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The Impact of Immersion through Virtual Reality in the Learning Experiences of Art and Design Students: The Mediating Effect of the Flow Experience

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Abstract: This study provides a theoretical model on the effectiveness of learning through virtual reality technology in bachelor art and design students. Surveys were applied to 200 undergraduate art and design students, and the data obtained were analyzed using multivariate partial least squares (PLS) structural equation modeling. Our model results indicate that immersion VR has a positive impact on the flow experience. Moreover, the data demonstrated a mediating effect of the flow experience on the learning experience variable explained through motivation, curiosity, cognitive benefits, reflective thinking, and the perception of value. These results have possibilities for academic art and design institutions to increase learning in the classroom through virtual reality technology, leaving the possibility of replicating the model in other areas of study.

Keywords: flow experience; virtual reality; learning experience

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1. Introduction

The idea of using virtual reality (VR) technology in education came about in the 1950s and was first put into practice in the 1960s [1]. The first educational applications of VR technology were created in the 1970s, allowing students to explore simulated environments and interact with virtual objects [2].

In the late 1980s, VR technology advanced to the point that it could create highly immersive and interactive learning experiences. This allowed educators to create highly immersive and interactive learning experiences [3], in addition to developing interactive simulations and virtual learning environments, which could be used to teach a variety of topics [4].

Since the 1990s, advances in technology have drastically increased the capabilities of VR technology in education [5]. Today, educators can create highly realistic virtual environments that allow students to explore and interact with virtual objects in ways that were previously impossible [6]. VR technology can be used to teach a wide range of topics, from language [7] and math [8] to science [9] and design [10,11]. VR technology is also being used to create immersive learning experiences in a variety of educational settings. Additionally, VR technology can be used to create simulations that allow students to gain first-hand experience in a variety of topics [12].

There are several types of virtual reality hardware currently available, including:

PC-based VR systems, which require a powerful computer to run; standalone VR headsets, which do not require a computer or console to run and are wireless; console-based VR systems, which are designed to work with the PlayStation console; mobile VR systems, which use smartphones as display and processing devices. Augmented reality (AR) systems superimpose computer-generated images on the user's view of the real world.

Coyne and Wang confirm that standalone VR headset technology has better immersion effects in a classroom learning context; for this reason, Meta Quest 2 technology was chosen for this project [13,14].

Immersion through VR technology (immersion VR) can also provide students with increased motivation, as they are encouraged to explore their surroundings and learn through a VR technology setting [15]. Additionally, using VR technology in the classroom can help increase student engagement by providing a rich visual and audio environment that encourages collaboration or simulated experimentation [16]. Furthermore, it encourages critical thinking and creative problem-solving, allowing them to apply what they have learned from traditional resources to real-world scenarios. Finally, it provides an immersive way for students to practice tasks such as languages, music, or other areas of study when traditional methods may not be applicable or accessible.

Therefore, this manuscript proposes a model that answers the following questions: Does control, the perception of ease of use, and the perception of usability impact immersion? Does flow experience moderate the impact of immersion VR on motivation, curiosity, cognitive benefits, reflective thinking, and perceived value?

Here, we propose that immersion through VR technology is mediated by the flow experience, which impacts motivation, curiosity, cognitive benefits, reflective thinking, and the perception of value in art and design students. Our model proposes that immersion VR can be explained through the variables of control, ease of perceived use, and usability perception. The model also explains the impact of immersion VR on motivation, curiosity, cognitive benefits, reflective thinking, and perceived value. Finally, the mediation of flow experience between immersion VR and the variables motivation, curiosity, cognitive benefits, reflective thinking, and perceived value is also studied. This study leads to an understanding of the impact of immersion VR mediated by flow experience in the learning of art and design students with VR technology. Therefore, we continue with the literature review and theoretical framework of the variables mentioned above.

2. Literature Review

2.1. Immersion VR

Freina and Ott define VR technology as a computer-generated simulation of a three-dimensional image or environment with which a person can interact in a real or physical way using special electronic equipment, such as a helmet with a screen inside or some gloves fitted with sensors [17].

