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The Influence of Personalized Web-Based Learning on The Mastery and Application of Concepts in Students with Different Learning Styles

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Abstract

Conventional learning has limitations, leading researchers to propose personalized web-based learning tailored to individual student characteristics. This study focuses on enhancing web-based learning at Bhinneka PGRI University in Indonesia by customizing content and activities to align with students' learning styles. The research methodology uses a quasi-experimental design involving 72 information technology education students. Data collection includes assessments of learning styles, concept mastery, and concept application through tests. Descriptive statistical analysis shows that personalized web-based learning has a more positive influence on the mastery and application of concepts compared to non-personalized learning. There is no significant correlation between personalized web-based learning and students' learning styles. The findings indicate differences in mastery and application of concepts among students using web-based learning, but no disparities based on different learning styles. In conclusion, personalized web-based learning leads to variations in mastery and application of concepts compared to non-personalized methods, with no discernible discrepancy in the mastery and application of concepts between students with different learning styles. Research indicates that personalized web-based learning is more effective in enhancing mastery and application of concepts compared to non-personalized methods. By customizing web-based learning to individual learning styles, students can enhance the quality and outcomes of their learning.

Keywords: Application of concepts, learning styles, mastery of concepts, personalization, web-based learning

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INTRODUCTION

At Bhinneka PGRI University Indonesia, students have equal opportunities to present material through presentations. However, conventional presentation techniques may not be optimal without a personalized approach (Cheng, 2014). To address this issue, researchers recommend implementing personalized web-based learning. This approach involves identifying student characteristics, adapting presentation styles, and learning activities based on their preferences. Web-based learning is an effective and efficient educational solution, as it offers easy access to

learning materials and enables communication through discussion forums or video conferences (Xiangyang et al., 2009).

Research has shown the advantages of web-based learning. Various studies by Hwang et al. (2012), Mampadi et al. (2011), Popescu (2010), and Yang et al. (2013) have suggested methods to enhance its effectiveness, such as focusing on addressing individual student needs. It is crucial to establish a learning environment tailored to individual requirements using computers and information technology (Srisawasdi and Panjaburee, 2015). In web-based learning, lecturers can customize each student's learning experience to their unique style, known as personalized web-based learning.

Studies by Dunn et al. (1984), Keefe (1987), Felder and Silverman (1988), Kolb et al. (1995), and Litzinger et al. (2007) emphasize the importance of individualized learning and the use of student characteristics assessments in personalized web-based learning. Kaburlasos et al. (2008), Panjaburee et al. (2010), Srisawasdi et al. (2012), Wanichsan et al. (2012), Hwang et al. (2013a, b), and Panjaburee and Srisawasdi (2013a, b) have proposed techniques to create personalized learning environments for enhanced learning outcomes.

Papanikolaou et al. (2002) developed a personalized web-based learning system that adjusts content based on students' knowledge levels. Tseng et al. (2008b) created a system that tailors content to students' knowledge levels and lecture complexity to enhance learning outcomes. Yang et al. (2013) designed a system with modules for individualized presentations to identify students' learning styles and cognitive preferences, enhancing the learning experience.

This research focuses on personalized web-based learning at Bhinneka PGRI University in Indonesia. The study aims to investigate the influence of personalized web-based learning on the mastery and application of concepts in students with different learning styles.

METHODS

This study employed a quasi-experimental approach with a 2x2 factorial pretest-posttest design using non-equivalent control groups (Tuckman & Harper, 2012). The quasi-experimental method was chosen as subjects were not randomly selected but were existing classes organized by the school where the research took place (Setyosari, 2013). The research design involved two non-randomized groups of research subjects, consisting of students 2017/2018 academic year from the Information Technology Education program at Bhinneka PGRI University, Indonesia. The subjects were divided into class 5A and class 5B, totaling 72 students with similar abilities. Class 5A received a peer learning strategy, while class 5B received traditional lecture-based teaching, both taught by the same team of lecturers to ensure consistency. The factorial research design is outlined in Table 1 below:

