

User-centered Design Strategies to Develop Mobile Application for Selection of Digital Forensics Tool

Erika Ramadhani, Agrian Persada Gama

Department of Informatics, Universitas Islam Indonesia, Jalan Kaliurang Km14.5, Sleman, Indonesia

Abstract – There are several types of digital forensics tool. Therefore, to help investigators to choose suitable tools, a recommendation system is needed. This research type is development of mobile application recommendation system. The development using User Centered Design (UCD) method. The evaluation system uses the Blackbox method and the User Acceptance Test (UAT) method. From the results, it is concluded that the application is useful, easy to use, and easy to learn by users. As for usability testing, it was found that the users found it very helpful to operate, which was 28 students with a margin of error of 5%.

Keywords – digital forensics, tool selection, mobile application, user-centered design.

1. Introduction

Digital forensics is a part of forensic science that aims to find, recover, and investigate data contained in digital devices such as computers, mobile phones, tablets, network devices, storage media, and etc. When conducting an investigation, investigators use a tool such as an application to assist in collecting data and analyze data, and to find digital data evidence.

DOI: 10.18421/SAR53-07

<https://doi.org/10.18421/SAR53-07>


Corresponding author: Erika Ramadhani,
*Department of Informatics, Universitas Islam Indonesia,
Jalan Kaliurang Km14.5, Sleman, Indonesia*
Email: erika@uii.ac.id

Received: 16 July 2022.

Revised: 17 September 2022.

Accepted: 23 September 2022.

Published: 27 September 2022.

 © 2022 Erika Ramadhani & Agrian Persada Gama; published by UIKTEN. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 License.

The article is published with Open Access at www.sarjournal.com

The data evidence usually is used in the court of law. In the process of investigation, forensics has certain procedures in its handling. One of a very important procedure is the selection of tools in the investigation process.

Investigator has to choose the appropriate tools to be used in the process of digital forensic investigation. Therefore, it takes the ability to quickly select and evaluate the tools to be used [1], [2], [3].

To get a computerized function, an expert system-based application is needed. In this case, the expert system serves as a substitute for someone who is an expert in the field of forensics. There have been several studies that have tried to design systems for recommendations for selecting tools in digital forensics investigations. Paper [4] designs an investigation tool selection system by utilizing a web-based expert system. The basis for selecting tools in the digital forensics field is based on a rule-based expert system using the forward chaining method. In terms of user experience (UX) the website created has a lot of disadvantages because it is not responsive, so it is not comfortable to use on the mobile device. Therefore, this can be facilitated with the help of a mobile application, so there is no need to use the internet, but require user to download update regularly. The mobility of mobile applications is also one of the main factors in improving the ability to handle tasks and activities on the go, so that users simply download the application on their smartphone and can access the tool selection feature easily without having to type in the website url and use a website that is not responsive [5], [6], [7].

In this paper, we develop the existing website for the selection tools that was made into a mobile device-based application. The tools recommendation system was made according to a website based for accessing data or information. The design is carried out with using the UCD method. UCD is a design philosophy that puts the user at the center of a process system development [8], [9]. The result of the paper is a mobile application design model that

can be better used by digital forensics students. According to the results of blackbox testing, it can be concluded that all features are successful, while the UAT test obtained an average value of 4.1 out of 5 using a Likert scale. From the average results, it can be concluded that the application made useful, easy to use, and easy to learn by users. As for usability testing, it was found that the users found it very helpful to operate, which was 28 students with a margin of error of 5%.

2. Literature Review

The related research tries to design an investigation tool selection system with utilizing a website-based expert system [4]. The basis of the selection of tools in the field of digital forensics in research is based on a rule-based expert system using forward chaining method. The results of these studies can help users in choosing tools the right one based on the functionality and characteristics. There is the weakness in this paper research; it is that in terms of user experience. It can still be researched and further developed to make it easier for users. Therefore, from the results of the analysis a solution was obtained, namely the development of applications into mobile version using the UCD. The website at resolution mobile devices can be seen in Figure 1. From Figure 1 it can be concluded that the website above has shortcomings in terms of flexibility of component layout or website layout (responsiveness) which can result in users do not feel at home or less comfortable when using the web. By setting a user as the center of the design, design process is expected to make the user experience appropriate to the wishes of the user.

