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Research Article

The Effect of Virtual Reality on Learning Outcomes Mediated by Interaction and Learning Experiences

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Abstract: In Indonesia, only a few educational institutions have implemented VR learning technology due to the lack of available content for learning and the insignificant effect for students after using VR. This study aims to examine the effect of VR learning technology (immersion, visualization, interaction) on learning outcomes (perceived learning effectiveness, satisfaction) with interaction experience (perceived usefulness, perceived ease of use) and learning experiences (motivation, interest, active learning) as mediators. 117 questionnaires are distributed to Junior High Schools, Senior High Schools, and Vocational High Schools students which have implemented the VR technology learningbased and implemented their classes with VR content, between the age of 12 until 19 years old. The data is analyzed by using Structural Equations Modelling (SEM) and Multiple Regression Analysis. We find VR learning technology affect student's motivation and learning activity and also improve student learning outcomes in terms of perceived learning effectiveness dimension. On the other hand, the interaction experience was unperceived because of a lack of learning content characteristics for the immersive dimension that can affect the perceived usefulness and perceived ease of use. This research showed that the characteristics of VR learning technology affect student's motivation and learning activeness. It improves student's learning outcomes for perceived learning effectiveness.

Keywords: Learning Technology, Virtual Reality, Learning Outcomes, Interaction Experiences, Learning Experiences

1. Introduction

Digital devices are increasingly being used in learning and education today (Zawacki-Richter & Latchem, 2018). Nowadays, Virtual Reality (VR) learning technology is implemented into education, teaching, and training. Therefore, it is important for the educational culture to adjust to the changes such as education culture must also change how teachers teach and encourage student to learn (Wuragil, 2020). Kantar EMNID, a research company from Germany, surveyed 606 teachers across Germany in 2016 to investigate what the teachers think about the application of teaching technology, especially VR in the classroom. They found that 92% of teachers supported the use of digital technology in the classroom during the learning process, 74% of them believed that the use of VR could increase student's motivation in learning, and 62% believed it increased student learning success (Samsung Newsroom, 2017).

Learning technology is the technology used by educators to support effectiveness in the learning process (Lever-Duffy, 2003). Learning technology must be supported by the environment so as to create lifelong learning. In this sense, learning environment with appropriate cognitive tools ensures the transfer of knowledge and lifelong learning (Coombs, 2017). VR can accurately describe some features and processes as well as allowing the users to explore through the experiences gained while using VR. Users can decide what to do when interacting with a virtual environment. VR allows users to learn while taking a constructivist approach and promoting the enhancement of logical and conceptual development of learning (Pantelidis, 2009). Dimensions of the characteristics of VR in learning technology are immersion, visualization, and interaction (Ying et al., 2017). Learning outcomes can be seen from changes in behavior in a person which may be caused by changes in the level of knowledge, skills, or attitudes (Arsyad, 2011). Learning experiences using VR technology could shape learning outcomes that are measured by perceived learning effectiveness and perceived learning satisfaction (Ai-Lim Lee et al., 2010).The characteristics of VR not only affect learning, but also the quality of the interactive and learning experiences that students perceive (Ai-Lim Lee et al., 2010). There are two beliefs in determining a person's intention in using technology, namely the perceived usefulness and perceived ease of use (Davis, 1989).The perceived usefulness and perceived ease of use have a significant influence on student satisfaction, and they have been applied to the information technology area to investigate new products or technologies (Sun et al., 2008).In this case, learning experiences from psychological factors such as attendance, motivation, interests, cognitive usefulness, control and learning activity and reflective thinking have provided evidence that learning experiences shape learning outcomes (Ai-Lim Lee et al., 2010).The model examines how important VR

features work together with other factors such as the concept to be learned, interaction and learning experiences that affect the learning process, which ultimately affects learning outcomes. VR features not only affect learning outcomes, but also that the effect is mediated by the quality of interactive and learning experiences. It was found that the achievement indicators of the dependent variable learning outcomes were not a significant indicator in the model, because there was no link between theoretical and VR features of the model (Ai-Lim Lee et al., 2010).