Table 1. 2 x 2 Factorial Research Design

Independent Variable		*Web-Based Learning* (X)			
		Personalized (X_1)		Non-Personalized (X_2)	
Moderator Variable		Mastery of Concepts (Y_1)	Application of Concepts (Y_2)	Mastery of Concepts (Y_1)	Application of Concepts (Y_2)
Felder Silverman Learning Style	*Sequential* (Z_1)	$Y_1 Z_1 X_1$	$Y_2 Z_1 X_1$	$Y_1 Z_1 X_2$	$Y_2 Z_1 X_2$
	Global (Z_2)	$Y_1 Z_2 X_1$	$Y_2 Z_2 X_1$	$Y_1 Z_2 X_2$	$Y_2 Z_2 X_2$

Information:

$Y_1 Z_1 X_1$ = Student mastery of concepts through personalized web-based learning with a sequential learning style

$Y_1 Z_2 X_1$ = Student mastery of concepts through personalized web-based learning with a global learning style

$Y_2 Z_1 X_1$ = Application of student concepts through personalized web-based learning with a sequential learning style

$Y_2 Z_2 X_1$ = Application of student concepts through personalized web-based learning with a global learning style

$Y_1 Z_1 X_2$ = Student mastery of concepts through non-personalized web-based learning with a sequential learning style

$Y_1 Z_2 X_2$ = Student mastery of concepts through non-personalized web-based learning with a global learning style

$Y_2 Z_1 X_2$ = Application of student concepts through non-personalized web-based learning with a sequential learning style

$Y_2 Z_2 X_2$ = Application of student concepts through non-personalized web-based learning with a global learning style

Control variables such as student abilities, material coverage, learning facilities, tools, test instruments, learning, and test time allocation were managed to minimize external influences on research results. These factors are believed to impact learning outcomes, particularly the mastery and application of concepts. Efforts were made to maintain consistency between the experimental and control groups to control for potential differences due to these variables.

The dependent variable in this research is the mastery and application of concepts, which can also be influenced by students' initial abilities and learning styles according to Felder Silverman. Students' initial abilities were assessed to ensure comparability between the two groups. The study aims to determine if there is a significant difference in the level of agreement between the personalized and non-personalized web-based learning groups. Pretest data on students' initial abilities were collected for both groups.

Validity of Instrument Content

Validation is conducted using a test grid and input from material experts. The course coordinator and lecturer reviewed this tool. Prior to testing mastery and application of concepts, the instrument must be validated by an expert.

Reliability and Validity of Instrument Items

The reliability and validity of each question item in the concept mastery and application test were assessed using a sample of 25 students. The test included a total of 47 questions. Validity was determined by comparing Cronbach's Alpha values before and after deleting each question item. A question item was considered valid if the Cronbach's Alpha value decreased when the item was deleted, indicating its reliability. A reliability threshold of 0.6 was used. (Singgih Santoso, 2015)
The data collection process includes the following steps:

1. Selecting research subjects for experimental and control groups.
2. Collaborating with course teachers to develop learning tools.
3. Developing and testing the validity and reliability of test instruments.
4. Identifying student learning styles using the Felder Silverman instrument.
5. Conducting experiments on experimental and control groups.
6. Monitoring the implementation of actions in both groups.
7. Evaluating students' mastery and application of concepts, analyzing data, and drawing research conclusions.

Data analysis

The data analysis techniques in this study are categorized into two groups: testing analysis requirements and testing research hypotheses. All research variables were analyzed. The analysis requirements were tested for data normality using the Shapiro-Wilk technique and for homogeneity of variance using Levene's test to meet parametric assumptions.

Research hypotheses were tested using the MANOVA (Multivariate Analysis of Variance) statistical technique with SPSS software. All parametric assumption tests were conducted at a significance level of 5%.

RESULTS & DISCUSSION

Student Learning Style Identification Results

The research was conducted on students enrolled in the information technology education study program at Bhinneka PGRI University, Indonesia, specifically in classes 5A and 5B. A total of 62 students participated in the research and were administered a learning style questionnaire to determine their preferred learning styles. The results of the student learning style identification are presented in Table 2.

Table 2. Results of Identification of Student Learning Styles

Student Learning Style	Non-personalized Web-Based Learning (class 4B)	Personalized Web-Based Learning (class 4A)	**Number of Students**
Sequential	12	11	6
Global	19	20	36
Number of students	31	31	62

The results of identifying student learning styles concluded that there was only one difference in learning styles between the two classes, indicating that the difference was not significant.

