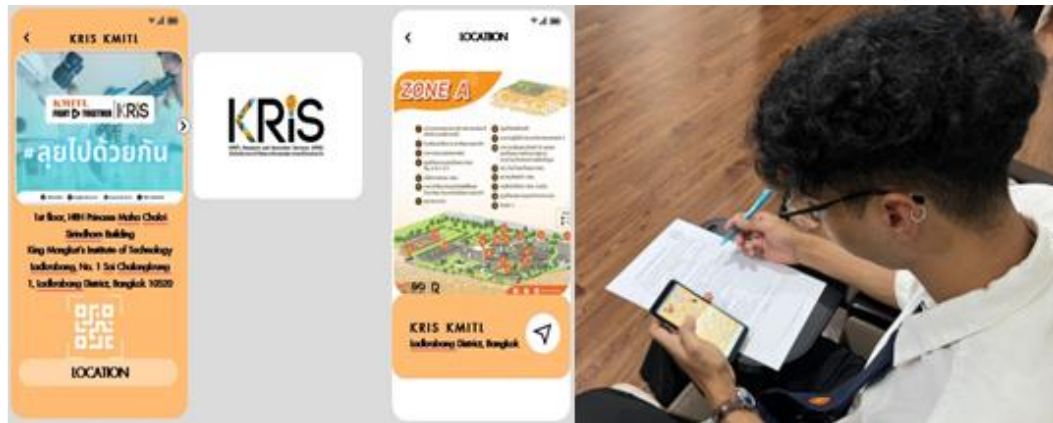


Figure 11. Evaluation of the research standard application

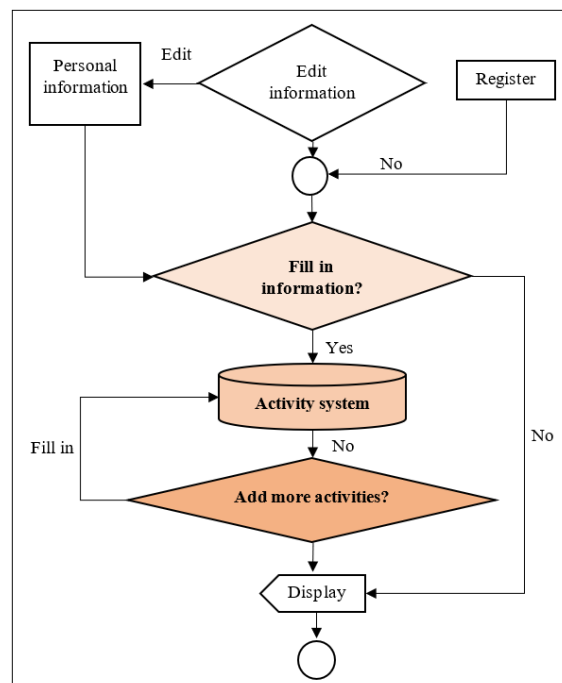


Figure 12. Activities in developing the application

can potentially drive engagement in research activities in higher educational institutions (Thu *et al.*, 2019) by making the application available on both Android and iOS systems, enabling innovation accessible to all sectors.

Learning to use the Application For Monitoring The Research Standards

The sampling groups consisting of the research standard service providers and recipients were engaged in the trial of the application and provided the guidelines for further development of the application in compliance with the promoting

activity to follow the research standards. They agreed to cooperate in creating the guidelines for developing the application, as displayed in Figure 12.

It can be said that the trial of the research standard practice application is both learning and suggestions for the development of the research system in line with the changes in contemporary technology, which is supported by the concept of information behavior and acceptance of information technology (Yarmoshenko *et al.*, 2016). This indicates the role and the guidelines for developing further cooperation between various mission groups.

