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Development of UI / UX Design in Web-Based Artificial Intelligence Learning on Student Learning Motivation with a User-centered Design Approach

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ABSTRACT

Artificial Intelligence (AI) is a study of intelligent machines. Starting from elementary school, children should have the opportunity to learn computer science, both from computational thinking and programming. Based on that case, an e-learning platform that discusses AI with block-based programming was created, namely eCraft2Learn. Based on the results of field studies, the measurement of user experience and user interface shows the "bad" category on each scale. Whereas in e-learning, UI/UX is the point of interaction as the key in achieving educational goals. It is necessary to develop UI/UX both in terms of structure and content presentation, collaboration, and interaction so that it can influence student learning and motivation. Thus, the UI/UX development is carried out by applying the four stages of the user-centered design method. After all stages of the method are carried out, it produces a UI/UX design whose value can be measured based on the measurement of user experience and the development of student learning motivation is also measured through four indicators, namely intrinsic motivation, identified regulation, external regulation, and amotivation. From these results, it can be concluded that the UI/UX design that has been developed produces an increased value and has a positive effect on the intrinsic motivation scale and identified regulation. However, the results of this UI/UX design have no influence on the scale of external regulation and motivation.

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1. INTRODUCTION

Artificial Intelligence is the study of the development of intelligent machines and software that can reason, learn, gather knowledge, communicate, manipulate, and understand objects (Pannu, 2015). The development of AI has made a statement that human existence already exists in the fourth industrial revolution, where technology has blurred the boundaries between many fields, from physical, digital, and biological fields (Pangkey, et.al. 2019). In a developing country like Indonesia, few people know about the benefits of AI. Thus, the most likely way to provide opportunities to advance in children is to introduce the key part of computer science, namely AI, through e-learning eCraft2Learn developed by Ken Kahn and Niall Winters (2018) (can be seen in https://ecraft2learn.github.io/ai/).

E-Learning is one of the learning methods that applies Information and Communication Technology (ICT) to support learning and facilitate students to be skilled. E-learning can be accessed using the internet by anyone, anywhere, anytime and is free to use by anyone (available to everyone) both in the form of mobile applications and websites (Maryani, 2016). E-Learning can make learning more flexible and increase the independence of students so, e-learning requires students to have independence because the potential and learning capacity develop according to their individual. If the student has the motivation, they can be more independent, able to study better and do better work (Aurora &; Effendi, 2019). Motivation in the realm of education is one of the important roles, because motivation can foster enthusiasm, curiosity, and be active in learning activities (Krismony, et.al. 2020). Each student has a different motivation to learn, because students have their own needs.

To better facilitate learning using E-learning, a good user interface is needed. According to Gautam & Tiwari (2016), in the use of e-learning, students will easily lose interest in learning if the page display is confusing or frustrating for students and modules that tend to be too much, long, or difficult to understand. Referring to **Table 1.1**, a field study was conducted at SMK Negeri 4 Bandung regarding to the user experience score of the eCraft2Learn website. The study used the User Experience Questionnaire (UEQ).

Table 1.1. UEQ Field Study Results.

Scale	Mean	Benchmark Comparison Results
Attraction	0.10	Bad
Clarity	-0.32	Bad
Efficiency	-0.18	Bad
Accuracy	0.28	Bad
Stimulation	0.32	Bad
Novelty	-0.03	Bad

Thus, in order to increase the comfort and motivation of students in learning through e-learning, the development of UI, UX and e-learning components of eCraft2Learn is carried out through the User-centered Design (UCD) method. The UCD method consists of four stages, namely: (i) identifying the user (Specify Context of Use); (ii) Specify User and Organization Requirements; (iii) Produce Design Solution; (iv) Evaluate Design Against User Requirements (Kaligis &; Fatri, 2020). The design of the method is designed based on the adaptation of user behavior in the use of a product.

In its implementation, according to Lister (2014), e-learning itself has four main elements, namely: (i) Structure and Security; (ii) Presentation of Content; (iii) Collaboration and Interaction; and (iv) Feedback. These elements need to be considered in e-learning design so

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that the learning provided can be carried out as well as possible. In order to increase student motivation, e-learning systems need to pay attention to User Interface (UI) and User Experience (UX), because this is one of the benchmarks for the ease of user interaction and success in using a website. Especially in e-learning, UI and UX usability are one of the keys in achieving goals (Alomari, et al. 2020), and in this case, an educational goals, such as the student getting better understanding of the material and getting better grades.

