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UI/UX Web Based Learning Design with UCD Approach to Basic Programming using FIGMA

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Abstract

The era of revolution 4.0 has had the impact of technological changes in learning, to learning in the form of technology. Online learning is designed using online technology and material is adapted to user needs. Web Based Learning is a website-based learning media that students use to learn the basics of programming. The problem of learning programming for vocational school students is that it is difficult to understand the basic syntax of programming and the flow of thinking, so learning media is needed that can make it easier for students to learn it. Interface design is one of the determinants of students' learning interest, so an appropriate design method is needed according to students' needs, namely using the UCD (User Center Design) method. So that the interface looks attractive, and the workflow is clear enough, an interface design assistant application, namely Figma, is used. Activities are emphasized on SUS testing by obtaining test results of Based on the prototype evaluation results, a MAUS score of 95 out of 100 was obtained at a high level. The MAUS value is at a high level. Meanwhile, the MIUS scores of the four scenarios tested received their respective scores, scenario 1 got a score of 76.25 with a medium level, scenario 2 got a score of 87.6 with a high level, scenario 3 got a score of 87.6 with a high level, and scenario 4 gets a score of 95.45 with a high level.

I. INTRODUCTION

The development of the era of the Industrial Revolution 4.0 has caused many changes in various areas of life. One of the areas affected is education. Education is expected to be able to adapt to technological change. According to data from the Central Statistics Agency (2020), from Association of Indonesian Internet Service Providers (APJII) conducted a survey from 2 to 25 June 2020, Based on the results, it states that there is an increase the number of internet usage in Indonesia is 196.7 million people, until the second three months of 2020 reached 73.7%. This figure is good enough for developments in the field of information technology for the country as wide as Indonesia. Reporting from Kompas (09/11/2020) APJII Secretary General Henri Kasyif stated,if in 2018 we assessed data on 171 million users, and comparison in assessing data from up to 196 million users. In the second quarter of 2020, this data increased by around 25 million users with intervention 73.7% or an increase of around 8.9% user. The use of ICT in learning has become a must in order to be able to solve learning problems in the era of Industry 4.0. Online learning, also known as e-learning or online learning, is an educational method that uses digital technology to deliver learning materials and facilitate interaction between teachers and pupils [2]. E-Learning enables students to learn at any time, anywhere, with a load connected to the Internet. One of the forms used is web-based learning.

The advances of information technology in the era of the rapidly evolving industrial revolution 4.0 and the emergence of the concept of web based learning make the field of education need to continue to adapt in order to remain relevant to the changing times. Web based learning is an interesting study in the age of the industrial Revolution 4.0 because the number of users is constantly increasing significantly.[3] Web-based learning is one of the virtual learning technologies that enables students to learn anywhere [4]. Web-based learning or better

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known as web based learning is a system whose learning process is facilitated by information technology [5]. The media used to implement web-based learning today are computers, laptops, and cell phones. Media used in web based learning must be connected to a network known as a website or the Internet, so that web- based learning offers a possibility of learning to be done anywhere and anytime [6], [7].

In the world of user design, the selection of design and typography is very important in order to develop media to be attractive in learning. The integration of user-centric design and software development processes is essential to ensure that the end interface meets the expected standards and provides an optimal user experience. Through a human-centric design approach, interaction designers can ensure that the actions available in the interface are intuitively aligned with the user's intentions based on purpose, promoting a symbiosis relationship in which the system feels like an extension of the user-thinking process[8]. Building an effective user interface and user experience for web-based instructional media is essential to enhance the overall learning experience. Interactive learning media design will bring students ease in using technology in learning [8], [9].

The vocational secondary school is a branch of secondary education that prepares students to have certain competences according to the field of work. Some students of the X grade of vocational secondary school 2 Bangkalan consider basic programming to be a difficult subject and make students reluctant to be studied. Based on the implementation of the Merdeka curriculum at the majority of Software Development and Game (PPLG), basic programming is a compulsory lesson to be mastered by students.