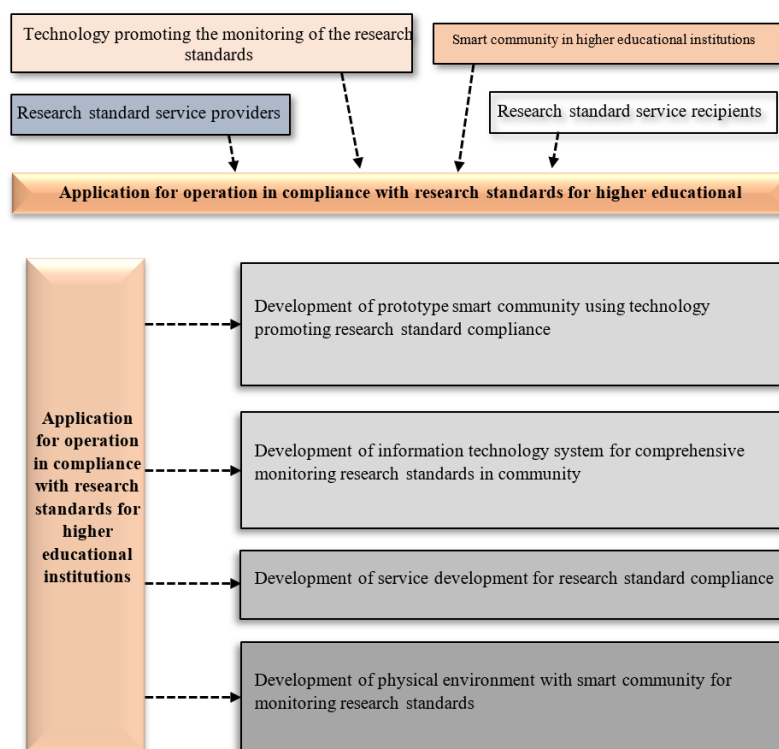


Figure 13. Development of the research standard application

Raising Awareness of Research Standards Compliance

In order to raise awareness of the creative practice of the research standards with the support of contemporary technology, the sample groups in the study area were involved in determining the format and directions of the development, which will create a coalition in forwarding widespread use of the application as illustrated in Figure 12, showing the participation in providing information for further development of the application and Figure 13 presents the results of the data presentation on the application promoting in compliance with the research standards.

Following the development of the research standard application, as Figure 13, in terms of the environmental development section, creating a research standards compliance group, participating in the design, and determining the direction of such development can be supported by integrating the research environment (Royal Thai Government Gazette, 2011). The development of an application to track the research standards can be used to communicate and manage the research standards, according to the following diagram:

The results obtained from investigating the management of the research standards tracking application revealed the participation and

cooperation in using contemporary technology with the continuous use of the application (Royal Thai Government Gazette, 2011). The beneficial suggestions are provided in the next section.

Recommendations for Creating Research Standard Applications

The study, An Application for Operation of Research Standards for Higher Educational Institutions: A Case Study of King Mongkut's Institute of Technology Ladkrabang, was conducted

via the survey process, design and evaluation. Cooperation from the service providers and recipients of the research standards and agencies related to the application development was given with the recommendations as follows:

Recommendations for Institutions

- 1) KRIS, the service section, should establish policies for presenting information and activities for promoting research practice in compliance with the research standards for higher educational institutions. The policies can be communicated to the target groups covering all channels, especially the technology in the form of applications.

- 2) The agencies that receive the research standards services and the researchers in all fields of higher educational institutions are suggested to collect the information regarding compliance with the research standards, present the contemporary technology operation options, as well as jointly develop the applications that are consistent with the times through research.

Recommendations for Group And Individual Users

- 1) Researchers and research teams are advised to study and promote compliance with the research standards for higher educational institutions as well as present the information promoting the use of contemporary technology and the caution when using the applications to the research standard group. In this regard, the committee should constantly join in developing the application to monitor the research standards to meet the regulations.
- 2) Using an application to track the research standards requires learning to use such contemporary technology for the benefit of research and innovation management and fully complying with the research standards with an awareness of using the technology safely.

Recommendations for Further Research

- 1) The study and development of this contemporary technology, "Research Standards Tracking Application", should be carried out with other research activities for effective recognition of the research standard services in higher educational institutions. This will help increase the quality of further research.

There should be a joint study and development of the "Research Standards Tracking Application" with the private sectors, which provide various services in other educational areas, so that good relationships can be built, and the research standard service options continue to increase.

Acknowledgement

This research project, An Application for Operation of Research Standards for Higher Educational Institutions: A Case Study of King Mongkut's Institute of Technology Ladkrabang, received research and innovation grants from Thailand Science Research and Innovation (TSRI) with the

aim to promote the compliance with the research standards for higher educational institutions. Without any support and kind assistance from the sampling groups of the research standard service providers and recipients, the experts on developing applications and information technology from KMITL, and the comments and guidance from the KMITL research and innovation funding committee, this project would not have been completed. We would like to express our heartfelt gratitude to all academics, researchers, and those involved, who cooperated in every step while conducting this research.

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