2. METHODS

This research uses a mixed-methods research method that combines qualitative and quantitative methods. Quantitative methods were conducted to measure student learning motivation using the Situational Motivation Scale (SIMS) questionnaire and the User Experience Questionnaire (UEQ). In qualitative methods, research was conducted with in-depth interviews with student representatives according to persona criteria to explore deeper insights related to pain points and user needs. There is also an approach used as a reference for design, namely user-centered design (UCD). According to Kaligis & Fatri (2020), the UCD method consists of four stages, namely:

2.1. Specify Context of Use

In this first stage, the determination of prospective users and the data collection of pain points, needs, and goals from eCraft2Learn website users are carried out. The data collection was carried out through the in-depth interview method using Zoom Meeting. Participants at this stage amounted to 5 people, consisting of 3 students who were familiar with artificial intelligence and machine learning and 2 students who were not familiar with them. Then mapping and grouping of the results of questionnaires and interviews that have been obtained are carried out. The data and information obtained are poured into bullet points using sticky notes with the help of the Figjam platform and then grouped based on several categories.

2.2. Specify User and Organization Requirements

After grouping the data, the user's specifications are poured into the user persona data. Then scenario mapping is carried out to determine solution opportunities based on pain points, user needs, and goals. The mapping is outlined in the form of user journey maps. After that, a requirement specification will be obtained for the next process at the stage of designing the solution. Once all is identified, the user flow is designed in the form of a flowchart, which will be the workflow used by users in using the features in eCraft2Learn e-learning.

2.3. Produce Design Solution

At this stage, solution design is carried out through three stages, namely wireframe design, system design, hi-fi design, and prototyping. The design is made based on the results of the data and information obtained from the previous stage. In making it, this design is made using tools on the Figma platform, and then the results will be observed again to ensure the design is appropriate or vice versa.

2.4. Evaluate Design Against User Requirements

At this evaluation stage, prototype testing is carried out using usability testing methods and in-depth interviews with students. This test was conducted directly in a one-on-one

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interview through the Google Meet platform. Users are asked to open the prototype link of the eCraft2Learn website using the Useberry platform and explore it according to a predetermined scenario. This is done to determine the suitability of the user interface, user experience, and website content with user needs. Then a survey was given in the form of a System Usability Scale (SUS) questionnaire to measure the usability of the UI / UX design of the eCraft2Learn website based on two sub-scales, namely usability and learnability. At this stage the next process is also determined, whether to proceed to the final stage or repeat the process at the relevant previous stage.

3. RESULTS AND DISCUSSION

3.1. UI/UX Design e-learning eCraft2Learn

The UI/UX design of e-learning eCraft2Learn is made based on pain points, needs and goals of users. Based on the first and second stages of UCD, namely Determining the Context of Use and Determining the Needs of Users and Organizations, a design solution can be found which can be seen in **Table 3.1** as follows. Users of eCraft2Learn are people who want to learn the basics of Machine Learning AI. In this study, the target users referred are students of SMKN 4 Bandung Vocational High School in the PPLG Department. Based on **Table 3.1**, it can be seen the pain points, needs and goals of the user. Thus, obtained opportunities for solutions designed to solve the user's problems.

Table 3.1. UI/UX Research Results with UCD Method.

Pain Points	Needs/Expectations	Solution Opportunities
The functions of some programs/features are poorly understood	Clear explanation of features/programs	Present information about features and programs that are clear and structured
Many unknown terms	Explanation of the new term	Provides a collection of explanations of terms (*glossary*)
The language in the discussion of dulit is understood	Easy-to-understand language	Make material discussions in Indonesian so that it is easily understood by users
Too much writing	Subtract the writing and . add illustrations	Make the material shorter and denser, but still understandable clearly and easily by the user Add illustrations in the form of images to the discussion of the material
Features are not well organized	Well-organized features . so that users can see the available features clearly and easily search for them	Group each feature clearly and neatly to make it easier for users to find
Navigation is difficult to use	Navigation that is visible and can be easily reached by users	Group and tidy up navigation to make it clearer and easier to use
Cluttered look	Neat and attractive look	Present a neat, attractive and easy to use appearance by adding illustrations, images, and grouping features or information.