One effort to improve the quality of human resources is through equal distribution of quality education services. Quality workers will be born from a quality education system, which is able to implement knowledge with the skills needed by the business world and the industrial world (DU/DI). To meet these workforce needs, the government is implementing skills and skills education programs through Vocational High Schools (SMK). Vocational Schools have a strategic role in producing skilled secondary workers. The government has made various efforts to improve the quality of vocational schools through various policies, including Presidential Instruction (Inpres) Number 9 of 2016 concerning the Revitalization of Vocational High Schools (SMK). The Presidential Instruction was addressed to 12 ministers, 34 governors and 1 agency head. The Presidential Instruction aims to improve the quality of vocational school graduates by creating synergy between ministers, heads of institutions and governors to work together in accordance with their respective duties and functions.

The Central Statistics Agency (BPS) has issued a report that the number of unemployed people in Indonesia until February 2022 reached 8.40 million people. This number decreased by 350 thousand compared to February 2021. Based on the percentage, the Open Unemployment Rate (TPT) for February 2022 was 5.83 percent, down by 0.43 percentage points compared to February 2021 which was 6.26 percent. This figure has increased compared to February 2020, exactly one month before the World Health Organization (WHO) announced cases of the spread of the Covid-19 virus as a global pandemic. It is known that the TPT figure for that year was 4.99 percent.

To reduce the unemployment rate for vocational school graduates, it is necessary to provide education in vocational schools that is in line with the demands of 21st century competencies. 21st century skills require readiness to enter the job market, the labor market demands students who have direct skills combined with soft skills. Almost all countries in the world are experiencing changes and challenges in facing changes in the labor market in the 21st century. Therefore, not only technical skills are needed but also non-technical skills. This approach is called a dual system approach, in preparing graduates who are ready to work in the 21st century.

The foundation of computer science education is programming, which helps students hone their analytical skills and solve problems. Courses in the degree program that come after an introductory programming course set the groundwork. Most educational institutions are updating the material in their beginning programming course as a result of realizing the difficulties. Therefore to meet industrys‘needs, programming course is an essential component of the curriculum to be studied. As a leader in the field of Technical and Vocational Education and Training‘ (TVET), polytechnic was also involved in this challenge.

In order for students to have a good learning interest in the basic lesson of programming, then made learning media design based on the needs of students with a User Center Design (UCD) design approach [10], [11]. UCD has deep advantages intuitive interface, UCD promotes user-friendly interfaces with clear navigation and organization of learning materials. This minimizes confusion and frustration, allowing learners to focus on their studies. Interactive Features: By incorporating user preferences, the design can include elements like gamification, interactive quizzes, and collaborative learning tools, leading to a more engaging learning process. Accessibility Features: UCD emphasizes accessibility for diverse users. This ensures learners with disabilities can access and utilize the platform effectively, promoting inclusivity in education [1], [2].

Applications and special software features appear that allow to modify vector graphics generatively, one of the design applications used to design the interface is figma. The FIGMA application offers a powerful platform for designers to apply user-centered design practices in the development of web-based learning media. By leveraging FIGMA's various features, designers can create and iterate on interactive prototypes, conduct user testing, and refine the interface to deliver a seamless and engaging learning experience for the target audience. Information design, which encompasses the effective organization and presentation of content, plays a crucial role in the design of learning experiences. Designers must carefully consider the cognitive principles of learning and

the appropriate use of multimedia elements to create instructional materials that facilitate student understanding and retention [3], [4], [5].

II. Related Works/Literature Review

The first research related to UCD with the title "Application of User Centered Design Methods to Android-based E-Learning Applications (Case Study: SMAN 3 Sidoarjo)" was conducted by Krisnoanto et al., (2018). This study resulted in an e-learning that has high usability values that have been adapted to the needs and abilities of the user. Usability test values in this study obtained using task scenarios found 96.7% success in student users and 94.6% success in teaching users [17].

The second study related to UCD with the title "Application of User Centered Design Methods (UCD) to User Interface Design Application Learning Web Programming Application" was conducted by Deswara et al., (2024). This research resulted in a design of the user interface display of a web programming learning application, resulting in an intuitive and effective learning experience [6]. The resulting interface design focuses on user needs, desires, and capabilities ensuring that the interface design not only has aesthetic value, but also supports the learning process optimally [18].