VR technology can offer significant advantages for learning: it allows a direct sensation of objects and events that are physically out of our reach, it supports training in a safe environment avoiding possible real dangers, and, thanks to the game approach, it increases participation and student motivation while expanding the range of supported learning styles.

VR technology, in general, is widely used in the fields of education due to its potential stimulation of interactivity [18] and motivation [15,19]. Immersion is a crucial element of a VR experience; however, Haskins comments that VR technology can also be non-immersive when the user is placed in a 3D environment that can be manipulated through a conventional graphics workstation using a monitor, keyboard, and mouse [20]. Spatial immersion in VR technology is a perception of being physically present in a non-physical world. Perception is created by surrounding the user of the VR system with images, sound, or other stimuli that provide a highly immersive environment. Spatial immersion occurs when a player feels that the simulated world is perceptually compelling, appears "authentic" and "real" and the player feels that he or she is really "there" [21]. This study used VR technology to use its full immersive potential.

2.2. Flow Experience

The flow experience is a self-reinforcing cycle of energy, motivation, and personal growth [22]. It can be described as an immersion into the present moment that leaves one feeling energized and fulfilled. It involves intense concentration, a lack of self-consciousness, a feeling of control over what one is doing, complete focus on the task at hand, and a breakthrough in performance [23,24].

A learning experience with a flow-based approach is one that stimulates and optimizes engagement, performance, and insight. This type of learning involves an adaptive, open-ended structure in which learners actively find their way through the learning materials on their own terms [25]. The flow state creates a feeling of being "in the zone" as the learner progresses without significant interruption or effort. During this state, learners can easily recall information taught in earlier modules; longer chains of understanding emerge; skills are built little by little; and new concepts are acquired more deeply than if they had been presented all at once [26]. Flow-based learning often begins with an assessment stage to identify individual needs and preferences [27]. Then, a personalized pathway is created so learners can progress at their own pace while being presented with relevant content matched to their interest levels, abilities, knowledge level, or other factors defined by the instructor [28]. Learners receive just-in-time feedback from mentors or peers related to their individualized goals and objectives throughout the entire process [17].

2.3. Learning Experience

Experiential learning is an educational philosophy that emphasizes hands-on activities, problem-solving, and real-world applications [29]. The idea of experiential learning has been around for centuries, but it was first formally named and developed by the American philosopher John Dewey in the early 1900s [30]. Dewey placed particular importance on the idea of reflection—a process by which students look back on the experience they have had and consider its implications—as essential to successful experiential learning. In 1959, psychologist David A. Kolb built upon Dewey's ideas with his Experiential Learning Theory (ELT) [1]. According to Kolb, successful experiential learning is composed of four distinct phases: concrete experience (learning through doing), reflective observation (pausing after completing a task and reflecting on what happened), abstraction (drawing generalizations from these observations), and active experimentation (testing out these generalizations in new situations) [31].

3. Conceptual Model and Hypothesis Development

3.1. Control, Perception of Usability, and Ease of Perceived Use in Immersion VR

In VR, user control is input from a user to the system, allowing them to interact with and manipulate virtual environments [32]. This can include moving around the environment, manipulating objects within it, or even controlling tools and other applications [33]. The type of control varies depending on the platform and application but typically includes toolbars or 3D cameras for navigating through menus or operating object manipulation interfaces. Recent advances in technology, such as room-scale tracking solutions, combined with improved artificial intelligence capable of simulating realistic behaviors for characters and objects within VR simulations, are also beginning to enable more interactive control capabilities [34].

Immersion VR is generally associated with a feeling of being "in control" or having a sense of agency. This can be seen in the gaming context, where users may feel empowered by their ability to control the game's environment and characters [35]. However, on the other hand, immersion VR can also be associated with a lack of control [36]. This can occur when the user is so immersed in the game that they are unaware of the choices and decisions they are making; or when the game's rules or mechanics are so complex that the user feels overwhelmed.

