G-Tech : Jurnal Teknologi Terapan
Vol. 9, No. 1, 2025, p. 373-380
E-ISSN: 2623-064X | P-ISSN: 2580-8737

Usability Evaluation of Sistem Informasi Teknik Industri (SITI) Using Performance Measurement

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Article Information

Article History

Received : December 23, 2024
Revised : January 07, 2025
Published : January 14, 2025

***Keywords*:**

Effective;
Efficient;
Performance Measurement;
Sistem Informasi Teknik Industri (SITI);
Usability.

ABSTRACT

Sistem Informasi Teknik Industri (SITI) is a web application developed by the Industrial Engineering Study Program, Kalimantan Institute of Technology, for interaction media between lecturers and students in Kerja Praktek (KP) and Tugas Akhir (TA). In the digital era, information systems play an important role in increasing efficiency and effectiveness in the field of education. This study aims to evaluate the usability of SITI using the Performance Measurement method, namely in the aspects of effectiveness and efficiency. The evaluation results showed that SITI had a very good level of effectiveness, with a task completion rate of 81.25% for lecturers and 81.82% for students. The average error rate reached 21.25% for lecturers and 9.95% for students, especially in the KP and TA guidance filling feature. However, the efficiency still needs to be improved, with a time-based efficiency of 0.09 goals/second for lecturers and 0.038 goals/second for students, as well as an overall relative efficiency of 67.03% for lecturers and 83.1% for students. SITI is effective in supporting academic interaction but needs improvements to features that have a high failure rate to improve efficiency and user experience.

INTRODUCTION

The development of the times has entered an all-digital era where technology is crucial in supporting human life, both in information exchange and seamless online communication (Christian & Ariani, 2018). One form of technological development is disseminating information using a web-based information system, which has been used in various fields, such as education. In education, web-based information systems are used to support learning, communication, and educational information management (Manuhutu & Wattimena, 2019).

One of the web applications in education is the Sistem Informasi Teknik Industri (SITI). SITI is a web application developed by the Industrial Engineering Study Program at the Kalimantan Institute of Technology used as a digital medium for the registration process, document uploading, and direct interaction related to Kerja Praktek (KP) and Tugas Akhir (TA) activities. SITI is relatively new; although it has been started to be used, it is still in the trial period, so it has never been evaluated based on User Experience (UX) or user experience to identify problems faced by users and improve the quality of SITI.

In producing a good and quality web application that can be used effectively and efficiently and provides satisfaction to users, it is necessary to follow development guidelines, one of which is to evaluate usability(Suandi & Wahyu Winarno, 2017). Usability is a quality measure that

assesses users' ease of an interface (Nielsen, 2012). UX evaluation in the development of educational web applications is critical to ensure that the system has met the needs and expectations of users, both lecturers and students. The ISO 9241-210 standard states that the user is a reference for consideration so that the system can be used effectively and efficiently and meet user satisfaction (ISO, 2019).

Several previous studies have shown that usability evaluation is important in increasing the satisfaction and effectiveness of web-based education systems where usability testing is used to evaluate the system directly to the end user (Alharbi, 2019). Performance Measurement emphasizes the importance of measuring success, speed of task completion, and the number of errors made by users so that they can know and identify areas or features that need to be developed (Tiarani et al., 2023). Based on this, this study evaluates the usability side of SITI based on UX where the testing process is a black box, namely testing that aims to find out the results of execution with test data and check the performance of SITI from the level of effectiveness and efficiency.

RESEARCH METHODS

This study uses a combination of quantitative and qualitative methods and an evaluative process that evaluates SITI based on UX. Usability comes from the word "usable," which means something that can be appropriately used by minimizing failures and providing benefits and satisfaction to the users (Setiowati et al., 2022).

Respondents

Respondents of this study are Industrial Engineering lecturers and students. The SITI interface differs between lecturers and students, with lecturers accessing features like student guidance and assessments, while students use features such as supervisor registration and mentoring. It is sufficient to use five individuals to identify usability issues, as this number is adequate to uncover more than 80% of usability problems (Nielsen, 2000). Lecturer respondents, with an average age of 31($\pm$2.5) years, consist of 8 respondents. While, student respondents who have never used SITI before with an average age of 19 ($\pm$1) years, consist of 32 respondents.