In Indonesia, only a few educational institutions have implemented VR technology in learning because of the high investment in the provision of VR technology, the lack of available content for the learning, and unclear effect for students who use VR as technology in learning. This study analyzes the influence of the characteristics of learning technology using VR on learning outcomes with interaction experiences and learning experiences as mediators.

The research contributes to the analysis and validation to what extent the effect of the learning process using VR learning technology on learning achievement. In this vein, the reference material and further research on the evaluation of the learning process using VR learning technology is perceived from learning achievement and the merit for educational institutions. In this frame, the institutions considered the application of the learning process using VR learning technology. At the same time, the government considers the application of learning using VR learning technology to face the industrial revolution 4.0. At this point, the digital gap in optimizing digital technology is restrained, and finally, VR content provider companies take into consideration learning based on content.

2. Research Model

The learning model using VR technology (Ai-Lim Lee et al., 2010) provides a starting point for making this conceptual framework and is supported by the VR characteristics of the (Saurik et al., 2019; Scristria, 2014; Skarbez et al., 2017; Ying et al., 2017), the interaction experience of (Davis, 1989; Sun et al., 2008), the learning experience from (Ai-Lim Lee et al., 2010; D. d, 2006; Schunk et al., 2014; Slameto, 2015; Syah, 2016), and the learning outcomes of (Ai-Lim Lee et al., 2010; Uskov et al., 2017). Figure 1 illustrates the conceptual framework of outcomes and causal relationships in a learning environment using VR technology. In this framework, the characteristics of VR influenced learning outcomes, namely the perceived effectiveness of learning and satisfaction indirectly through mediating interaction experiences such as perceived usefulness and perceived ease of use, and learning experiences such as motivation, interest, and active learning.

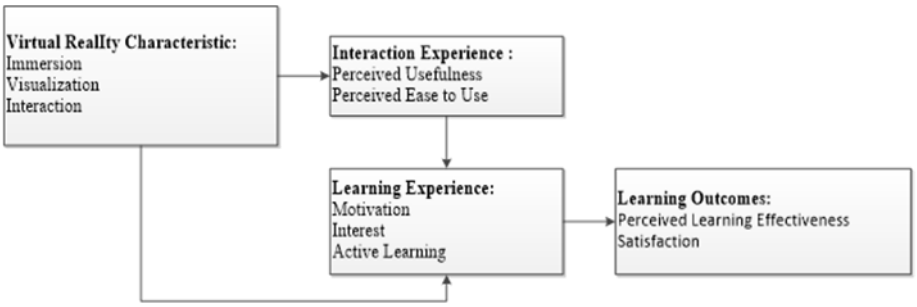

Figure 1. Conceptual Framework

In this study, following the model in Figure 1, three research variables are categorized as follows:

- The independent variable: Characteristics of Virtual Reality Learning Tecnology (X).
- The mediation variables: Interaction Experience (M1), Learning Experience (M2).
- The dependent variable: Learning Outcomes (Y).

2.1. Research Hypothesis

Figure 1 is redefined into a dimension of each research variable so that there are several hypotheses as described in Figure 2.