Results of Mastery and Application of Concepts for Students Using Web-Based Learning

The Table below summarizes the results of SPSS data processing on the mastery and application of concepts among groups of students who received personalized and non-personalized web-based learning treatments.

Table 3. Results of Mastery and Application of Concepts for Students Using Web-Based Learning

Test Type	Felder Silverman Learning Styles	N	Mastery of Concept			Application of Concept		
			Mean	Sig. Levene's Test	t-test	Mean	Sig. Levene's Test	t-test
Pretest	Non-Personalized	31	63,01	0,796	0,000	64,71	0,508	0,000
	Personalized	31	76,13			78,02		
Posttest	Non-Personalized	31	69,46	0,935	0,000	82,97	0,553	0,000
	Personalized	31	83,55			86,45		

The analysis results indicated no significant differences in the variety of mastery and application of concept scores between the control group and the experimental group. However, significant differences were observed after the personalized web-based learning treatment. The experimental group demonstrated improvements in the mastery and application concept scores.

Results of Mastery and Application of Concepts for Students with Sequential and Global Learning Styles

The table below summarizes the results of SPSS data processing on the mastery and application of concepts among groups of students with sequential and global learning styles.

Table 4. Results of Mastery and Application of Concepts for Students with Sequential and Global Learning Styles

Test Type	Felder Silverman Learning Styles	N	Mastery of Concept			Application of Concept		
			Mean	Sig. Levene's Test	t-test	Mean	Sig. Levene's Test	t-test
Pretest	Sequential	23	68,26	0,607	0,366	71,93	0,756	0,571
	Global	39	70,34			71,03		
Posttest	Sequential	23	75,65	0,278	0,624	84,29	0,411	0,301
	Global	39	77,01			84,96		

The analysis indicated no significant differences between the control and experimental groups in the mastery and application of concepts. Conclusions drawn from pretest and posttest data suggest that sequential and global learning styles have similar impacts.

Results of Web-Based Learning on Mastery and Application of Concepts with Sequential and Global Learning Styles

The table below summarizes the results of SPSS data processing comparing the mastery and application of concepts among students who received personalized and non-personalized web-based learning treatments based on sequential and global learning styles.

Table 5. Results of Web-Based Learning on Mastery and Application of Concepts with Sequential and Global Learning Styles

Web-Based Learning	Test Type	Felder Silverman Learning Styles	N	Mastery of Concept		Application of Concept	
				Mean	Std. Deviation	Mean	Std. Deviation
Non-Personalized	Pretest	Sequential	12	61,95	4,373	65,86	2,469
		Global	19	63,68	6,177	63,98	1,424
	Posttest	Sequential	12	68,61	4,370	82,77	1,235
		Global	19	70,00	6,186	83,11	1,829
Personalized	Pretest	Sequential	11	75,15	5,843	78,56	2,023
		Global	20	76,67	5,824	77,72	1,605
	Posttest	Sequential	11	83,33	3,334	85,95	1,234
		Global	20	83,67	6,657	86,73	2,055

The pretest and posttest results indicated an increase in mastery and application of concepts among students with sequential and global learning styles after using personalized web-based learning.

Analysis Requirements Test

Before conducting hypothesis testing, analysis requirements testing is carried out to assess the feasibility of parameterization. This includes normality tests and homogeneity tests for univariate or multivariate analysis. Hypothesis testing involves examining the main effects and interactions among research variables based on the analysis requirements.

1. Normality test

Data normality in each treatment group was assessed using the Shapiro-Wilk test with a significance level of $\alpha = 0.05$. The test evaluated the distribution of mastery scores and learning media concept application. The null hypothesis (Ho) assumes a normal distribution. The decision is based on the significance value: < 0.05 indicates a non-normal distribution, while > 0.05 indicates a normal distribution.

Table 6. Normality Test Results for Students' Mastery and Application of Concepts Using Web-Based Learning and Felder Silverman's Learning Style

		Shapiro Wilk			
		Mastery of Concept		Application of Concept	
		df	Sig.	df	Sig.
Web-Based Learning	Non-Personalized	31	0,139	31	0,537
	Personalized	31	0,094	31	0,235
Felder Silverman Learning Styles	Sequential	23	0,143	23	0,910
	Global	39	0,152	39	0,596

The normality test results indicated that the posttest scores in both groups followed a normal distribution (significance value > 0.05). This allows for conducting multivariate analysis to compare the mastery and application of material between the experimental and control groups using web-based learning and the Felder Silverman learning style.