The third UCD-related research entitled "User Interface Design Based on User Experience E-learning Applications Using User Centered Design Methods to Support the Learning Process Case Studies: Santa Maria 3 Cimahi High School" was conducted by Bagaskoro et al., (2020), This research produces a display of the interface that matches needs and user analysis. The display test uses the SUS test method and obtains a result of 71.6 which can be drawn to the conclusion that the result can be declared acceptable to the user [19].

The fourth UCD-related study, entitled "Design of User Interface Web Application E-learning for Healthcare Cadets with User-Centered Design Methods (UCD)" was conducted by Ulinuha et al., (2022). This research produced a design interface for e-learning web applications specifically for health frameworks. The output of this interface design is adapted to the user's conditions and wishes, so that the outcome of the design is tailored to user needs. The test results of the design use SUS with a score of 81 which belongs to the acceptable category [20]. The difference with previous research is that it is based on research subjects, web based learning developed for SMK students to be interested in learning basic programming.

The fifth research related to the application of the UCD method is entitled "Development of UI/UX Design for Learning Management System Applications with a User Centered Design Approach" conducted by Novianto & Rani, (2022). This research produces an LMS design that suits the needs of users, is effective, efficient, and has good use value. This is proven by the results obtained from the evaluation stage with the results of the effectiveness value using the completion calculation getting a percentage of 84%, the results of the efficiency value using the ORE calculation of 91% and the results of the usability value using the SUS calculation of 75.38% [7]

Several previous studies have conducted research using the User Centered Design approach in designing user interfaces, namely research conducted by Dicky Larson Kaligis and Refyul Rey Fatri in 2020, regarding developing interface displays by involving users directly using User Centered Design (UCD) research results shows that the interface design designed using the UCD method has a better usability value from the effectiveness aspect, 100% successful and the user satisfaction aspect, feeling satisfied with the interface appearance [8]. The difference in previous research is that the implementation of UCD was used to develop web based learning, the material used was basic programming for vocational high school students.

III. Methods

The study uses the User Centered Design (UCD) method to evaluate the user interface and user experience using fiqma software. The UCD used in the design of user interfaces and user experiences is a recurring design process in which a designer focuses on the user's wishes and needs in each phase of the design process [21].

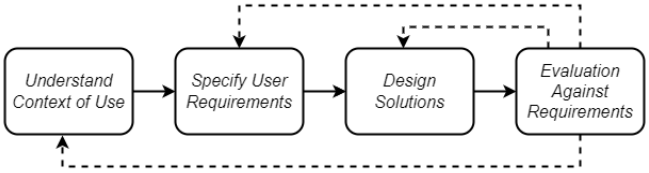

Fig. 1 UCD concept for develop web based learning

The stages of the research method using UCD include, understand context of use, specify user requirements, design solutions, and evaluation against requirements [22].

1. Understand Context of Use
   This first step the author will perform the identification of the user who will use the designed application. Identification of the intended user is a description of the condition of the user, knowing the user's basic

abilities in using similar applications. Identification is done by observation method or interview to prospective users.

2. Specify User Requirements
   Stage two the author will perform an advanced identification of the previous stage. The identification is done to find out what features the user needs based on the results of the first stage.
3. Design Solutions
   The third phase is the creation of a prototype design as a solution offered to the user. The design stage is the most important of the four UCD phases, as the resulting design will be tested to the users.
4. Evaluation Against Requirements
   The fourth phase will test the design of the prototype that has been created in the previous phase. This phase of evaluation occurs an iteration of the UCD method, because if the result of the tested prototype does not match the wishes of the user, then the author must repeat the design solutions phase or the previous stage.

Tests are carried out for every scenario that has been created, with the aim of obtaining effective and valid results. A list of user needs already specified in the specify user requirements stage is used as a reference in the implementation of usability testing. Usability testing is done online using the Maze application. The result of usability testing using Maze applications is a usability score that reflects the level of user ease in using a design. The methods used to measure usability are the Mission Usability Score (MIUS) and the Maze Usability score (MAUS). MIUS is used to evaluate the score of each task using the formula on equation 1, whereas MAUS was used to assess the score on the entire task by finding the MIUS average for each task according to table 1.

$$MIUS = DSR + \left(\frac{IDSR}{2}\right) - \left(\frac{MCR}{2}\right) - \left(Min\left(10, Max\left(0, \left(\frac{AVGD-5}{2}\right)\right)\right)\right) \quad (1)$$