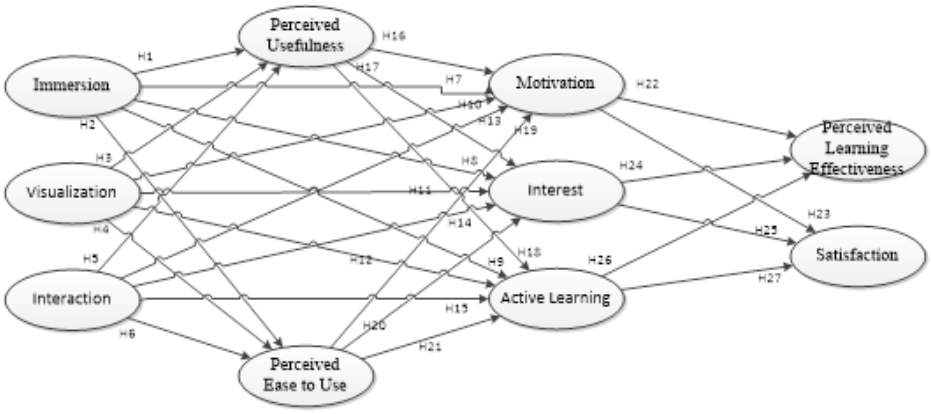

Figure 1. Fig. 2. Detailed Model of Theoretical Framework and Hypotheses

The hypotheses to be tested in this study are:
H1: The characteristics of VR (immersion) has a significant effect on the interaction experience (perceived usefulness).
H2: The characteristics of VR (immersion) has a significant effect on the interaction experience (perceived ease of use).
H3: The characteristics of VR (visualization) has a significant effect on the interaction experience (perceived usefulness).
H4: The characteristics of VR (visualization) has a significant effect on the interaction experience (perceived ease of use).
H5: The characteristics of VR (interaction) has a significant effect on the experience of interaction (perceived usefulness).
H6: The characteristics of VR (interaction) has a significant effect on the interaction experience (perceived ease of use).
H7: The characteristics of VR (immersion) has a significant effect on the learning experience, (motivation).
H8: The characteristics of VR (immersion) has a significant effect on the learning experience (interest).
H9: The characteristics of VR (immersion) has a significant effect on the learning experience (activity).
H10: The characteristics of VR (visualization) has a significant effect on the learning experience (motivation).
H11: The characteristics of VR (visualization) has a significant effect on the learning experience (interest).
H12: The characteristics of VR (visualization) has a significant effect on the learning experience (activity).
H13: The characteristics of VR (interaction) has a significant effect on the learning experience (motivation).
H14: The characteristics of VR (interaction) has a significant effect on the learning experience (interest).
H15: The characteristics of VR (interactions) has a significant effect on the learning experience (activity).
H16: Interaction experience (perceived usefulness) has a positive and significant effect on the learning experience (motivation).
H17: Interaction experience (perceived usefulness) has a significant effect on the learning experience (interest).
H18: Interaction experience (perceived usefulness) has a positive and significant effect on the learning experience (activity).
H19: Interaction experience (perceived ease of use) has a positive and significant effect on the learning experience (motivation).
H20: Interaction experience (perceived ease of use) has a significant effect on the learning experience (interest).
H21: Interaction experience (perceived ease of use) has a positive and significant effect on the learning experience (activity).
H22: Learning experience (motivation) has a positive and significant effect on learning outcomes (perceived learning effectiveness).
H23: Learning experience (motivation) has a positive and significant effect on learning outcomes (perceived learning effectiveness of satisfaction).
H24: Learning experience (interest) has a significant effect on learning outcomes (perceived learning effectiveness).
H25: Learning experience (interest) has a significant effect on learning outcomes (perceived learning effectiveness of satisfaction).
H26: Learning experience (activity) has a positive and significant effect on learning outcomes (perceived learning effectiveness).

H27: Learning experience (activity) has a positive and significant effect on learning outcomes (perceived learning effectiveness of satisfaction).

2.2. Data Sources

The study uses a questionnaire and conducts direct interviews with VR users if additional data are needed. The questionnaire is using a Likert scale. The criteria are grouped into "Strongly Agree", "Agree", "Neutral", "Disagree", "Strongly Disagree" and represent the value of 5 – 1 respectively. The secondary resources utilized a reference and analyzed existing data. Moreover, the literature studies are carried out in various forms such as journals, books, e-books, papers, and others.

2.3. Data Analysis

2.3.1.Measurement Model

A valid indicator is signified by an outer loading value below 0.4. If the results of the research instrument validity have outer loading values above 0.4, it can be concluded that all indicators in this study are valid.

Reliability is a test of how consistent the measuring instrument is in measuring whatever concept is being measured, the composite reliability (CR) > = 0.7 can be called reliable. If the reliability test results in the study have composite reliability above 0.7, it can be concluded that all research indicators are reliable.

