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Developing Programming Competence Among Physics Education Students With Multi-Platform E-Learning During COVID-19

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Abstract: This research examines the effectiveness of a multi-platform e-learning approach in developing programming competence among physics education students at Mataram University's Faculty of Teaching and Education during the COVID-19 pandemic. The R2D2 model, an iterative and cyclical constructivist learning design process emphasizing creative learning experiences, serves as the methodological framework. Data collection employs questionnaires and tests. The research yields two primary findings: the development of a multi-platform e-learning media for a computer programming course by combining features from SIA, SPADA Unram, YouTube Channel, Google Drive, and WhatsApp groups; and student learning outcomes falling within the "satisfaction" category. Statistical analysis of class A and B data (means and standard deviations: 76.429/0.782 and 74.57/1.06, respectively) reveals insufficient evidence to conclude a significant difference in data variability between the two groups.

Keywords: Programming Competence, Multi-platform e-Learning, Physics Education Students, Covid-19

Introduction

Two factors that drove and accelerated the development of Universitas Mataram's online learning system were the 2018 Lombok earthquake and the COVID-19 pandemic. Firsly, the earthquake. The four major earthquakes which had magnitudes of 6.4, 7.0, 6.2, and 7.0, respectively, were followed by aftershocks totaling over 2,500, had a devastating impact on Lombok, particularly in coastal, mountainous, and urban areas. They caused widespread damage to buildings and infrastructure, and hundreds of people were killed (Ayub,2021). The earthquake also caused significant damage to Universitas Mataram's buildings, namely The Graduate School Building, the Faculty of Economics, the Faculty of Mathematics and Natural Sciences, the Faculty of Sociology, and the Unram Education Hospital. (Yuliandi,2018). The Faculty of Law and the Faculty of Engineering, on the other hand, only experienced minor damage(Rasyid,2018). As a result, the university was forced to hold lectures in emergency tents. Lectures in emergency tents were challenging for both students and faculty members. The tents were often hot and humid, making it difficult to concentrate. In addition, the noise from the surrounding area, made it difficult to hear the lectures (Jurnas, 2018). This experience showed the university the importance of having a robust online learning system in place.

Secondly, the COVID-19 pandemic. On 31 December 2019, the World Health Organization (WHO) was alerted to the emergence of cases of pneumonia of unknown etiology detected in Wuhan city, China. Within days, Chinese health authorities identified 44 more cases. A novel coronavirus (COVID-19) was subsequently isolated from patients. A putative epidemiological link was made with exposures in a seafood market in Wuhan city.1 By the end of January 2020, 9720 cases of 2019-nCoV were confirmed throughout China, with further 15,238 suspected cases and 213 deaths. More worryingly, 106 cases were also confirmed abroad in 19 countries, from neighboring countries such as Japan and Vietnam to more distant countries such as Finland, Canada, and Australia. On 30 January 2020, the Emergency

Committee of the WHO, under the 2005 International Health Regulations, declared COVID-19 acute respiratory disease a public health emergency of international concern(Lee,2020).

The wide spread and transmission of covid-19 with the potential for death which is high, face-to-face learning becomes impossible to implement because it is vulnerable. Throughout the COVID-19 pandemic, there has been a growing reliance on the use of technology to learn, live, and stay connected (Goldschmidt & Msn, 2020; Mujiono & Gazali, 2021). The pandemic forced universities around the world to move their classes online. The university quickly developed a new online learning system that allowed students to continue their studies even though they were unable to attend in-person classes.

Determined to stay ahead of the curve, Universitas Mataram launched SPADA Unram, its online learning platform. SPADA Unram is a comprehensive online learning system that offers a variety of features, including: a). Lectures: SPADA Unram provides access to recorded lectures, as well as live lectures that students can attend online; b). Assignments: SPADA Unram allows students to submit assignments, such as essays, projects, and exams; c). Discussion forums: SPADA Unram provides a forum for students to discuss course material with each other and with their instructors; d). Online library: SPADA Unram provides access to a digital library of books, articles, and other resources.

Online learning platforms have revolutionized education, but they still face technical challenges. One crucial issue is platform inaccessibility, particularly during lecture hours. When the main platform crashes or becomes unavailable, learning activities stall and students and instructors scramble for alternative solutions. Often, they resort to impromptu communication channels like WhatsApp, leading to fragmented and suboptimal learning experiences.