Information:
MIUS = Mission Usability Score
DSR = Direct Success Rate
IDSR = Indirect Success Rate
MCR = Misclick Rate
AVGD = Average Duration
Function:
Max : max(number_1, number_2) => to find the maximum value between number_1 dan number_2
Min : min(number_1, number_2) => to find the minimum value between number_1 dan number_2

TABLE 1
SKOR MAUS

No	Value	Description
1	80 - 100	Height
2	50 - 80	currently
3	0 - 50	Low

IV. RESULTS

The research results follow the UCD method process , understand context of use, specify user requirements, design solutions, dan evaluation against requirements.

1. Understand Context of Use

This first stage aims to understand and determine the user context. Understanding and determining user context can be achieved by collecting relevant information regarding the user. How to collect information through interviews. The conclusions from the results of the interviews that have been conducted are as follows:

a. More than 50% of class students have never used web-based learning as a supporting learning resource.
b. Students' ability to understand and use the features available in the software system is considered quite good.
c. Students experience difficulties in using learning resource services available on the internet because the content in them has a very technical linguistic structure so that students who do not have a background in programming skills will have difficulty understanding basic programming concepts.
d. Some students do not have laptop or computer devices, so they have difficulty learning and practicing coding skills.
e. Users prefer a website display that is simple and easy to understand

2. Specify User Requirements

Thus second stage aims to detail feature requirements that are solutions to user problems. User feature needs can be detailed as follows:

a. Accessing materials

This page is the page that will be displayed when the user with the student user level successfully logging in. Web based main page In this learning process, there are six main features that can be utilized in the process learning and setting up student user accounts. The main page will immediately appear displays the material that students will study later.

b. Access live coding
This page will be accessed when students have completed understanding the material on material features. This exercise is used to practice coding skills each student after understanding the previous material. Knob run on this page is used to run program code that has been written, the refresh button is used to reset the page display, the previous button is used to access previous practice questions, and the next button is used to access previous practice questions.

c. Access the leaderboard
This page can be accessed by students to see who owns it the most points during the learning process. Player data displayed on this leaderboard page is only the top eight data.

The next step is creating a scenario model. The scenario model is used to find out what the user will do. Therefore, the secondary activities that will be carried out by the user are as follows:

a. The scenario model opens web based learning. Create a web based learning account. This page is the first page that appears when the website is based learning is accessed by users. Users are asked to enter a username and the password that was previously registered on this page. You can also log in This is done by entering your email address and password. This page can be accessed when student users do not yet have an account can be used to log into the web based learning system. The registration page contains columns that must be filled in by the user, namely full name, username, password, email, and class.
b. Log in to your web based learning account. This page is the first page that appears when the website is based learning is accessed by users. Users are asked to enter a username and the password that was previously registered on this page. You can also log in This is done by entering your email address and password.
c. Scenario models study the material. Choose web based learning materials. This page can be accessed when a student user clicks the learn button next on the main page. The material details page will be displays materials according to the topic of discussion. Delivery of material can be in text or video form and view detailed material information
d. Live coding scenario model. Access live coding. Doing live coding. View live coding feedback. A few programmers can collaborate in real-time on the same code thanks to the live coding feature. This can be accomplished by providing an online code editor, enabling all programmers to view and edit code in a collaborative manner. This feature is very helpful for collaborating on projects, resolving collaborative code issues, and learning from one another simultaneously. There are two CRUD functions in this live coding document: update and read. Both of those functions are used to retrieve data related to live coding as well as to identify missions that need to be completed by students through peer collaboration.
e. Leaderboard scenario model, user can access the leaderboard. The next stage is creating a use case diagram to define the functions that can be performed by users based on user needs. The use case diagram is designed as a whole, in which there are developed features, which can be seen in Fig. 2.