2.3.2.Structural Model

Figure 2, was further translated into multiple regression equations as follows, where testing the coefficients of the regression is actually corresponding to the respective variables related to the hypothesis mentioned in section 3.1:

$$EFT=\beta 11MTV+\beta 12MTV+\beta 13AKF+\varepsilon 1 \quad (1)$$

$$STS=\beta 12MTV+\beta 22MNT+\beta 23AKF+\varepsilon 2 \quad (2)$$

$$MTV=\beta 31MFT+\beta 32IMS+\beta 33VSL+\beta 34INT+\beta 35MDH+\varepsilon 3 \quad (3)$$

$$MNT=\beta 41MFT+\beta 42IMS+\beta 43VSL+\beta 44INT+\beta 45MDH+\varepsilon 4 \quad (4)$$

$$AKF=\beta 51MFT+\beta 52\ IMS+\beta 53VSL+\beta 54INT+\beta 55MDH+\varepsilon 5 \quad (5)$$

$$MFT=\beta 61IMS+\beta 62VSL+\beta 63INT+\varepsilon 6 \quad (6)$$

$$MDH=\beta 71IMS+\beta 72VSL+\beta 73INT+\varepsilon 7 \quad (7)$$

Remark:

EFT = Perceived Learning Effectiveness

STS = Satisfaction

MTV = Motivation

MNT = Interest

AKT = Active Learning

MFT = Perceived Usefulness

MDH = Perceived Ease of Use

IMS = Immersion

VSL = Visualization

INT = Interaction

$\beta 11$, $\beta 21$ = Coefficient variable MTV (Motivation)

$\beta 12$, $\beta 22$ = Coefficient variable MNT (Interest)

$\beta 13$, $\beta 23$ = Coefficient variable AKF (Active Learning)

$\beta 31$, $\beta 41$, $\beta 51$ = Coefficient variable MFT (Perceived Usefulness)

$\beta 32$, $\beta 42$, $\beta 52$, $\beta 61$, $\beta 71$ = Coefficient variable IMS (Immersion)

β33, β43, β53, β62, β72 = Coefficient variable VSL (Visualization)

β34, β44, β54, β63, β73 = Coefficient variable INT (Interaction)

β35, β45, β55 = Coefficient variable MDH (Perceived Ease of Use)

ε1 until ε7 = Standard error

For the calculation results of the above SEM equations, the multiple regression analysis is employed. The comparison of validity and reliability test calculations used the SmartPLS application. After the results are calculated and evaluated, the conclusions and suggestions for further research are obtained.

3. Result and Discussion

3.1. Profile of Respondents

The scope of this research involved Junior High Schools, Senior High Schools, and Vocational High Schools in Indonesia which have implemented the VR technology learningbased and implemented their classes with VR content with a total sample of 117 students.

This study uses a sampling technique with probability sampling because the researcher must provide equal opportunities for each member of the population to be selected as a member of the sample. Technically, the simple random sampling method involved members of the sample from the population without paying attention to the existing strata of the population by assuming population members are homogeneous. the study comprises individuals from junior high schools, senior high schools, and vocational high schools in Indonesia who have used VR as their learning technology and targeted in the trial of learning technology with VR content from a minimum sample size of 114 students, having margin of error rate of 5%, and is based on Stovin's formula.

Of the 117 respondents, 60 respondents were female and 57 were male. The majority were between 15-17 years old (5 people), 12-14 years old and 15-17 years old (103 people), and 18 -19 years (9 people). The majority of respondents are students at Junior High Schools, Senior High Schools, and Vocational Schools in Indonesia, totaling 110 students and 7 students represent Junior High Schools.

3.2. Analysis and Research Results

3.2.1.Validity Test

Of the 49 indicators provided, there is one invalid and unreliable indicator. The MDH2 indicator has an outer loading below 0.4 and it is excluded. The indicator should be removed from the measurement model if it has an outer loading value below 0.4 (Hair et al., 2016).
Table 1 explains the results of the validity test for outer loading after MDH2 is removed.