After determining the solution, the next UCD stage is to design with a prototype in the form of lo-fi and hi-fi design. In **Figure 3.1**, you can see the results of the UI/UX design for the landing page that will be seen first by the user. This page has several main components,

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including information about the eCraft2Learn website, information on what artificial intelligence is and what Snap! and component parts that can connect to learning collections or materials.

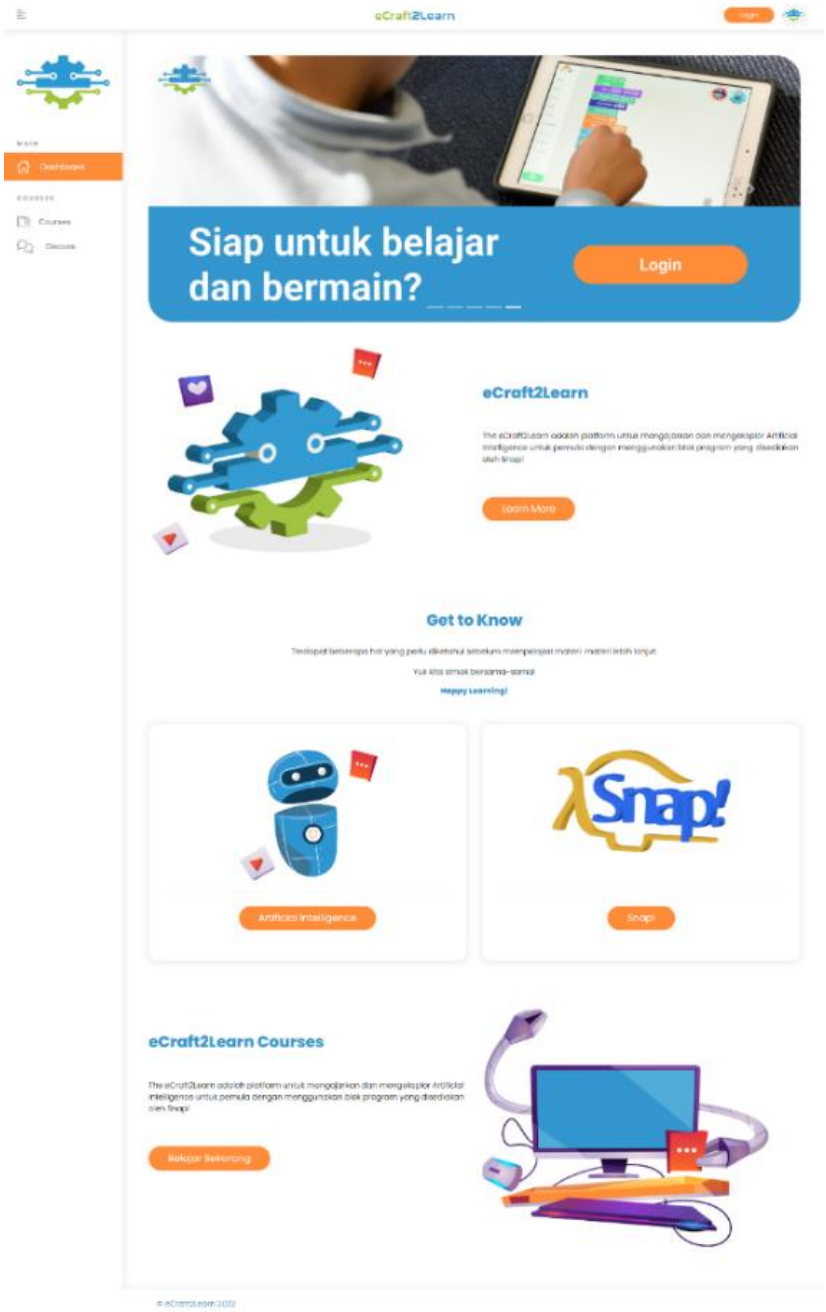

Figure 3.1. Desain UI/UX Landing Page eCraft2Learn.

While in **Figure 3.2**, you can see the results of the UI / UX design for the content page, where on that page users can read learning materials with a neater appearance and illustrations used so that users are not easily bored. This is also supported by navigation that can facilitate users in searching for sub-material.