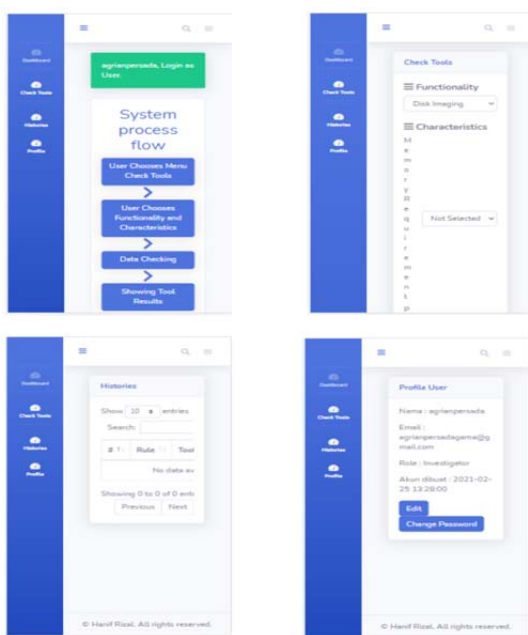


Figure 1. Website of expert system for selection tool in digital forensics investigation

In this research, a topology is developed, which is commonly used to help digital forensic examiner in tool selection. The designated tool is a commercial tool as well as open source. The output of this research is a collection of tool characteristics that can be used as selection criteria [10]. Tool selection characteristics are obtained from distributing questionnaires to digital forensic experts. The results obtained from the results of the questionnaire were used in this study simultaneously with the application functionality type as a parameter to determine the tools that match to investigator.

3. Method

In this paper we use UCD as a method to design the system. The stages in UCD are depicted in Figure 2. The stages consist of: (1) understanding the user context, (2) determine the user requirement, (3) design solution, and (4) evaluation. Planning is the first step of the process in the designing that focus on the user. The output of the stage is the system that meet to the user requirement.

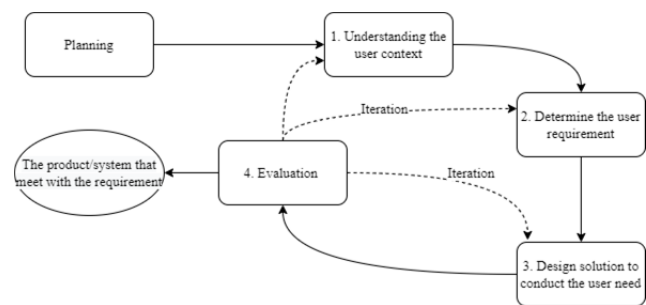


Figure 2. UCD process

3.1. Planning

In the planning process we have to hold discussions with people who will work on the project, to get a commitment that the process project development is user-centered or user. That means that the project will have the time and tasks to engage users or users in the beginning and end of the process or where they are needed. People who are working on the project should know very well about this method through literature studies, training or seminars [11].

3.2. Understanding the User's Context

In the stage of understanding the user's context, there is identification of digital forensics students who will later use this app. It aims to explain why and under what conditions students use the application. The problem that arises is difficulty of the user to determine or match what tools will be used in solving a case. It takes a long time because

they have to match the tools one by one with the case that the user is currently handling this. With the website, it is still less effective in helping users, because when matching tools one has to access it through the website. In addition, based on the results of usability tests of investigators by previous web-based research concluded that some parts of the system display are not in accordance with the user experience, so that the problem regarding system interface design is an important issue that will try to solve with the design and manufacture of this mobile application.

After analyzing the problem, the next thing to do is to determine who have this problem. From the problem, it is assumed that the investigator or students are those who have this problem. This is because the website-based system is previously also built with the main user base being students and digital experts for forensics. This mobile application has no features for experts so that investigators/users are the people most likely to use this mobile application.

3.3. Determine the User's Requirement

On the determining user's requirement, we determine what functionality and characteristics are needed by students. User personas are formed and grouped according to predetermined characters previously.

The objective is to focus more on designing the system in order to create real user needs. Users or students are obtained from the results of user analysis and persona selection that is determined through interviews. There are two personas selected from digital forensic students who are studying their field of study.

Furthermore, the data in the form of goals and frustrations above are used as a reference in application prototyping. The difficulties encountered by users are in terms of the layout of the system is still disorganized well, so it is not comfortable to use.

3.4. Design the Solution to Conduct the User's Need

3.4.1. Use Case Diagram

Use case diagram is made accordingly with the goals by the personas. Use case is used to find out what an actor can do in the application, which describes the interaction relationship between the system and the actor. Use case can describe the type of interaction between the user of the system and the system. The use case diagram of the system can be seen in Figure 3. The component of use case diagram is system, actor, and use case. A system is depicted

in the form of a square. Its function is to limit use cases with interactions from outside the system.