Table 1. Outer Loading Validity Test Results

Variable	Indicator	Outer Loading	Result
Immersion	IMS1	0.801	Valid
	IMS2	0.839	Valid
	IMS3	0.646	Valid
	IMS4	0.867	Valid
	IMS5	0.844	Valid
Visualization	VSL1	0.835	Valid
	VSL2	0.904	Valid
	VSL3	0.852	Valid
	VSL4	0.865	Valid
Interaction	INT1	0.787	Valid
	INT2	0.918	Valid
	INT3	0.829	Valid
Perceived Usefulness	MFT1	0.885	Valid
	MFT2	0.902	Valid
	MFT3	0.883	Valid
	MFT4	0.922	Valid
Perceived Ease of Use	MDH1	0.885	Valid
	MDH3	0.887	Valid

	MDH4	0.876	Valid
Motivation	MTV1	0.864	Valid
	MTV2	0.840	Valid
	MTV3	0.844	Valid
	MTV4	0.823	Valid
Interest	MNT1	0.877	Valid
	MNT2	0.898	Valid
	MNT3	0.811	Valid
	MNT4	0.875	Valid
Active	AKT1	0.809	Valid
	AKT2	0.872	Valid
	AKT3	0.825	Valid
	AKT4	0.844	Valid
	AKT5	0.861	Valid
	AKT6	0.856	Valid
Perceived Learning Effectiveness	EFT1	0.874	Valid
	EFT2	0.843	Valid
	EFT3	0.850	Valid
	EFT4	0.823	Valid
	EFT5	0.789	Valid
	EFT6	0.832	Valid
	EFT7	0.799	Valid
	EFT8	0.816	Valid
Satisfaction	STF1	0.843	Valid
	STF2	0.819	Valid
	STF3	0.468	Valid
	STF4	0.882	Valid
	STF5	0.897	Valid
	STF6	0.907	Valid
	STF7	0.877	Valid

3.2.2.Reliability Test

The composite reliability (CR) value above or equal to 0.7 is considered reliable (Hair et al., 2016).The reliability test in this study shows that all the variables used are reliable because the score (CR) is above 0.7 so that all research indicators can be considered reliable. Table 2 describes the results of reliability testing.

Table 2. Reliability Testing Results

Variable	**Composite Reliability**	**Result**
Immersion	0.900	Reliable
Visualization	0.922	Reliable
Interaction	0.883	Reliable
Perceived Usefulness	0.943	Reliable
Perceived Ease of Use	0.914	Reliable
Motivation	0.908	Reliable
Interest	0.923	Reliable
Active	0.937	Reliable
Perceived Learning Effectiveness	0.946	Reliable
Satisfaction	0.936	Reliable

3.3. Hypothesis Testing

Research hypothesis analysis was carried out to obtain the conclusions.

3.3.1.Hypothesis Test of Direct Effect Among each Variables

The analysis is useful for testing the hypothesis between the independent variable and dependent variable. Based on the results, it obtained t table value of 1.96 and a p-value is less than 0.05 from smartPLS with the path coefficients between variables can be seen in Table 3, where the values in parentheses at the p-values.

Table 3. Hypothesis Testing Results for Direct Effect

Hypothesis	Regression	Original Sample (O)	T Statistics (O / STDEV)	P Values	Result
H1	Immersion →Perceived Usefulness	0.173	1.608	**0.108**	Not Significant
H2	Immersion →Perceived ease of use	0.015	0.133	**0.894**	Not Significant
H3	Visualization →Perceived Usefulness	0.439	4.925	**0.000**	Significant
H4	Visualization →Perceived ease of use	0.421	3.636	**0.000**	Significant
H5	Interaction →Perceived Usefulness	0.297	2.414	**0.016**	Significant
H6	Interaction →Perceived ease of use	0.411	3.411	**0.001**	Significant
H7	Immersion →Motivation	0.195	1.521	**0.129**	Not Significant
H8	Immersion →Interests	0.069	0.561	**0.575**	Not Significant
H9	Immersion →Activeness	0.018	0.179	**0.858**	Not Significant
H10	Visualization →Motivation	0.020	0.164	**0.870**	Not Significant
H11	Visualization →Interests	0.019	0.131	**0.896**	Not Significant
H12	Visualization →Activeness	0.161	1.665	**0.097**	Not Significant
H13	Interaction →Motivation	0.188	2.084	**0.038**	Significant
H14	Interaction →Interests	0.336	2.997	**0.003**	Significant
H15	Interaction →Activeness	0.461	5.102	**0.000**	Significant
H16	Perceived Usefulness →Motivation	0.211	1.817	**0.070**	Not Significant
H17	Perceived Usefulness →Interests	0.219	1.275	**0.203**	Not Significant
H18	Perceived Usefulness →Activeness	-0.001	0.010	**0.992**	Not Significant
H19	Perceived ease of use →Motivation	0.331	3.684	**0.000**	Significant
H20	Perceived ease of use →Interests	0.266	2.573	**0.010**	Significant
H21	Perceived ease of use →Activeness	0.329	4.064	**0.000**	Significant
H22	Motivation →Perceived Learning Effectiveness	0.404	4.926	**0.000**	Significant
H23	Motivation →Satisfaction	0.263	2.762	**0.006**	Significant
H24	Interests →Perceived Learning Effectiveness	0.185	2.297	**0.022**	Significant
H25	Interests →Satisfaction	0.358	2.271	**0.024**	Significant
H26	Activeness →Perceived Learning Effectiveness	0.387	5.146	**0.000**	Significant
H27	Activeness →Satisfaction	0.297	1.896	**0.058**	Not Significant