Task Creation

First, tasks were created to conduct a pilot study before data collection. The task scenarios were designed to test the usability of SITI. Here are the tasks and opportunities incorrectly assigned

Table 1. Task Scenario

No	Task Lecturers	Task Students
1	Log in to the SITI account using the prepared email and password.	Register the student account for SITI
2	Input the seminar grades for the students' practical work.	Log in with the registered account
3	Input the seminar grades for the student's final project proposals.	Submit the registration for the internship supervisor
4	Input the grades for the student's final project defense.	Submit the registration for the final project supervisor
5	Fill feedback in the guidance for the student's practical work.	Register for the internship results seminar
6	Fill feedback in the guidance for the student's final project.	Register for the final project proposal seminar
7	Change password.	Register the final project defense
8	Log out of the account.	Fill internship guidance data
9	-	Fill final project guidance data
10	-	Change password.
11	-	Log out of the account.

Pilot Study

A pilot study was carried out to assess the experimental design that had been developed (Rizalmi et al., 2021). Pilot studies refine experimental or research procedures and clarify the definition of various things to be measured in a study (Nielsen, 1994). The pilot study involved two respondents for each group, two lecturers and two students. The aim is to ensure that the tasks for the lecturers and the students are by the desired scenario.

Data Collection

Data was collected 3 times using performance measurement, RTA, and SUS questionnaire methods. Data collection on performance measurement will be done with direct observation, followed by verbalization of user thoughts and experiences with RTA. Finally, a SUS questionnaire was used to measure user satisfaction.

Performance Measurement

The effectiveness is measured by the percentage of tasks completed by the respondents (Completion Rate) with a binary score of '1' for success and '0' for failure (Wahyuningrum, 2021)

$$Completion\ Rate = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N} n_{ij}}{RN} \times 100\% \quad (1)$$

Information:

N : Total Tasks

R : Number of Participants

n_{ij} : The result of task i by participant j will be worth 1 or 0

The effectiveness measurement is then interpreted with the Ministry of Home Affairs and Development reference standards (Ayu, 2017).

1. Effectiveness Ratio is less than 40%, the achievement level is Highly Ineffective.
2. Effectiveness Ratio is between 40% and 59.99%, the achievement level is Ineffective.
3. Effectiveness Ratio is between 60% and 79.99%, the achievement level is Effective.
4. If the Effectiveness Ratio is 80% or higher, the achievement level is Highly Effective.

The subsequent calculation of effectiveness, the percentage of errors made (Error Rate), by providing opportunities for each task tested based on the task where users are likely to make mistakes (Krueger, 2016).

$$Error\ Rate = \frac{Total\ Error}{Total\ Opportunities} \times 100\% \quad (2)$$

The level of efficiency, measured through the calculation of the percentage of task time successfully completed by respondents correctly (Time-Based Efficiency) and assessing the overall efficiency by respondents (Overall Relative Efficiency) (Wahyuningrum, 2021)

$$Time\ Based\ Efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N}\frac{n_{ij}}{t_{ij}}}{RN} \quad (3)$$

$$Overall\ Relative\ Efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N} n_{ij}t_{ij}}{\sum_{j=1}^{R}\sum_{i=1}^{N} t_{ij}}.100\% \quad (4)$$

Informations:

N : Total Tasks

R : Number of Participants

n_{ij} : The result of task i by participant j will be worth 1 or 0

t_{ij} : The time required for participant j in task scenario i.

RESULTS AND DISCUSSION

The results and discussion sections contain the results of data analysis (not raw data). The measurement of SITI's performance for lecturers and students, namely effectiveness and efficiency, is as follows.

Lecturer

The following is the time and level of completion of lecturers at SITI, where the red column indicates tasks that have failed to be completed.

Table 2. Data Performance Measurement Lecturers

Respondents	TD1	TD2	TD3	TD4	TD5	TD6	TD7	TD8
RD1	53	62	39	45	79	71	31	3
RD2	38	82	41	44	124	61	36	2
RD3	32	42	50	38	53	69	53	2
RD4	34	52	32	48	106	23	38	1
RD5	22	40	34	36	75	44	21	4
RD6	23	65	38	26	121	72	19	2
RD7	37	85	69	50	106	78	56	2
RD8	27	38	28	29	88	62	39	1

The calculation of the completion rate is known in Table 5, and the total tasks the lecturer has completed are as many as 34 tasks, along with the results.

$$Completion\ Rate\ Lecturers = \frac{34}{64} \times 100\% = 81{,}25\%$$

From the results of this calculation, the effectiveness of SITI on lecturers is 81.25%, and very effective. Furthermore, the error rate is measured by the number of errors, and the percentage of errors obtained for each assignment by the lecturer is as follows.