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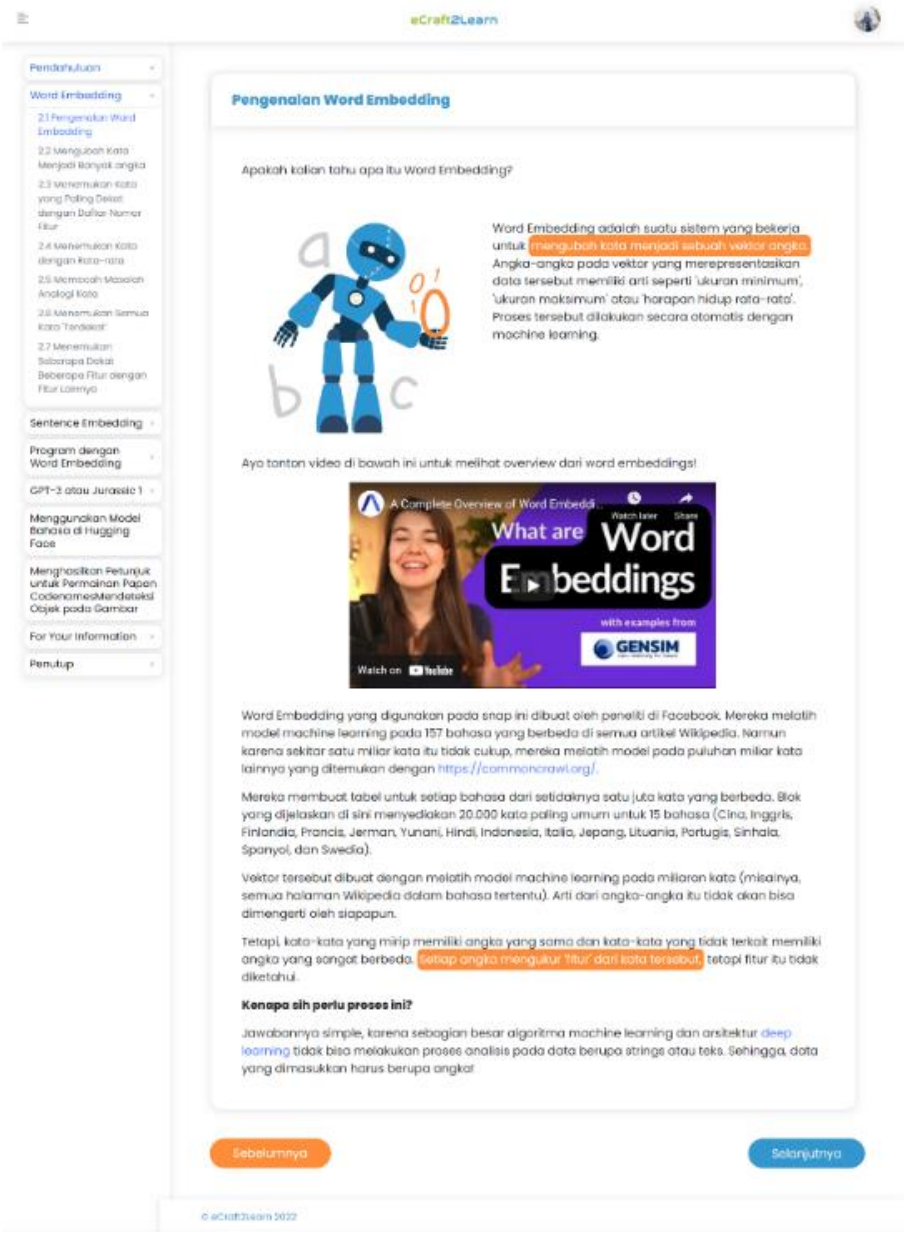

Figure 3.2. UI/UX Design eCraft2Learn Learning Material Content Page.

Furthermore, in **Table 3.2**, usability testing is carried out using System Usability Scale measurements to students to find out whether the design that has been designed can be followed up or vice versa. Here are the results of the testing that can be seen:

Table 3.2. Usability Testing Result.

Scale			
Odd items	Even items	Skor SUS (/100)	Grades
19	16	87.5	**A**
17	18	87.5	**A**
14	14	70	**B**
17	20	92.5	**A**
17	19	90	**A**
	Average score SUS	**85.50**	**A**

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Based on **Table 3.2**, the calculation of the SUS scale in this system has obtained an average value of 85.50. Thus, this design can be said to be the best imaginable or in other words this system is very good to be able to proceed to the next stage.