Based on these results, it can be concluded the characteristics variable of VR learning technology for the immersive dimension do not have a significant effect on the interaction experience variable for the dimensions of perceived usefulness ($p > 0.05$) and perceived ease of use ($p > 0.05$).The characteristics variable of VR learning technology for the dimensions of visualization and interaction have a significant influence on the variable of interaction experience for the dimensions of perceived usefulness and perceived ease of use.The characteristics variable of VR learning technology for immersive and visualization dimensions do not have a significant effect on learning experience variables for the dimensions of motivation, interest, and activeness.The characteristics

variable of VR learning technology for the interaction dimension has a significant influence on the learning experience variable for the dimensions of motivation, interest, and activeness.The interaction experience variable for the perceived usefulness dimension does not have a significant effect on the learning experience variable for the dimensions of motivation, interest, and activity.The interaction experience variable for the perceived ease of use dimension has a significant influence on the learning experience variable for the dimensions of motivation, interest, and activeness.Learning experience variables for the dimensions of motivation and interest have a significant influence on learning outcomes variables for the dimensions of perceived learning effectiveness and satisfaction.The learning experience variable for the activeness dimension has a significant effect on the learning outcome variable for the perceived learning effectiveness dimension but does not have a significant effect on the satisfaction dimension.

3.3.2.Hypothesis Test of Indirect Effect

Indirect effect analysis is useful for testing the hypothesis of the indirect effect of a variable that affects (independent) the affected variable (dependent) which is mediated by an intervening variable (mediator). If the p-value is less than 0.05, it is significant. It means that the intervening variable (mediator) mediates the effect of an independent variable on a dependent variable. In other words, the effect is indirect. If the p-value is more than 0.05, it is not significant. It means that the intervening variable (mediator) does not mediate the effect of an independent variable on a dependent variable or in other words, the effect is direct.

Based on the results, SmartPLS generated t table value of 1.96 and a p-value is less than 0.05. The Specific Indirect Effects between variables can be seen in Table 4 below.

Table 4. Hypothesis Testing Results of Indirect Effect

Regression	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O / STDEV)	P Values
Immersion→Perceived Usefulness→Motivation→Perceived Learning Effectiveness	0.015	0.016	0.015	0.974	**0.331**
Immersion→Perceived Usefulness→Interests→Perceived Learning Effectiveness	0.007	0.007	0.009	0.744	**0.457**
Immersion→Perceived Usefulness→Activeness→Perceived Learning Effectiveness	0.000	-0.001	0.008	0.009	**0.993**
Immersion→Perceived ease of use→Motivation→Perceived Learning Effectiveness	0.002	0.004	0.017	0.118	**0.906**
Immersion→Perceived ease of use→Interests→Perceived Learning Effectiveness	0.001	0.001	0.007	0.106	**0.916**
Immersion→Perceived ease of use→Activeness→ Perceived Learning Effectiveness	0.002	0.003	0.016	0.125	**0.901**
Immersion→Motivation→Perceived Learning Effectiveness	0.079	0.076	0.053	1.479	**0.140**
Immersion→Interests→Perceived Learning Effectiveness	0.013	0.017	0.027	0.463	**0.643**
Immersion→Activeness→Perceived Learning Effectiveness	0.007	0.007	0.039	0.179	**0.858**
Visualization→Perceived Usefulness→ Motivation→Perceived Learning Effectiveness	0.037	0.035	0.024	1.580	**0.115**
Visualization→Perceived Usefulness→Interests→Perceived Learning Effectiveness	0.018	0.019	0.018	0.971	**0.332**
Visualization→Perceived Usefulness→ Activeness→Perceived Learning Effectiveness	0.000	0.000	0.020	0.010	**0.992**