To mitigate these disruptions and ensure uninterrupted learning, this research proposes a multi-platform learning system, namely : a).Website: Moodle and Google Classroom are popular e-learning platforms that provide a variety of features for delivering content, facilitating discussion, and assessing student learning; b).Mobile: WhatsApp Business is a messaging app that can be used to communicate with students and groups of students; c). Social media: Facebook, Messenger, and YouTube are social media platforms that can be used to share content, collaborate on projects, and promote student engagement; d) Teleconference: Zoom and Google Meet are video conferencing platforms that can be used for live lectures, group discussions, and peer-to-peer tutoring.

The integration of these four platforms provides a number of advantages for physics education students: a). Flexibility: Students can access content and participate in activities on the platform that best suits their needs. b). Engagement: The variety of platforms and features can help to keep students engaged and motivated; c). Collaboration: Students can collaborate with each other and with their instructors on a variety of projects and activities; d). Support: Students can receive support from their instructors and peers through a variety of channels (Astriani, & Ismah, 2021; Pratomo, & Wahanisa, 2021; Fakhruddin et al., 2022).

This system leverages four platforms simultaneously, acting as a safety net in case of unexpected technical difficulties. If the main platform experiences downtime, instructors and students can seamlessly switch to any of the three backup platforms, minimizing disruptions and maintaining optimal learning continuity.

This research aims to implement and evaluate the effectiveness of a multi-platform learning system in ensuring uninterrupted and accessible online learning. The findings will offer valuable insights for educators and platform developers to enhance the reliability and resilience of online learning environments.

Method

The type of research used is research and development. The research was conducted at the Physics Study Program, Department of Mathematics and Natural Sciences, Faculty of Teacher Training and Education, University of Mataram. The development carried out in this study is to produce an excellent multi-platform e-learning learning system by minimizing technical disruptions. This research is a research and development study with the Recursive Reflective Design and Development (R2D2) design developed by Willis (1995). This model consists of 3 components, namely (1) identification, (2) design and development, and (3) dissemination.

The identification activity is focused on (a) creating teamwork, (b) progressive problem solving, and (c) contextual understanding of the problem. The

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design and development activity is focused on the effort to (a) learn the context of learning, (b) choose formats and media, (c) determine evaluation strategies, and (d) design and develop products. The dissemination activity is focused on (a) authentic evaluation, and (b) making the final product package according to the context.

To analyze the learning outcome data for classes A and B, the researcher used descriptive statistics, created histograms of the distributions of the two classes, and used ANOVA and MANOVA to analyze the differences in learning outcomes.

ANOVA is a statistical test used to compare the means of two or more groups. It does this by examining the variance between groups and within groups. (Binus,2023). ANOVA is a parametric statistical test that is used to compare the means of two or more groups. ANOVA works by comparing the variance between groups to the variance within groups. If the variance between groups is significantly greater than the variance within groups, then it is likely that there is a difference between the means of the groups. ANOVA can be used to test a variety of hypotheses, including:

H0: $\mu1 = \mu2 = \mu3$ (all means are equal)
H0: $\mu1 \neq \mu2$ (the means of the two groups are not equal)
H0: $\mu1 < \mu2$ (the mean of the first group is less than the mean of the second group)
H0: $\mu1 > \mu2$ (the mean of the first group is greater than the mean of the second group).

MANOVA is a multivariate statistical test that is used to compare the means of two or more groups for multiple dependent variables. MANOVA works by comparing the variance between groups for each dependent variable to the variance within groups for each dependent variable. If the variance between groups is significantly greater than the variance within groups for any of the dependent variables, then it is likely that there is a difference between the means of the groups for that dependent variable. MANOVA can be used to test a variety of hypotheses, including:

H0: $\mu1 = \mu2 = \mu3$ (all means are equal for all dependent variables)
H0: $\mu1 \neq \mu2$ (the means of the two groups are not equal for any of the dependent variables)
H0: $\mu1 < \mu2$ (the mean of the first group is less than the mean of the second group for any of the dependent variables)
H0: $\mu1 > \mu2$ (the mean of the first group is greater than the mean of the second group for any of the dependent variables)

Result and Discussion

Following the completion of the Multi-platform e-Learning system, a computer programming course was implemented for both Class A and Class B students. The learning outcomes were subsequently evaluated after one semester of instruction. Due to the absence of pre-tests, data was solely collected through post-tests administered to students in both classes. Descriptive Statistics Learnig Outcome Class A and B is presented in table 1.