The perception of usability in immersion VR learning is that it can be a powerful and effective tool for improving student engagement and learning [37]. It can be used to create engaging, interactive learning experiences that allow students to explore topics more deeply through VR environments or simulations. Immersion VR in learning can also provide opportunities for collaboration between students and give them the tools they need to apply their knowledge in a meaningful way.

As users become more immersed in a user interface, they generally perceive it to be more usable [38]. This is because users who are more immersed in an interface can better understand and interact with it, leading to a better overall experience and a greater sense of usability. In addition, immersion VR can also lead to users feeling more comfortable and confident using the interface, leading to an improved perception of usability [39].

The more immersive the experience, the easier it is for users to use the technology [40]. Immersion VR also increases user engagement, which can lead to a better overall user experience, while also making the technology easier to use [41].

Immersive experiences create a sense of presence and connection to the task at hand [42]. This leads to a higher level of engagement, which in turn leads to an easier-to-use experience. Immersive experiences are becoming increasingly popular as users seek more engaging, interactive, and personalized experiences that are easy to use and understand [43]. Additionally, immersion VR to learning offers an engaging and immersive experience that can help keep learners interested in what they are doing. In addition, immersion VR provides an easy-to-use interface that makes it easier for teachers and students alike to access tools quickly and easily [44]. Hence, the hypotheses would be:

Hypothesis 1. *Immersion VR is positively affected by control.*

Hypothesis 2. *Immersion VR is positively affected by the perception of usability.*

Hypothesis 3. *Immersion VR is positively affected by ease of perceived use.*

3.2. Immersion VR in Motivation, Curiosity, Cognitive Benefits, Reflective Thinking, and Perceived Value

Immersion VR can motivate learning by giving students an opportunity to explore a subject in a hands-on and interactive environment [5]. Immersion VR experiences allow students to explore a subject in a way that traditional classrooms cannot [45]. Through field trips, interactive exhibits, and VR technology, students can gain a deeper understanding of a subject and become more engaged in their learning [46]. Immersion VR also provides students with an opportunity to learn in an environment that is tailored to their individual interests and abilities [47]. This allows them to gain a more personalized learning experience and can increase motivation as they explore topics they are truly interested in.

The immersion VR experience can provide a unique opportunity for students to explore and develop their curiosity [48]. By providing hands-on learning experiences and interactive activities, students can engage with the subject material in a new and exciting way [49]. This encourages students to ask questions, explore possibilities, and think critically [50]. Immersion VR experiences also allow students to make connections between the material they are learning and the real world. This helps them to contextualize their learning and develop a deeper understanding of the material. Immersion VR experiences can also be used to introduce new topics, allowing students to develop a curiosity about the subject and become more engaged with their learning [51].

Immersion VR in a learning environment can provide cognitive benefits to students learning by providing an opportunity for students to interact with their peers in a real-world setting [52]. This encourages real-world problem-solving, collaboration, and communication skills essential for success in the classroom [53]. Additionally, immersion VR can help students to develop a deeper understanding of the culture and context of the material they are learning, which can lead to a more meaningful learning experience [54].

VR technology has the potential to positively affect reflective thinking by providing a realistic, immersive environment that allows users to explore their thoughts and feelings in a non-judgmental, safe manner [55]. Furthermore, by using VR technology, users can interact with virtual objects and scenarios, allowing them to test out different approaches or solutions to problems or situations. This can help to promote a deeper level of self-reflection and understanding, as users are able to explore their thoughts and feelings in a more meaningful way [56]. In addition, VR can also provide a sense of presence, allowing users to feel like they are in the virtual environment, and helping to further enhance their reflective thinking [57].