3. Design Solutions

This third stage contains three application design processes in the form of low-fidelity prototype, design guideline, and high-fidelity prototype. The low-fidelity prototype process is the initial design of a web-based learning that is created. The low-fidelity prototype design focuses on creating a framework for organizing all the content contained in the based learning web page. This process can be used as a reference during the further design process. The process of determining design guidelines for designing web based learning. Design guidelines are a collection of elements, graphic visual designs, and rules for making product designs to ensure harmony or consistency in designing products. So, the high-fidelity prototype design process that will be carried out next will be easier because the design framework and guidelines have been prepared in advance. The final process in the design solutions stage is the high-fidelity prototype. A high-fidelity prototype is a design that has a very high similarity to the final product in terms of design and functionality aspects. This type of prototype is often interactive and allows users to have almost the same experience as using the actual product.

4. Evaluation Against Requirements

The final stage of the UCD phase is used to test the prototype design that has been created at the design solution stage and refers to the results of the context and needs analysis at the understand context of use and specify user requirements stages. If the results of the prototype solution offered do not match the user's wishes, then the developer must repeat the design solution phase by improving the prototype and continue with the stage of evaluating the prototype design again.

Testing is carried out for each scenario that has been created, the aim is to obtain effective and valid results. The list of user requirements that have been determined in the specify user requirements stage is used as a reference in carrying out usability testing. Usability testing is carried out online using the Maze application. Maze is the result of usability testing using the Maze application, which is a usability score that reflects the user's level of ease in using a design. The methods for measuring the usability level are the Mission Usability Score (MIUS) and the Maze Usability Score (MAUS). MIUS is used to assess the score for each task using the formula in equation 1, while MAUS is used to assess the score for all tasks by finding the average MIUS for each task according to table 1.

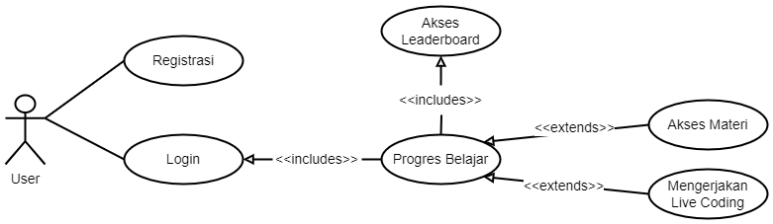

Fig. 2 Use Case Diagram Web Based Learning

The first process at this stage is designing a low-fidelity prototype. Design is carried out to describe the framework for structuring an item on a website page so that designers can easily convey the concept and solution being designed. Low-fidelity prototype design at this stage uses the Balsamiq application software. The low-fidelity web based learning prototype design can be seen in Fig. 3.

The second process at this stage is determining the guideline design. Design guidelines are a collection of elements, graphic visual designs, and rules for making product designs to ensure harmony or consistency in designing products. Guideline design has many elements in it, namely typography, button icons, color palettes, checkboxes, and so on.