Table 7. Results of Web-Based Learning Normality Test on Mastery and Application of Concepts in Students with Felder Silverman Learning Style

Learning outcomes	Web-Based Learning	Felder Silverman Learning Styles	Shapiro Wilk	
			df	Sig.
Mastery of Concept	Non-Personalized	Sequential	12	0,109
		Global	19	0,577
	Personalized	Sequential	11	0,064
		Global	20	0,129
Application of Concept	Non-Personalized	Sequential	12	0,341
		Global	19	0,099
	Personalized	Sequential	11	0,819
		Global	20	0,454

The Shapiro-Wilk normality test results indicate that the data in both the experimental and control groups are normally distributed (p > 0.05), allowing for further multivariate analysis.

2. Homogeneity Test

The homogeneity test was conducted to assess the consistency of variance in the mastery and application of concepts across treatment groups. The Levene test of homogeneity of variances was used with a significance level of 0.05. A significance level greater than 0.05 indicates that the sample variances are homogeneous (Santoso, S. & Tjiptono, F, 2002:39).

Table 8. Data Homogeneity Test Results Result of Mastery and Application of Concepts

	Levene's Test		
	df1	df2	Sig.
Mastery of Concept	2	59	0,276
Application of Concept	2	59	0,246

Levene's test results indicate that the data on mastery and application of concepts are homogeneous (p > 0.05). Therefore, a multivariate analysis of variance (MANOVA) can be conducted as the assumptions of normality and homogeneity of the data are satisfied.

Test the Research Hypothesis

Analysis of web-based learning revealed significant differences in the mastery and application of concepts between personalized and non-personalized approaches (p < 0.05). Personalized web-based learning resulted in higher mastery and application of concepts. Refer to Figure 1 for a comparison of post-test scores.

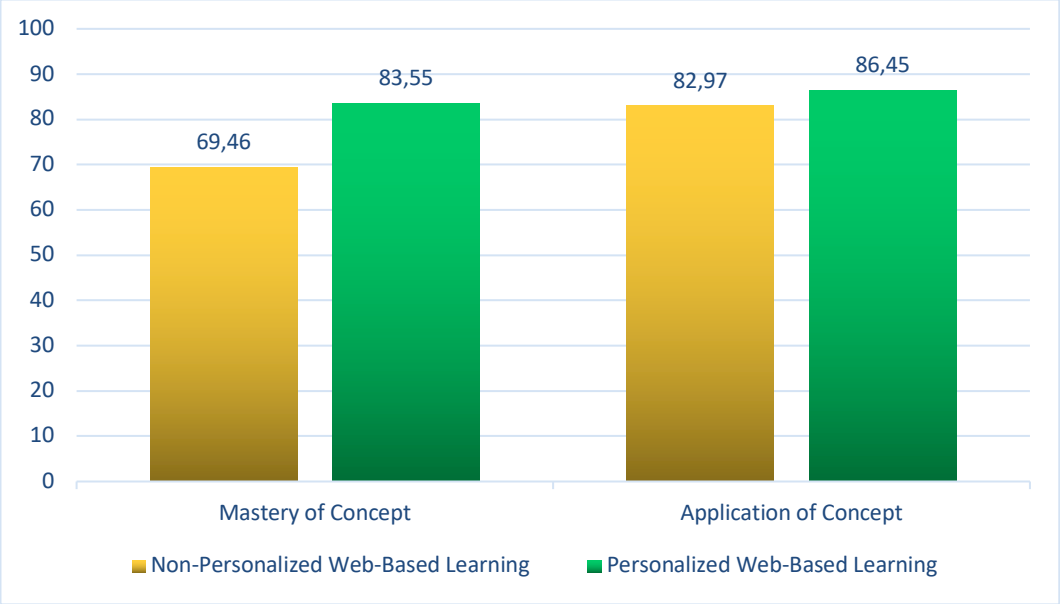

Figure 1. Comparison of Posttest Scores for Mastery and Application of Concepts for Students Using Personalized and Non-Personalized Web-Based Learning

Analysis of the learning style revealed significant differences in the mastery and application of concepts between sequential and global learning styles ($p < 0.05$). The Global learning style resulted in higher mastery and application of concepts. Refer to Figure 2 for a comparison of post-test scores.