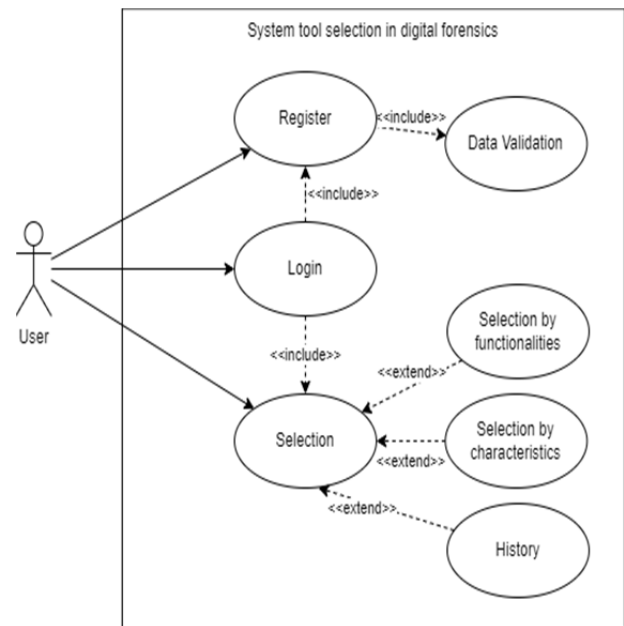


Figure 3. Use case diagram

The actor of the system is an investigator that has the limitation of access in the system. The limitation is that the investigator can only do process register, login, checking the popular tool in the home screen, get recommendation for the investigation tool, manage history, and manage profile. The explanation is as follows:

1. User: people who can access or use the application, from logging into the application to take actions on applications such as select the tool and check the history.
2. Register: register is the first step taken by the user when he does not have access to the application. Register uses personal data into the application for identification.
3. Login: after getting an account, the user has to login in order to access various features of the application.
4. Selection: the user's activity to select the tool for a recommendation. The user can select the tool according to the functionality and character of the tool.

3.4.2. Hierarchical Task Analysis (HTA)

HTA is a method that details what work steps are needed to achieve a goal. The form of HTA is a breakdown tree with several levels, where the lower level will explain the level above it. Level 0 is the goal to be achieved. Level 1 is the steps that have to be taken to achieve the goal. Level 2 details the steps at level 1, and so on until the most detailed steps cannot be broken down anymore.

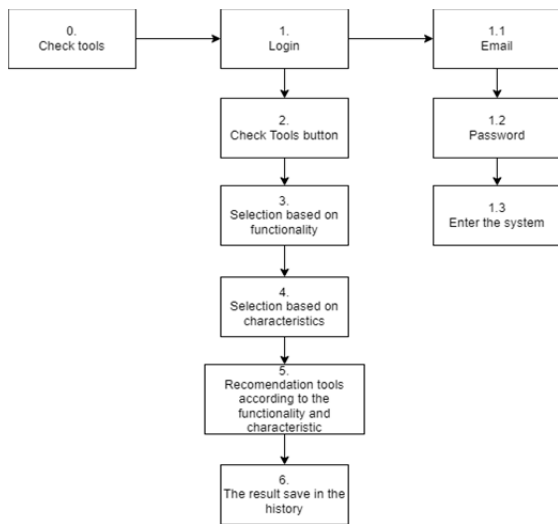


Figure 4. HTA of the application

The output of HTA is a hierarchy of tasks and sub-tasks as well as plans describing in what terms the demand and under what conditions the sub-tasks are carried out. Figure 4 describes the steps to find tools according to the functionality and characteristics result in suitable tools with the case being worked on by the user.

3.4.3. Flowchart

A diagram describes the process flow of an application. In building application, flowcharts play an important role in translating the running process of application so that it is easier to understand. Flowchart plays an important role in deciding a step or functionality of a programming project that involves many people at once. In addition, using a process flow chart from a program will be clearer, concise, and reduce the possibility for misinterpretation. The use of flowcharts in programming is also a great way to connect technical and non-technical requirements. The flowchart of the application is depicted in Figure 5.