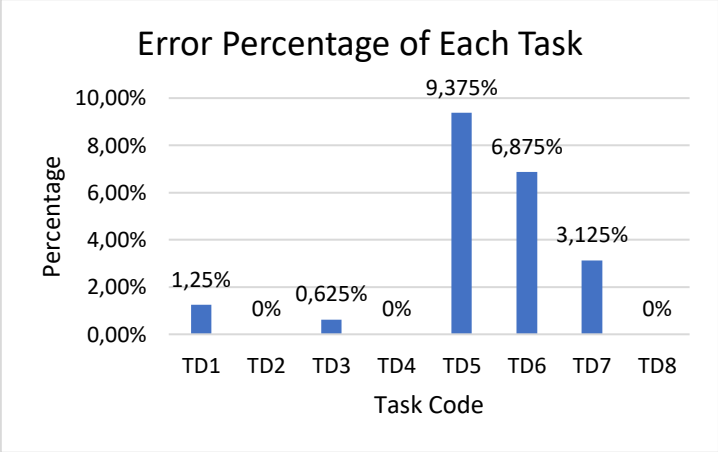

Figure 1. Error Percentage by Lecturer

The average percentage of error rate is 21.25%. Sauro (2010) stated that the average user error is 70%, so the lecturer's error rate does not exceed a reasonable limit. Based on the calculation of the error rate, it is known that the highest percentage of errors occurred in Task 5, filling in student KP guidance of 9.375%. The error was due to the respondent not opening the guidance file, incorrectly entering the guidance file link, and archiving the KP guidance. The second highest percentage of errors by Task 6 is filling in TA guidance at 6.875%, whereas the mistakes made are the same as those made by Task 5. Furthermore, Task 7 is to change the password by 3.125%; errors by the respondent include mistakes in entering the old and latest passwords because there is no password view feature, so they cannot be sure whether they have entered the password correctly.

The measurement of efficiency in lecturers with Time-Based Efficiency and Overall Relative Efficiency is as follows.

$$Time\ Based\ Efficiency = \frac{\frac{1}{53} + \frac{1}{38} + \ldots + \frac{1}{1}}{8\,.\,8}$$
$$= 0{,}09\ \text{goal/sec}$$

The average respondent can complete tasks as much as 0.09 (9%) per second, which is relatively low based on the average total time required to complete the entire task. Next, the calculation of the overall efficiency percentage:

$$Overall\ Relative\ Efficiency = \frac{1.958}{2.921}.100\%$$
$$= 67{,}03\%$$

Overall relative efficiency of SITI lecturers is 67.03%, and inefficient because it has not reached the efficiency target of 100% where respondents fail to complete their tasks.

Student

The following is the time and level of completion of students at SITI :

Table 3. Data Performance Measurement Students

Responden	TM 1	TM 2	TM 3	TM 4	TM 5	TM 6	TM 7	TM 8	TM 9	TM 10	TM 11
RM1	97	36	91	37	119	98	83	201	103	30	6
RM2	153	53	150	156	213	146	133	56	42	33	3
RM3	109	31	101	143	210	126	153	88	62	24	8
RM4	117	25	128	123	207	165	91	92	61	19	5
RM5	73	28	93	92	216	78	109	150	86	48	3
RM6	95	23	125	133	225	182	152	83	43	39	2
RM7	84	33	131	93	168	74	64	78	32	21	4
RM8	134	63	223	131	220	136	45	161	52	25	3
RM9	160	99	209	113	275	125	123	144	95	67	5
RM10	122	66	194	41	163	112	101	153	104	22	5
RM11	109	15	186	88	267	126	90	106	44	20	4
RM12	76	10	121	45	144	137	74	67	37	125	3
RM13	79	41	156	104	175	127	102	109	46	27	2
RM14	67	14	88	93	104	90	69	65	53	52	3
RM15	93	8	84	82	157	81	71	97	50	31	4
RM16	101	26	73	49	186	69	121	49	41	21	7
RM17	80	31	61	78	114	76	72	59	49	17	4
RM18	95	9	136	124	219	127	78	116	60	29	6
RM19	99	11	125	42	181	110	89	73	55	37	8
RM20	163	16	69	48	159	124	82	182	80	36	5
RM21	76	20	52	60	104	96	80	24	23	19	2
RM22	71	19	121	152	192	115	100	150	69	46	4
RM23	215	98	211	115	212	122	178	144	105	69	3
RM24	75	16	46	38	132	55	62	66	43	17	2
RM25	78	57	206	123	226	121	158	233	72	24	3
RM26	88	22	98	78	230	112	159	151	114	62	5
RM27	110	47	68	81	219	77	111	125	79	40	4
RM28	86	12	140	139	127	78	84	80	61	19	3
RM29	93	45	129	216	229	184	124	149	109	31	3
RM30	108	46	64	59	250	143	99	107	103	24	4
RM31	113	36	104	53	233	157	85	179	95	41	6
RM32	104	64	123	62	221	95	126	100	31	43	2