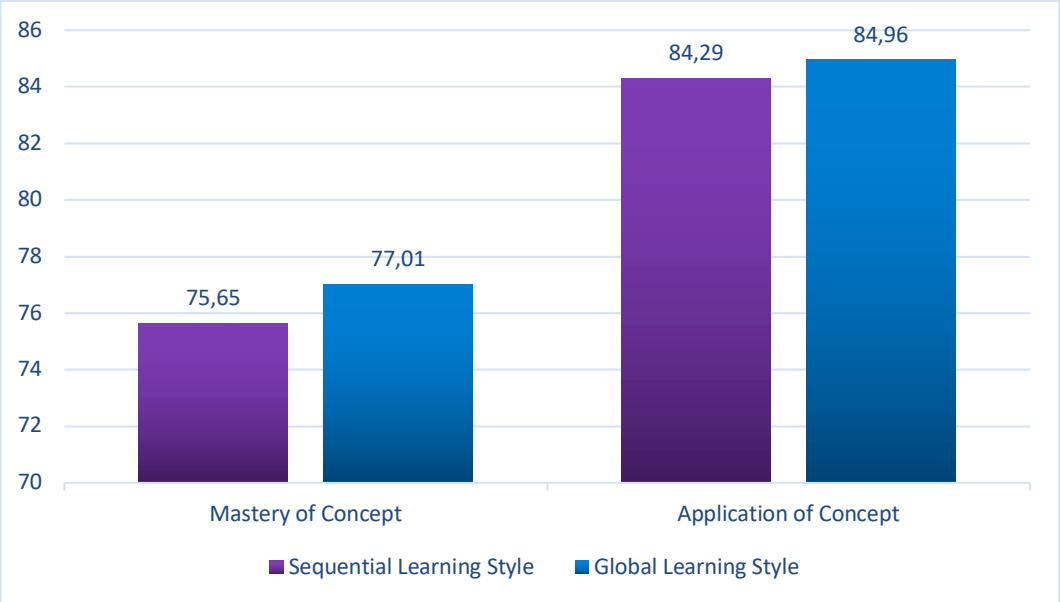

Figure 2. Comparison of Posttest Scores for Mastery and Application of Concepts for Students with Different Learning Styles

Correlation analysis between web-based learning and learning styles indicates no significant difference in mastery and application of concepts between sequential

and global learning styles (p >0.05). Posttest scores for mastery and application of concepts are higher with personalized web-based learning compared to non-personalized web-based learning. Refer to Figure 3 for a comparison of posttest scores.