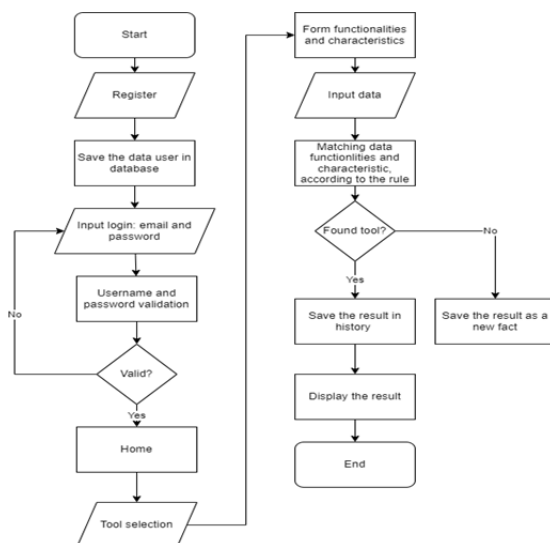


Figure 5. Flowchart user

3.4.4. Wireframe

Wireframe is formed according to the needs of personas and HTA. Personas have goals which will be used as a reference in the wireframe. Wireframe is a framework or blueprint in UX Design that becomes a visual representation of the structure of a website or application. To understand wireframes simply, one can imagine the process of making a house. Before applying paint and placing furniture, an architect needs to draw a floor plan. He needs to make sure the space in the house is functioning properly and in accordance with the expectations of its occupants.

In this illustration the floor plan can be thought of as a wireframe when building a website. One needs to create a wireframe before entering all the elements and elements that support the interface of a website. The wireframing process itself is usually carried out during the exploration phase of the product life cycle. During this phase, the designer will typically examine product scope, collaborate on ideas, and identify business requirements.

The wireframe itself will be shaped like a simple black and white layout without specific colors, fonts, logos or other design elements. There are at least 3 main elements that usually exist in a wireframe, namely: (1) Design information consists of the main information such as the structure and the layout of the application, (2) Design navigation made the navigation to increase the experience of user, and (3) Design interface which gives the visualization and user description. The main purpose of a wireframe is to illustrate the hierarchy, website structure and interface elements that will exist and be populated during site development.

In this stage we focus on the page of check tool. Home page check tools display the functionality of the tools which will be used later by investigator/user. On the second page, check tool includes the characteristics of the tools which want to be used by investigators/users, because each tool has different characteristics.

3.4.5. API Design

In this stage we design the database and show how to retrieve the data and design the endpoint API. Database is used for storage of each data used on each processes in the system. The application retrieve data from an existing database, has two stakeholders, namely users and admins, but only chooses/takes one of these classes and uses it in the applications created.

API endpoint design fetches data from existing database, API connects two different system scopes. API endpoints are gateway to the entry of data that will later connect the API and the mobile application to be created. There are 13 endpoints created in this application.

3.4.6. Application Evaluation Result (AER)

This stage is the stage used in testing the smoothness of a program which has been made. In this paper, the application testing uses the Usability Testing method and Blackbox method.

User Acceptance Testing (UAT): UAT (User Acceptance Testing) testing is a testing process by users who intended to produce documents that are used as evidence that the system developed can be accepted or not by the user. If the test results are acceptable deemed to meet the needs of the user, the application can be implemented. Usability testing needs to be done to find out in advance possible obstacles usage when using the app and also to get feedback from user.

Blackbox Testing: Blackbox testing is a software testing technique that focuses on specifications functionality of a software. Advantages of using the blackbox testing method are: (1) Testers do not need to learn about a particular programming language, (2) Testing is done from the user's point of view, and (3) Programmers and testers depend on each other.

3.4.7. Prototype

This page is the main application page. The main page design is made with minimize writing or sentences and replace with images. The Check Tools page matches the case being handled by the user by incorporating functionality and characteristics according to predetermined rules by experts which can be seen in Figure 6.

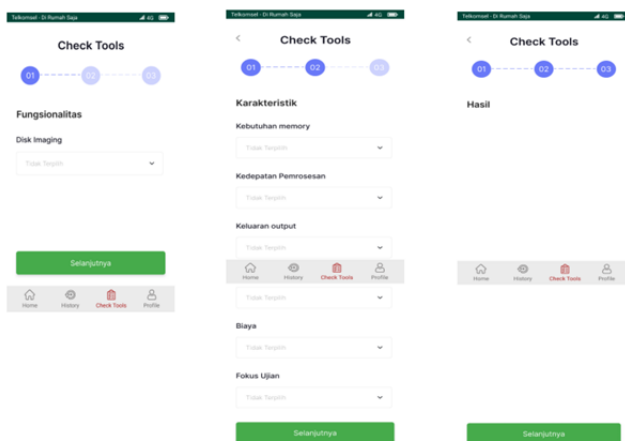


Figure 6. Check tools page

4. Results

4.1. Mobile Application for Tool Selection in Digital Forensics

The login and dashboard page can be seen in Figure 7 and Figure 8. The login page is the page used by the user when using this features contained

in the system. User has to enter email and password. Then, the system performs the authentication process. If the data is appropriate then it will be directed to the user's home page.