Visualization→Perceived ease of use→Motivation→Perceived Learning Effectiveness	0.056	0.053	0.024	2.395	**0.017**
Visualization→Perceived ease of use→ Interests→Perceived Learning Effectiveness	0.021	0.021	0.014	1.442	**0.150**
Visualization→Perceived ease of use→Activeness→Perceived Learning Effectiveness	0.054	0.051	0.020	2.655	**0.008**
Visualization→Motivation→Perceived Learning Effectiveness	0.008	0.010	0.048	0.166	**0.868**
Visualization→Interests→Perceived Learning Effectiveness	0.003	0.001	0.029	0.118	**0.907**
Visualization→Activeness→Perceived Learning Effectiveness	0.063	0.063	0.040	1.556	**0.120**
Interaction→Perceived Usefulness→Motivation→Perceived Learning Effectiveness	0.025	0.023	0.017	1.449	**0.148**
Interaction→Perceived Usefulness→Interests→Perceived Learning Effectiveness	0.012	0.014	0.016	0.749	**0.454**
Interaction→Perceived Usefulness→Activeness→Perceived Learning Effectiveness	0.000	0.002	0.018	0.007	**0.994**
Interaction→Perceived ease of use →Motivation→Perceived Learning Effectiveness	0.055	0.057	0.026	2.153	**0.032**
Interaction→Perceived ease of use→Interests→Perceived Learning Effectiveness	0.020	0.023	0.016	1.277	**0.202**
Interaction→Perceived ease of use→Activeness→ Perceived Learning Effectiveness	0.052	0.056	0.027	1.963	**0.050**
Interaction→Motivation→Perceived Learning Effectiveness	0.076	0.076	0.041	1.838	**0.067**
Interaction→Interests→Perceived Learning Effectiveness	0.062	0.062	0.033	1.856	**0.064**
Interaction→Activeness→Perceived Effectiveness	0.179	0.174	0.051	3.528	**0.000**
Perceived Usefulness→Motivation →Perceived Effectiveness	0.085	0.081	0.050	1.701	**0.089**
Perceived Usefulness→Interests →Perceived Effectiveness	0.040	0.044	0.042	0.961	**0.337**
Perceived Usefulness→Activeness→ Perceived Effectiveness	0.000	0.001	0.046	0.009	**0.993**
Perceived ease of use→Motivation→Perceived Effectiveness	0.134	0.134	0.046	2.935	**0.003**
Perceived ease of use→Interests→Perceived Effectiveness	0.049	0.053	0.031	1.593	**0.112**
Perceived ease of use→Activeness→Perceived Effectiveness	0.127	0.129	0.041	3.068	**0.002**

Based on these results, it can be concluded the interaction experience variables for perceived ease of use and learning experience variables for motivation mediate the influence of the characteristic variables of VR learning technology for visualization on learning outcomes variables for perceived learning effectiveness because the results of hypothesis testing show that the value of T statistics is 2,395 which is more than 1.96 and the p-value is 0.017 which is less than 0.05.Interaction experience variables for perceived ease of use and learning experience variables for activeness mediate the influence of the characteristic variables of VR learning technology for visualization on learning outcomes variables for perceived learning effectiveness because the results of hypothesis testing show that the value of T statistics is 2.655 which is more than 1.96 and the p-value