VR technology provides users with an immersive experience that can be both educational and entertaining [58]. It can also provide users with a heightened sense of presence and a feeling of being part of the environment [59]. This feeling of immersion VR can increase users' perceived value of the experience [60]. Additionally, VR technology can help to create a sense of immersion VR and presence, making users feel as though they are part of the experience [61]. This can increase user engagement and satisfaction, leading to increased perceived value. Finally, VR technology can help to create a sense of realism and believability, which can help to increase the perceived value of the experience [62]. Hence, the hypotheses would be:

Hypothesis 4. *Motivation is positively affected by immersion VR.*

Hypothesis 5. *Curiosity is positively affected by immersion VR.*

Hypothesis 6. *Cognitive benefits are positively affected by immersion VR.*

Hypothesis 7. *Reflective thinking is positively affected by immersion VR.*

Hypothesis 8. *Perceived value is positively affected by immersion VR.*

3.3. Immersion VR and Flow Experience

Immersion VR in a flow experience can be a powerfully positive experience [63]. It can help to reduce stress, increase focus, and promote creativity [14]. Immersion VR can also increase motivation and give individuals a sense of purpose and identity [64]. It can also lead to a greater connection to the environment and those around us. Immersion VR can help to foster a sense of presence, allowing us to be more mindful of the moment and better appreciate our experiences [65]. Some studies reported positive relationships between learning using virtual reality and the flow experience [66,67]. Finally, immersion VR can lead to deeper learning and understanding as we become more aware of our thoughts and feelings [68]. Hence, the hypotheses would be:

Hypothesis 9. *Flow experience is positively affected by immersion VR.*

3.4. Mediating Flow Experience

Immersion VR can increase motivation and curiosity [69], leading to increased cognitive benefits [52], reflective thinking [56], and perceived value [62]. However, it is important to note that the degree to which these benefits are experienced largely depends on the individual's ability to achieve a state of flow [70]. Flow is a state of intense concentration and focus where the individual is completely absorbed in the task at hand [71]. If individuals achieve this state, they are likely to experience greater levels of motivation, curiosity, and cognitive benefits as a result of the immersive experience [72]. Additionally, the individual is likely to find greater value in the experience due to the intense level of focus they achieve [24,59] However, if an individual is unable to achieve a state of flow, they may not experience the same level of benefit from the immersive experience [73]. Hence, the hypotheses would be:

Hypothesis 10. *The effect of immersion VR on motivation is moderated by flow experience.*

Hypothesis 11. *The effect of immersion VR on curiosity is moderated by flow experience.*

Hypothesis 12. *The effect of immersion VR on cognitive benefits is moderated by flow experience.*

Hypothesis 13. *The effect of immersion VR on reflective thinking is moderated by flow experience.*

Hypothesis 14. *The effect of immersion VR on perceived value is moderated by flow experience.*

Based on the literature review, the following research model is proposed, in which the relationships of immersion VR with motivation, curiosity, cognitive benefits, reflective thinking, and perceived value are mediated through flow experience. Furthermore, the relationships formulated in this study were measured in an educational context by means of VR technology (Figure 1).