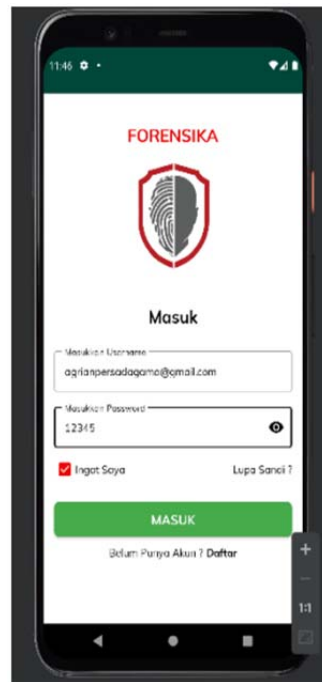


Figure 7. Login page

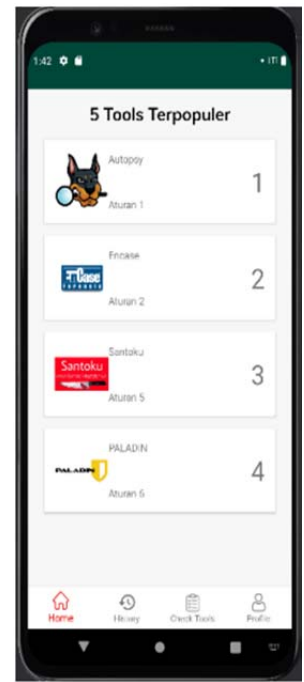


Figure 8. Home/dashboard page

The dashboard/Home page is the main system page that can be accessed after log in. Home has 5 most popular tools obtained from the most number of tools often searched for when users perform Check Tools. Thus, each user has one top search app. Then to get the final result of 5 most popular app which can be seen by all users hence top app of all users are regrouped, counted and sorted by the top 5 tools.

The Check Tools page is a feature that users use to make decision in digital forensic investigation tools. On this page there is a layout change during implementation program with the initial design, namely when filling out the functionality and characteristics form. On the initial design, two forms were separated into two different pages, but during implementation the designs are combined into one. This is because there are still a lot of free space if the two are not combined, resulting in a waste of space.

This feature can be used if admin or expert has added functionality data, characteristics, applications and rules. To select tools, users are required to fill out a form in the form of functionality and characteristics according to the rules that have been set by experts and not may be blank or not selected for its functionality and characteristics. Check tools page can be seen in Figure 9.

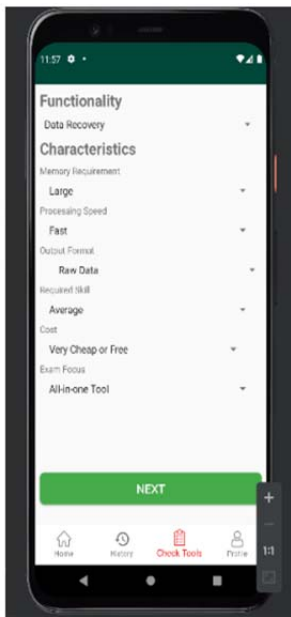


Figure 9. Check tools page Figure 10. The result page

After the user fills out the form, the system will check the user data with the data from the rules in the system. If it is successful, the system will display data in the form of a description of the application, the name of the application, and the characteristics and functionality of the application. Successful results can be seen in Figure 10.

The data from the selection of tools is directly saved into the user history page. If the results are not found then it will save as a new fact. If the functionality data and the characteristics do not match, the system will display the “do not match” result.

4.2. Application Evaluation Results (AER)

4.2.1. Usability Testing

Usability testing on application uses the Nielsen model in which the method used is user testing. Indicators of usability success in application of appropriate digital forensic tools has five aspects or indicators, namely learnability, memorability, efficiency, error, and satisfaction. Each indicator is explained in the section on filling out the questionnaire. Then, the method asks respondents to do testing on the application, which are then given questions in a questionnaire. User testing is carried out in the form of observation and testing of the application.