is 0.008 which is less than 0.05.Interaction experience variables for perceived ease of use and learning experience variables for motivation mediate the influence of the characteristic variables of VR learning technology for interaction on learning outcomes variables for perceived learning effectiveness because the results of hypothesis testing show that the value of T statistics is 2.153 which is more than 1.96 and the p-value is 0.032 which is less than 0.05.The learning experience variable for activeness mediates the effect of the characteristic variable of VR learning technology for interaction on learning outcomes variables for perceived learning effectiveness because the results of hypothesis testing show that the T statistical value is 3.528 which is more than 1.96 and the p-value is 0.000 which is less than 0.05.The learning experience variable for motivation mediates the influence of the interaction experience variable for perceived ease of use on the learning outcomes variable for perceived learning effectiveness because the hypothesis testing results show that the T statistical value is 2,935 which is more than 1.96 and the p-value is 0.003 which is less than 0.05.The learning experience variable for motivation mediates the influence of the interaction experience variable for perceived ease of use on the learning outcomes variable for satisfaction because the hypothesis testing results show that the T statistical value is 2.184 which is more than 1.96 and the p-value is 0.029 which is less than 0.05.The learning experience variable for activeness mediates the effect of the interaction experience variable for perceived ease of use on the learning outcomes variable for perceived learning effectiveness because the results of hypothesis testing show that the T statistical value is 3.068 which is more than 1.96 and the p-value is 0.002 which is less than 0.05.

4. Conclusion

This study aims to examine the influence of the characteristics of learning technology using VR on learning outcomes. From the analysis and discussion carried out in the previous section, the conclusions are the learning experience variable for the motivation dimension through the interaction experience variable for the perceived ease of use dimension mediates the effect of the characteristic variable of VR learning technology only for the visualization and interaction dimensions on the learning outcome variable for the perceived learning effectiveness dimension but does not mediate the immersive dimension. The learning experience variable for the activeness dimension through the interaction experience variable for the perceived ease of use dimension also mediates the effect of the characteristic variable of VR learning technology only for the visualization dimension on the learning outcome variable for the perceived learning effectiveness dimension but does not mediate the immersive and interaction dimensions. And the learning experience variable for the activeness dimension directly mediates the effect of the characteristic variable of VR learning technology only for the interaction dimension on the learning outcome variable for the perceived learning effectiveness dimension but does not mediate the immersive and visualization dimensions. The learning experience variable for the dimension of interest does not mediate the effect of the characteristic variable of VR learning technology on the learning outcome variable for the perceived learning effectiveness dimension.The learning experience variable for the dimensions of motivation and activeness mediates the effect of the interaction experience variable only for the perceived ease of use dimension on the learning outcome variable for the perceived learning effectiveness dimension but does not mediate the perceived usefulness dimension. Meanwhile, the interest dimension of the learning experience variable did not mediate the effect of the interaction experience variable on the learning outcome variable for the perceived learning effectiveness dimension.The learning experience variable for the motivation dimension mediates the interaction experience variable for the perceived ease of use dimension against the learning outcome variable for the satisfaction dimension but does not mediate the perceived usefulness dimension.

Therefore, the results of this study contribute to providing perceived usefulness to educational institutions and the government. They can take into consideration the application of the learning process using VR learning technology because it has been proven that the characteristics of VR learning technology affect student motivation and learning activeness and improve learning outcomes for perceived learning effectiveness.

As for VR content providers, this research can provide perceived usefulness in improving the characteristics of learning content creation for the immersive dimension, so that the interaction experience can be felt and can affect the perceived usefulness and perceived ease of use.

5. Suggestion

This research showed that the characteristics of VR learning technology affect student's motivation and learning activeness. It improves student's learning outcomes for perceived learning effectiveness. However, the interaction experience is unperceived because of the lack of learning content characteristics for the immersive dimension that can affect the perceived usefulness and perceived ease of use.

The author's suggestions are for educational institutions and the government, it can be a consideration for learning process implementation using VR learning technology because from this research, it is proven that the characteristics of VR learning technology affect student motivation and learning activity and improve learning outcomes for perceived learning effectiveness. The perceived ease of use dimension of the interaction experience variable, it improves the learning experience and learning outcomes in terms of perceived learning effectiveness. For VR content providers, it is hoped that it will further improve the characteristics of VR learning technology when creating learning content, especially the immersive dimension so that it can influence the interaction experience and learning experience of students. The visualization dimension, it can influence the student's learning experiences. The perceived usefulness of the interaction experience from the characteristics of VR learning technology do not affect the learning experience and student learning outcomes.

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