Table 1. Simple Descriptive Learning Outcome

Variable	Mean	SE Mean	StDev	Variance
LOA	76.429	0.782	3.585	12.854
LOB	74.57	1.06	4.87	23.72

The results of these post-tests are presented in Figures 1 and 2.

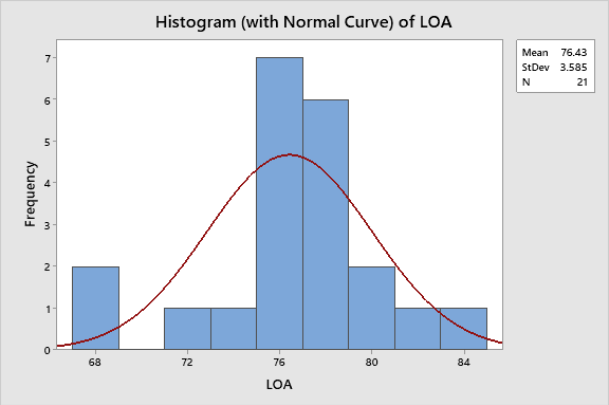

Figure 1. Learning Outcomes Class A

In figure 1 shows Class A learning outcomes averaged 76.43 with a standard deviation of 3.585.

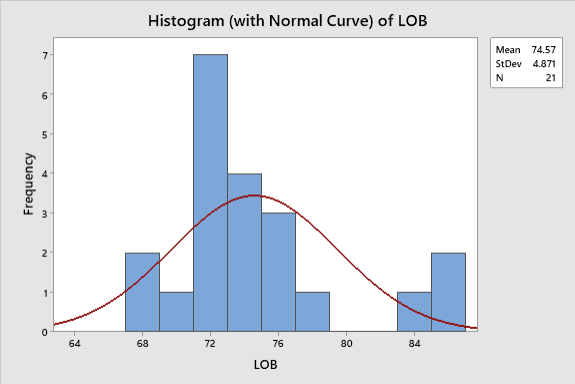

Figure 2. Learning Outcomes Class B

In figure 2 shows class B averaged 74.57 with a standard deviation of 4.871.

To determine whether the two classes received the same influence from the multi-platform e-learning system, the researcher used ANOVA analysis and the results are presented in Table 1.Data analysis Learning Outcomes Class A and B using One way ANOVA, Wilks, lawley-Hotelling, Pillai and Roy, presented on table 2 and table 3.

Table 2. Data analysis ANOVA Learning outcomes class A and class B

Source	DF	AdjSS	AdjMS	F-Value	P-Value
Factor	1	36.40	36.40	1.99	0.166
Error	40	731.53	18.29		
Total	41	767.93			

Table 2 presents the results of an Analysis of Variance (ANOVA) test used to compare the learning outcomes between Class A and Class B. The analysis of variance (ANOVA) revealed that the multi-platform e-learning media resulted in statistically equivalent outcomes for both Class A and Class B students. This is evidenced by the p-value of 0.166, which exceeds the conventional significance level of 0.05. In simpler terms, the observed differences between the classes are not statistically significant and can likely be attributed to chance variations.

Table 3. MANOVA Tests for LOB

Criterion	Test Statistic	F	DF		P
			Num	Denom	
Wilks'	0.02443	7.048	17	3	0.067
Lawley-Hotelling	39.93676	7.048	17	3	0.067
Pillai's	0.97557	7.048	17	3	0.067
Roy's	39.93676				

Table 3 Lists four different statistical tests used in MANOVA to assess differences between groups based on multiple dependent variables. The p-value, indicating the probability of observing the F-value (or a more extreme value) if there's no true difference between groups. All four tests yield a p-value of 0.067, suggesting marginal evidence for a potential difference between groups based on the LOB variable. Table 3's MANOVA results provide suggestive but not definitive evidence of a possible difference between groups based on the LOB variable. Further investigation is recommended for a more conclusive understanding of these relationships.

Conclusion

The present study suggests that the utilization of multi-platform e-learning media during the COVID-19 pandemic demonstrably facilitated the delivery of computer programming lecture materials. This assertion is supported by the achievement of high learning outcomes in both Class A and Class B. However, further research with larger sample sizes and more rigorous control groups is necessary to conclusively establish the generalizability and causal efficacy of the observed outcomes.

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