To get good usability test results, it is necessary to calculate the number of sample to the existing population. In this paper, it is known that the population used all active graduate students who focus on the field of Digital Forensics, namely as many as 30 students. To get the right number of samples (n) from the population (N), Slovin's

formula is used with a margin of error (e) of 5% as in equation (1).

$$\eta = \frac{N}{1+Ne^2} \quad (1)$$

From the results of calculations using equation (1) above, the number of samples obtained is used are as many as 28 students out of a total of 30 with a margin of error of 5%. The recap for the results of filling out the questionnaire can be seen in Table 1.

Table 1. User questionnaire results

No	Indicator	Score
1	Learnability	4.13
2	Memorability	3.93
3	Efficiency	4.13
4	Error	3.73
5	Satisfaction	4.22
6	Usability	4.25

4.2.2. Blackbox Testing

Black box testing focuses on the functional requirements of the software, based on the requirements specification of the software. In this paper, black box is a test that is carried out only by observing the results of execution going through the test data and checking the functionality of the API. Black box testing performs tests without detailed knowledge of internal structures of the system or component being tested. It is also known as behavioral testing, specification-based testing, input/output testing or functional testing. With this blackbox testing, it is hoped that if there are any errors in the application they can be immediately identified as early as possible. In this paper there are thirteen test scenarios, the results show that each scenario went well with no errors.

5. Conclusion

The UCD method can contribute to a design that is interactive and according to user's needs. UCD begins by conducting a problem analysis and focuses on user analysis. After that, the design is carried out from the wireframe stage to the prototype. Finally, an evaluation of the design is carried out so that the design can be more optimal.

The level of system convenience is measured based on the results of usability testing and obtained an average value of 4.1 out of 5 using a Likert scale. From the average result it can be concluded that the application made is useful, easy to use, and easy learned by users. In addition, from usability testing, it was found that users felt very helpful in choosing the tools to be used, which is 28 students with a margin of error of 5%.

References

- [1]. Antwi-Boasiako, A., & Venter, H. (2017, January). A model for digital evidence admissibility assessment. In *IFIP International Conference on Digital Forensics* (pp. 23-38). Springer, Cham.
- [2]. Arshad, H., Jantan, A. B., & Abiodun, O. I. (2018). Digital forensics: review of issues in scientific validation of digital evidence. *Journal of Information Processing Systems*, 14(2), 346-376.
- [3]. Čosić, J., Čosić, Z., & Bača, M. (2011). An ontological approach to study and manage digital chain of custody of digital evidence. *Journal of Information and Organizational Sciences*, 35(1), 1-13.
- [4]. Ramadhani, E., Pratama, H. R., & Wahyuni, E. G. (2021, June). Web-based expert system to determine digital forensics tool using rule-based reasoning approach. In *Journal of Physics: Conference Series* (Vol. 1918, No. 4, p. 042003). IOP Publishing. doi: 10.1088/1742-6596/1918/4/042003.
- [5]. Lu, J., Liu, C., & Wei, J. (2017). How important are enjoyment and mobility for mobile applications?. *Journal of Computer Information Systems*, 57(1), 1-12.
- [6]. Truong, D. (2014). How To Design a Mobile Application to Enhance Teaching and Learning?. *International Journal of Emerging Technologies in Learning (iJET)*, 9(3), 4-11.
- [7]. Nurbekova, Z., Grinshkun, V., Aimicheva, G., Nurbekov, B., & Tuenbaeva, K. (2020). Project-based learning approach for teaching mobile application development using visualization technology. *International Journal of Emerging Technologies in Learning (iJET)*, 15(8), 130-143. doi: 10.3991/ijet.v15i08.12335.
- [8]. Djamaluddin, R., Priyadi, Y., & Darwiyanto, E. (2022, January). User-Centered Design to Improve Personal Development In Comic Application. In *2022 IEEE 12th Annual Computing and Communication Workshop and Conference (CCWC)* (pp. 0966-0973). IEEE.
- [9]. Li, P., & Li, C. (2020). A four-in-one teaching model for fundamental nursing based on UCD theory. *International Journal of Emerging Technologies in Learning (iJET)*, 15(15), 188-201.
- [10]. J. Richard “Rick” Kiper. (2018). *Pick a Tool, the Right Tool: Developing a Practical Typology for Selecting Digital Forensics Tools* SANS Institute: Reading Room - Tools. Retrieved from: <https://www.sans.org/reading-room/whitepapers/tools/paper/38345> [accessed: 02 June 2022].
- [11]. ISO - ISO 9241-210:2019 - *Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems*. Retrieved from: <https://www.iso.org/standard/77520.html> [accessed 25 April 2022].