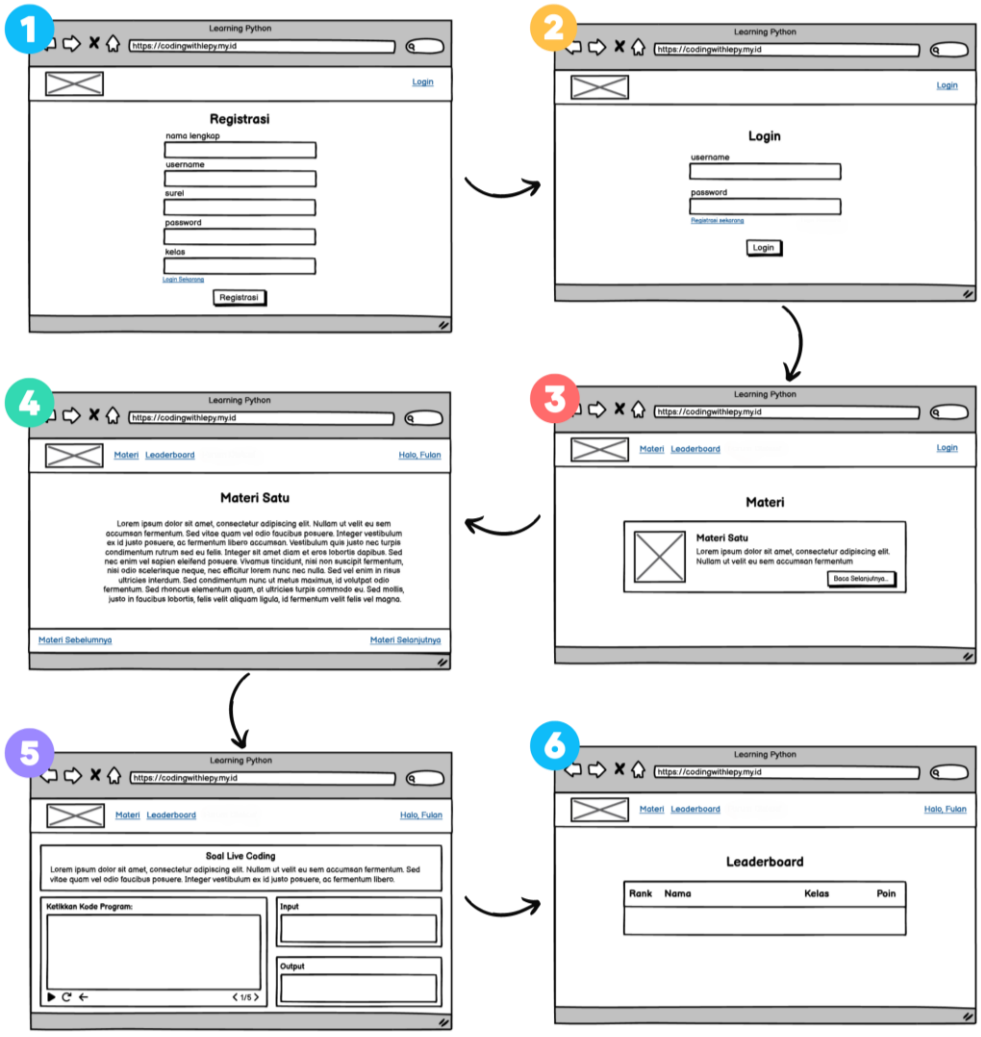

Fig. 3 Low-Fidelity Prototype Web Based Learning

The third process at this stage is designing a high-fidelity prototype using the Fiqma application which is an implementation of a previously designed low-fidelity prototype. Designing a high-fidelity prototype aims to facilitate interaction between users and the product. The high-fidelity prototype display will be used at the evaluation stage to measure the usability of the web-based learning that will be designed. The appearance of the high-fidelity prototype can be seen in Fig.4.

Fig. 4 shows the layout of each item to be used in the application view. These items consist of logos, buttons, images, navigation, and so on. Starting with display number 1, an overview of the account registration page used to create a new user account. In this display, there is a user personal data field that will be used to log in to the user account. Display number 2, an image that shows the user account login page before accessing all web based learning features. Display number 3 shows the main page for users to explore a choice of learning material topics. Display number 4 shows a detailed page for one of the learning material topics. Each feature can be accessed if the previous feature has been fulfilled by the user. Display number 5 is a live coding page display for one of the learning material topics. This live coding feature can be accessed to write program code according to the instructions in the fields provided. Run the program code using the run button. The refresh button is used to reload the live coding page. The back button is used to return to the learning material detail page. If the work instructions use the input() function, then the program code is written in the input field. The output of the program code that the user has written will be displayed in the output field. If the program code structure written by the user matches the answer key that has been stored in the database, then the user will get a score of 20 points. Display number 6 is the leaderboard page display. This page contains the 10 users with the highest scores

Fig. 4 High Fidelity Web-Based Learning Prototype Design

4. Evaluation Against Requirements

This stage carried out high-fidelity testing of the web based learning prototype on users. Testing takes the form of validating the solution based on a list of user requirements that have been determined in the specify user requirements stage. This test was carried out with a total of 20 evaluators.

The results of prototype testing using Maze with a total of 20 respondents produced a MAUS score of 95 out of 100 which is shown in Fig. 5. The value is at a high usability level.