The calculation of the Completion Rate (success rate) is known in Table 7. The total number of tasks successfully done by students is 288, and the results.

$$Completion\ Rate\ Students = \frac{288}{352} \times 100\% = 81{,}82\%$$

The effectiveness of SITI on students is 81.82% and very effective. Furthermore, the error rate is measured by the number of errors, and the percentage of errors obtained for each assignment by the student is as follows.

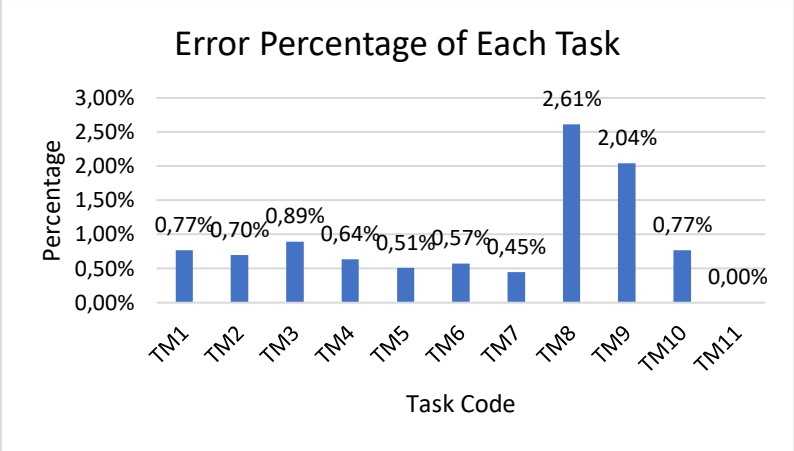

Figure 2. Error Percentage by Student

The average percentage of error rate is 9.95%, so the student's error rate does not exceed a reasonable limit. Based on the results of the calculation of the error rate in SITI student respondents, it is known that the features that need to be improved with the highest percentage of errors occurring in Task 8 filling in KP guidance, which is 2.61% where the error is due to the respondent entering the wrong KP guidance file link, repeating the guidance filling, and not filling in the guidance notes. The second highest percentage of errors was Task 9, filling in TA guidance at 2.04%, where the mistakes made by respondents were in the form of errors in entering the TA guidance file link, repeating the filling in the guidance, and not filling in the guidance notes.

The measurement of efficiency with Time-Based Efficiency and Overall Relative Efficiency is as follows.

$$Time\ Based\ Efficiency = \frac{\frac{1}{97} + \frac{1}{153} + \ldots + \frac{1}{2}}{11.32}$$
$$= 0{,}038\ goal/sec$$

The average respondent can complete the task as much as 0.038 (3.8%) per second, which is relatively low based on the average total time required to complete the entire task. Next, the calculation of the overall efficiency percentage:

$$Overall\ Relative\ Efficiency = \frac{26.085}{31.394}.100\%$$
$$= 83{,}1\%$$

The overall relative efficiency of the SITI for students is 83.1%, and inefficient because it has not reached the efficiency target of 100% where respondents fail to complete their tasks.

CONCLUSION

The results of the evaluation of the usability of the Sistem Informasi Teknik Industri (SITI) show that this system has an excellent level of effectiveness, with a success rate of 81.25% for lecturers and 81.82% for students. However, the system's efficiency is still not optimal, as shown by the time-based efficiency of 0.09 goals/second for lecturers and 0.038 goals/second for students, as well as the overall relative efficiency of 67.03% for lecturers and 83.1% for students. The average error rate reached 21.25% for lecturers and 9.95% for students, where critical features such as filling in Kerja Praktek guidance (KP) and Tugas Akhir (TA) are areas that often experience errors. To improve user experience and system efficiency, improvements to features that have a high failure rate are an essential priority. With further development, SITI is expected to support academic interaction better, effectively, and efficiently.

ACKNOWLEDGEMENTS

Thank you to the Kalimantan Institute of Technology for its support so that this research can be carried out smoothly until it is completed.

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