3.2. User Experience Assessment on UI/UX Design

After obtaining the initial and final results of the User Experience Questionnaire (UEQ), in Figure 3.3 a comparison is made between the two results which can be seen the results.

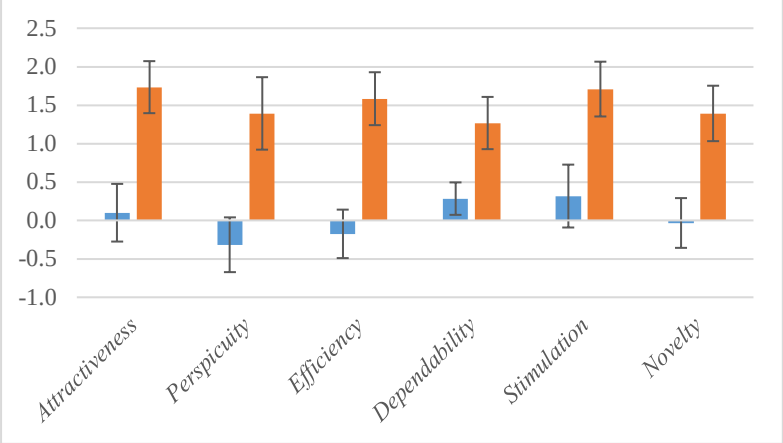

Figure 3.3. Early and Final UEQ Comparison Results.

Based on the graph in **Figure 3.3**, the entire scale has undergone a significant increase. The attractiveness scale increased from an initial mean value of 0.10 to a final value of 1.73. Then on the perspicuity scale (clarity) increased from the initial mean value of -0.32 to the final value of 1.39. On the efficiency scale, it increases from the initial mean value of -0.18 to the final value of 1.58. On the dependability scale, it increases from an initial mean value of 0.28 to a final value of 1.27. Furthermore, the stimulation scale increased from the initial mean value of 0.32 to the final value of 1.71. Finally, the novelty scale increased from the initial mean value of -0.03 to the final value of 1.39.

3.3. Learning Motivation Assessment

Student learning motivation is measured through four cycles. The first cycle without any practice, the second is given the eCraft2Learn website before the UI / UX is developed, the third is learning chapter 4 material with the eCraft2Learn website after the UI / UX is developed, and finally learning chapter 5.

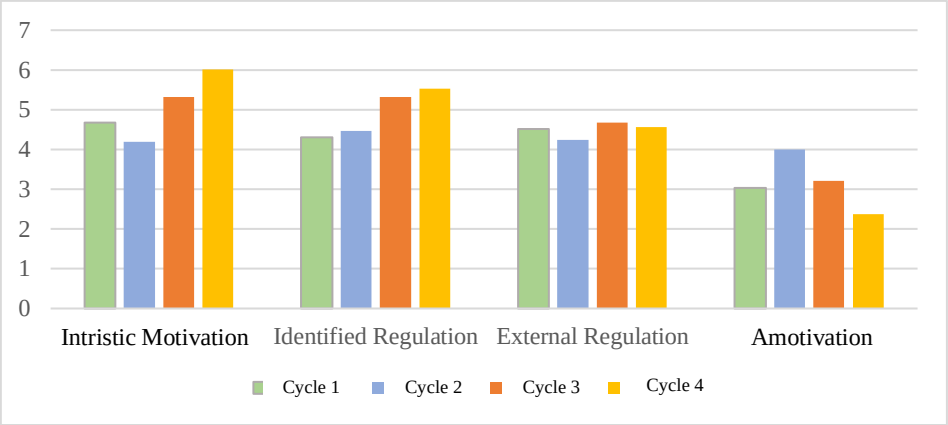

Figure 3. 4 Visualization of the Development of Learning Motivation Scales.

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Based on the graph in **Figure 3.4**, we can see the development of four different scales on student learning motivation. On the intrinsic motivation scale, students experience improvement from the first cycle to the last, which shows that students have an ever-increasing drive of themselves in following learning activities using eCraft2Learn from the beginning to the end cycle. Then on the identified regulation scale, students improved from the first cycle to the last, indicating that students felt that the activities in this study were important to them. Furthermore, on the external regulation scale, it can be seen that the decline from the first to the second cycle and from the third to the fourth cycle. This happens because some students participate in this activity not only to avoid punishment and get rewards, but the student feels a compulsion in carrying out the activity. While the amotivation scale increased in the second cycle, which showed that students were neither intrinsically nor extrinsically motivated. This happens because the appearance and content of the material on eCraft2Learn before it is developed makes them uncomfortable.