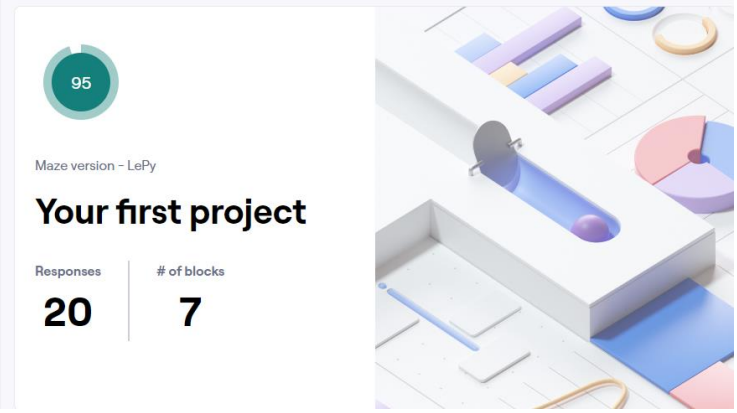

Fig. 5 MAUS Value Results of Prototype Testing

TABLE 2
PROTOTYPE TESTING MIUS VALUE RESULTS

Criteria	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Tester	20	20	20	20
Success Rate	95%	95%	95%	100%
Indirect Rate	5%	5%	5%	0%
Misclick Rate	28,9%	8,6%	8,5%	9,1%
Avg Duration	18,6s	16,2s	16,2s	3,9s
Mission Usability Score	76,25	87,6	87,6	95,45
Level Of Threshold	average	high	high	high

Table 2 shows the MIUS value for each scenario out of a total of 20 testers who can complete all scenarios up to the fourth scenario. It is known that the highest misclick rate occurs in scenario 1, this is because users are not used to using the Maze application as usability testing software.

V. DISCUSSION

The design of web based learning was carried out using the interview method in the understand context of use stage in the UCD method. Based on the interview results, it was found that most users had never used web-based learning, their ability to use learning websites was good, they had difficulty understanding the learning resources currently used, and there were still some users who did not have devices that supported them to practice their coding skills.

The researcher then designed a web based learning UI/UX design using UCD based on the needs analysis that had been used. Web based learning design contains solutions from problem findings according to the specify user requirements stage. Then an evaluation was carried out on the web based learning prototype using the Maze application.

Based on the results of the prototype evaluation, a MAUS score of 95 out of 100 was obtained. The MAUS score is at a high level. Meanwhile, the MIUS scores of the four scenarios tested received their respective scores, scenario 1 got a score of 76.25 with a medium level, scenario 2 got a score of 87.6 with a high level, scenario 3 got a score of 87.6 with a high level, and scenario 4 gets a score of 95.45 with a high level.

VI. CONCLUSIONS

Based on the results of the analysis of the web based learning application using UCD, it was found that the design and features of the application were in accordance with the user's needs, and the features developed were easy for the user to understand. UCD is a valuable design methodology that can provide many benefits to businesses and organizations. By implementing UCD, companies can create better products or services, increase user satisfaction, and achieve learning goals. The information displayed at the beginning when the system is running is adequate, there is already a fairly complete menu that can be accessed by the user. The application of

UCD to the development of a basic programming learning website as designed in this research can increase the effectiveness and efficiency of the application. In this way, the quality of experience felt by users can also increase, thereby indirectly improving the quality of online teaching and learning. Overall, the results designed using a user center design approach can be well received by users.

REFERENCES

[1] M. Zarini, D. N. Wilson, N. Y. Mar, and T. Varis, "Overview: the growing role of ICTs in education and training," in *International Handbook of Education for the Changing World of Work*, C. Chinien, Ed., Germany: Springer, 2009, pp. 1834–1846. doi: 10.1007/978-1-4020-5281-1_124.

[2] E. Daryanto, B. Siregar, and S. Januariyansah, "A Meta-Analysis of the E-Learning Influence on Vocational Education and Training (VET): Preliminary Study of Virtual to Actualization," *International Journal of Education in Mathematics, Science and Technology*, vol. 10, no. 3, pp. 710–721, 2022, doi: 10.46328/ijemst.2509.

[3] H. Subramonyam, D. Thakkar, J. Dieber, and A. Sinha, "Content-Centric Prototyping of Generative AI Applications: Emerging Approaches and Challenges in Collaborative Software Teams," Feb. 2024, [Online]. Available: http://arxiv.org/abs/2402.17721

[4] G. Piccoli and R. Ahmad, "Web-Based Virtual Learning Environments: A Research Framework and a Preliminary Assessment of Effectiveness in Basic IT Skills Training," 2001.