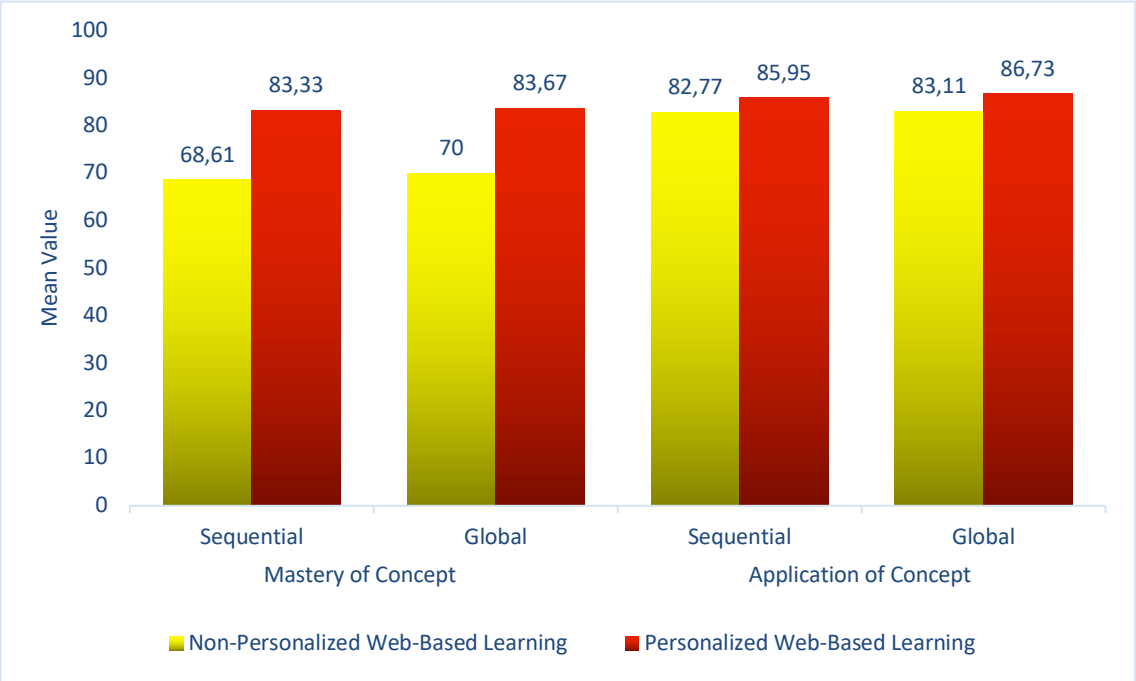

Figure 3. Comparison of Correlation Values of Web Based Learning on Mastery and Application of Concepts with Different Learning Styles

The results of the research on Between-Subjects Effects in MANOVA tests are presented in Table 9 below:

Table 9. Results of Tests of Between-Subjects Effects MANOVA

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Posttest Mastery of Concept	3127,888[a]	3	1563,944	50,851	,000
	Posttest Application of Concept	188,111[b]	3	94,056	31,377	,000
Intercept	Posttest Mastery of Concept	330628,561	1	330628,561	10750,186	,000
	Posttest Application of Concept	415944,314	1	415944,314	138759,028	,000
Web-Based Learning	Posttest Mastery of Concept	897,744	1	897,744	29,190	,000
	Posttest Application of Concept	66,203	1	66,203	22,085	,000
Learning Style	Posttest Mastery of Concept	52,393	1	52,393	1,704	,197

	Posttest Application of Concept	,678	1	,678	,226	,636
Web-Based Learning * Learning Style	Posttest Mastery of Concept	4,313	1	4,313	,187	,594
	Posttest Application of Concept	12,578	1	12,578	,365	,422
Error	Posttest Mastery of Concept	1814,581	59	30,756		
	Posttest Application of Concept	176,859	9	2,998		
Total	Posttest Mastery of Concept	367829,401	2			
	Posttest Application of Concept	445294,080	2			
Corrected Total	Posttest Mastery of Concept	4942,469	1			
	Posttest Application of Concept	364,970	1			

Hypothesis 1

H_0: There is no difference in mastery of concept between personalized and non-personalized web-based learning.

H_1: There is a difference in mastery of concept between personalized and non-personalized web-based learning.

The F value calculated from the Tests of Between-Subjects Effects Table was 29.190, with a significance of 0.000 ($p < 0.05$, H_0 rejected). This indicates a significant difference in mastery of concept between personalized and non-personalized web-based learning. In conclusion, personalized web-based learning resulted in better mastery of concept compared to non-personalized web-based learning.

Hypothesis 2

H_0: There is no difference in application of concept between personalized and non-personalized web-based learning.

H_1: There is a difference in application of concept between personalized and non-personalized web-based learning.

The F value calculated from the Tests of Between-Subjects Effects Table was 22,085, with a significance of 0.000 ($p < 0.05$, H_0 rejected). This indicates a significant difference in application of concept between personalized and non-personalized web-based learning. In conclusion, personalized web-based learning resulted in better application of concept compared to non-personalized web-based learning.

Hypothesis 3

H_0: There is no difference in mastery of concept between students with sequential and global learning styles.

H_1: There is a difference in mastery of concept based on students' learning styles.

The F value from the Between-Subjects Effects Table is 1.704, with a

significance of 0.197 ($p > 0.05$, H_0 accepted). This indicates no significant difference in mastery of concept between sequential and global learning styles. In conclusion, both learning styles do not lead to better the mastery of concept.