3.4. The Effect of UI/UX Design on Learning Motivation

Based on students' answers to the User Experience Questionnaire (UEQ) and Situational Motivation Scale (SIMS) questionnaires, data processing was carried out with test results which can be seen in **Table 3.3**. using the Gain Test to find out how the UI/UX of the eCraft2Learn website improves.

Table 3.3. N-Gain Test Result.

Questionnaire Scale	N-Gain Category	N
User Experience Questionnaire (UEQ)	Average	17
	Low	13
Intrinsic Motivation	High	14
	Average	11
	Low	5
Identified Regulation	High	2
	Average	21
	Low	7
External Regulation	Average	10
	Low	20
Amotivation	Low	30

Based on Table 3.3 can be seen the results of the N-Gain Test from the first and last UI/UX questionnaires, and the motivation from cycle 2 and cycle 4. N-Gain results from UI / UX were obtained as many as 17 students in the Average category and 13 students in the Low category. The N-Gain results from the intrinsic motivation scale were 14 students who had an increase in the High category, 11 students in the Average category, and 5 students in the Low category. Then on the identified regulation scale, there were 2 students who had an increase in the High category, 21 students in the Average category, and 7 students in the Low category. On the external regulation scale, there are 10 students who have improved in the Average category and 20 students in the Low category. Averaged on the amotivation scale there are 30 students who have improved with the Low category.

From the results obtained, testing can be carried out in Table 3.4 related to the influence of UI / UX design on student learning motivation. The test is performed using Simple Linear Regression Test and T Test. Here are the results of the test:

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Table 3.4. Results of Simple Linear Regression Test and T Test.

Bound Variables	Unstandardized Coefficients B		T	Sig.
	Constant	UI/UX		
Intrinsic Motivation	.435	.493	2.143	.041
Identified Regulation	.335	.350	2.041	.051
External Regulation	.026	.073	.226	.823
Identified Regulation	-.624	-.186	-.415	.681

Based on **Table 3.4**, it can be seen that the significance value of the intrinsic motivation scale obtained is 0.041 < 0.05 and the t value of the table is calculated > t table is 2.143 > 1.701, so it can be concluded that the design of UI / UX (Variable X) affects the intrinsic motivation scale (Variable Y1). Then based on the significance value of the identified regulation scale, a value of 0.051 ≤ 0.05 was obtained and the t value of the table > t was 2.041 > 1.701, so it can be concluded that the design of UI / UX (Variable X) affects the identified regulation scale (Variable Y2). There is also an external regulation scale that obtains a significance value of 0.823 > 0.05 and a t-value calculated < t table of 0.226 < 1.701, so it can be concluded that the design of UI / UX (Variable X) has no effect on the external regulation scale (Variable Y3). Averaging the amotivation scale obtained a significance value of 0.681 > 0.05 and t calculated < t table which is -0.415 < 1.701, so it can be concluded that UI/UX design (Variable X) has no effect on the amotivation scale (Variable Y4).

4. CONCLUSION

Based on the results of research that has been conducted on the development of User Interface (UI) and User Experience (UX) designs in web-based artificial intelligence learning on student learning motivation with a User-Centered Design approach, it can be concluded that UI and UX design has received an increase from UEQ measurements at each sub-scale. There is also a measurement of student learning motivation using SIMS obtained an increase from the four cycles carried out on the scale of intrinsic motivation and identified regulation and there was a decrease in the scale of external regulation and amotivation. Thus, the results of improvement are obtained on each scale with different categories. Based on this, it was also found that the influence of this UI / UX design on each motivation scale, including the intrinsic motivation scale with a significance value of 0.041 < 0.05 and the t value of the table > t which is 2.143 > 1.701, and the identified regulation scale with a significance value of 0.051 ≤ 0.05 and a t value calculated > t table i.e. 2.041 > 1.701. The average UI/UX design has no effect on the external regulation scale because the significance value obtained is 0.823 > 0.05 and the t value of the table < t is 0.226 < 1.701, and also the motivation scale with a significance value of 0.681 > 0.05 and t calculate the table t < which is -0.415 < 1.701.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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