[5] R. Harahap, "Fenomena Online Learning di Masa Pandemi," *Jurnal Bahasa & Sastra*, vol. 5, no. 2, pp. 146–156, 2020, doi: http://dx.doi.org/10.31604/linguistik.v5i2.146-156.

[6] M. Carney *et al.*, "Teachable machine: Approachable web-based tool for exploring machine learning classification," in *Conference on Human Factors in Computing Systems - Proceedings*, Association for Computing Machinery, Apr. 2020. doi: 10.1145/3334480.3382839.

[7] T. M. Kuo, C. C. Tsai, and J. C. Wang, "Linking web-based learning self-efficacy and learning engagement in MOOCs: The role of online academic hardiness," *Internet and Higher Education*, vol. 51, Oct. 2021, doi: 10.1016/j.iheduc.2021.100819.

[8] G. V Davidson-shivers, K. L. Rasmussen, and P. R. Lowenthal, *Web-Based Learning*. USA: Springer, 2018.

[9] A. I. Mahardika, N. Wiranda, and M. Kamal, "Web-Based Interactive Learning Medium to Foster Students ' Understanding on Magnetic Theory Using the Tutorial Method," vol. 6, no. 1, pp. 37–44, 2023, doi: 10.18421/SAR61.

[10] J. Filipe, A. Ghosh, R. O. Prates, and L. Zhou, "Communications in Computer and Information Science 1428 Editorial Board Members." [Online]. Available: http://www.springer.com/series/7899

[11] Y. Widharto, D. Nurkertamanda, and H. Fahreza, "User Interface Design for Arm Robot Controller Application using User-Centered Design Method as a Learning Media," *International Journal of Current Science Research and Review*, vol. 06, no. 04, Apr. 2023, doi: 10.47191/ijcsrr/V6-i4-18.

[12] M. Multazam and Z. Syahrial, "Development Of Learning Models In Web Programming Courses With Computer-Based Learning Tutorials."

[13] W. S. L. Nasution and P. Nusa, "UI/UX Design Web-Based Learning Application Using Design Thinking Method," *ARRUS Journal of Engineering and Technology*, vol. 1, no. 1, pp. 18–27, Aug. 2021, doi: 10.35877/jetech532.

[14] S. S. Smith, *Web-Based Instruction second edition Web-Based Instruction*.

[15] R. Alokaily, *INSTRUCTIONAL DESIGN*. Routledge.

[16] R. M. Branch, *Instructional Design*. 2020. doi: 10.1007/978-3-319-15347-6_300893.

[17] A. Krisnoanto, A. H. Brata, and M. T. Ananta, "Penerapan Metode User Centered Design pada Aplikasi E-Learning Berbasis Android (Studi Kasus : SMAN 3 Sidoarjo)," *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer (J-PTIIK) Universitas Brawijaya*, vol. 2, no. 12, pp. 6495–6501, 2018.

[18] M. B. Deswara, R. H. Sutrisno, T. Pujiansyah, P. Mukrim, O. Safardan, and F. Nopriani, "Penerapan Metode User Centered Design (UCD) pada Perancangan User Interface Aplikasi Pembelajaran Pemprogram Web," *Jurnal Informatika dan Komputer (JIK)*, vol. 15, no. 1, pp. 76–82, 2024.

[19] A. S. Bagaskoro, R. Fauzi, and N. Ambarsari, "Perancangan User Interface Berdasarkan User Experience Aplikasi E-learning dengan Menggunakan Metode User Centered Design untuk Mendukung Proses Pembelajaran Studi Kasus: SMA Santa Maria 3 Cimahi," *e-Proceeding of Engineering*, vol. 7, no. 2, pp. 7565–7573, 2020.

[20] Z. Ulinuha, S. Suakanto, and E. N. Alam, "Aplikasi Web e-Learning untuk Kader Kesehatan dengan Metode User-Centered Design (UCD)," *Jurnal Telematika*, vol. 17, no. 1, pp. 8–16, 2022.

[21] IxDF, "What is User Centered Design?," Interaction Design Foundation. [Online]. Available: https://www.interaction-design.org/literature/topics/user-centered-design

[22] T. D. A. Dakhilullah and B. Suranto, "Penerapan Metode User Centered Design Pada Perancangan Pengalaman Pengguna Aplikasi I-Star," *Journal UII*, 2022.