Hypothesis 4

H_0: There is no difference in application of concept between students with sequential and global learning styles.

H_1: There is a difference in application of concept based on students' learning styles.

The F value from the Between-Subjects Effects Table is 0,226, with a significance of 0,636 ($p > 0.05$, H_0 accepted). This indicates no significant difference in application of concept between sequential and global learning styles. In conclusion, both learning styles do not lead to better the application of concept.

Hypothesis 5

H_0: There is no correlation between web-based learning and students' mastery of concepts with sequential and global learning styles.

H_1: There is a correlation between web-based learning and students' mastery of concepts with sequential and global learning styles.

The F value from the Between-Subjects Effects Table is 0.187, with a significance of 0.594 ($p > 0.05$, H0 accepted), indicating no correlation between web-based learning and students' mastery of concepts based on sequential and global learning styles. In conclusion, web-based learning has similar effectiveness for students with sequential and global learning styles.

Hypothesis 6

H_0: There is no correlation between web-based learning and students' application of concepts with sequential and global learning styles.

H_1: There is a correlation between web-based learning and students' application of concepts with sequential and global learning styles.

The F value from the Between-Subjects Effects Table is 0,365, with a significance of 0,422 ($p > 0.05$, H0 accepted), indicating no correlation between web-based learning and students' application of concepts based on sequential and global learning styles. In conclusion, web-based learning has similar effectiveness for students with sequential and global learning styles.

Research Discussion

The results of hypothesis testing indicate a significant difference in learning outcomes between students using personalized web-based learning and those using non-personalized web-based learning. The group using personalized learning showed better mastery and application of concepts compared to the group not using personalized learning. Therefore, it can be concluded that personalized web-based learning is more effective. This study compared students utilizing personalized web-based learning with those using non-personalized web-based learning and found a significant impact on learning outcomes. These findings are consistent with previous research by Oliver (2007), Cerra et al. (2013), and Papastergiou and Gerodimos (2012), highlighting differences in learning

outcomes between web-based learning approaches and lecture-based learning. Several studies have demonstrated the effectiveness of web-based learning. Xiangyang Luo, D. Wang, Wei Hu, and F. Liu (2009) investigated "Blind Detection For Image Steganography: A System Framework and Implementation," concluding that web-based learning is an efficient and effective educational method. These findings are supported by research from Panjaburee et al. (2010), Srisawasdi et al. (2012), Wanichsan et al. (2012), Hwang et al. (2013a, b), and Panjaburee and Srisawasdi (2013a, b), advocating personalized web-based learning as a technique to enhance learning outcomes.

The results of hypothesis testing indicate no significant differences in the ability to master and apply concepts between students with sequential and global learning styles. Students with a global learning style demonstrate superior abilities compared to those with a sequential learning style. The global learning style positively influences students' mastery and application of concepts. According to Akbulut and Cardak (2012), students possess unique learning styles, emphasizing the importance of personalized support tailored to individual learning styles.

The data analysis indicates that there is no significant influence of web-based learning and students' learning styles on their ability to master and apply concepts. However, aligning web-based learning with students' learning styles can enhance the quality of the learning process, resulting in improved learning outcomes in mastering and applying concepts. Dunn et al. (1984), Keefe (1987), Felder and Silverman (1988), Kolb et al. (1995), and Litzinger et al. (2007) emphasize the importance of personalizing learning experiences in web-based learning. The F score and significance tests demonstrate that there is no direct impact of web-based learning and learning styles on concept mastery and application. Regardless of the sequential or global learning style, similar scores are shown with personalized and non-personalized web-based learning.

The test results indicate a strong influence of the independent variable on the dependent variable. However, the relationship among the independent variable, the moderator variable, and the dependent variable in terms of learning outcomes is not significant. Web-based learning has a dominant impact on student learning outcomes, with learning style as a moderator showing a weak contribution. Significant differences are observed between sequential and global learning styles in the context of web-based learning.

CONCLUSION

Research indicates that personalized web-based learning is more effective in enhancing mastery and application of concepts compared to non-personalized methods. Studies show that students with a global learning style can achieve similar levels of mastery and application as those with a sequential learning style, but the global style has a more positive impact. By customizing web-based learning to individual learning styles, students can enhance the quality and outcomes of their learning.

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