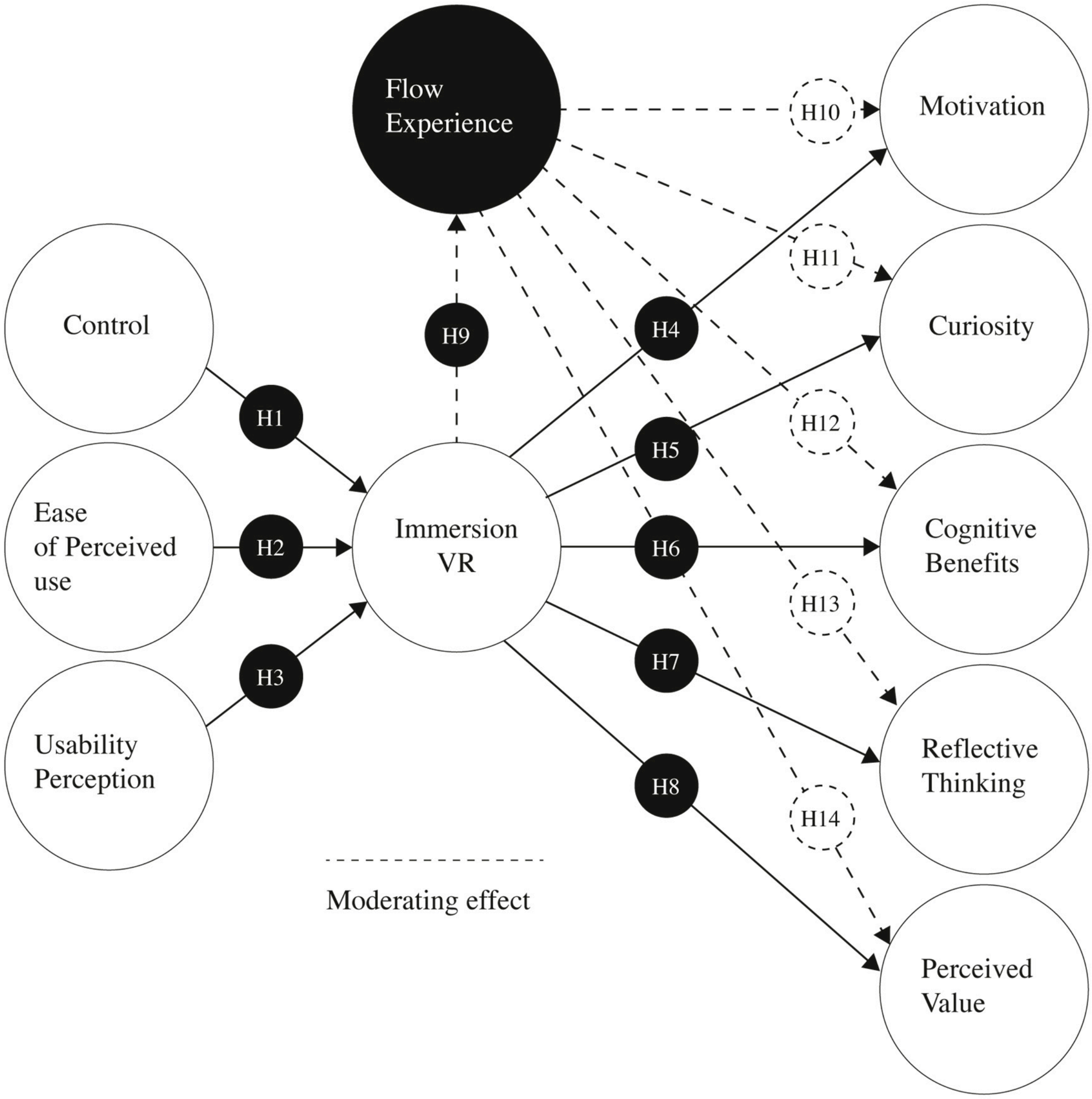

Figure 1. Conceptual model.

4. Research Method

Our hypothesis was tested through a quantitative study since this is an adequate method to test the cause–effect relationships between variables [74]. Our research question was focused on cause-and-effect relationships between the use of VR and its effect on motivation, curiosity, cognitive benefits, reflective thinking, and perceived value moderated by flow experience. We collected 200 valid surveys (Table 1). All the information obtained from the questionnaires was collected in the semester of August–December 2022 through two different universities in the state of Nuevo León in Mexico. The first was the School of Art and Design of the University of Monterrey where the courses were (1) Fundamentals of Visual Culture and (2) Introductory Study to Visual Thinking. The second school was the School of Visual Arts of the Autonomous University of Nuevo León where the courses were

(1) Management and Self-promotion and (2) Management and Cultural Marketing. During the months of September, October, and November, the students worked between five and ten 90-min sessions using virtual reality technology through Meta Quest 2 equipment (Figure 2). All 200 students had no previous experience with virtual reality technology, so they received 30 min of training before starting the sessions. In these sessions, the student's perception of learning was measured by exposing and viewing the work of his/her classmates through the Spatial Virtual Reality software. Through this platform, students were able to present their work and view that of their classmates interactively and collaboratively. Being in a controlled environment allowed them to practice their skills without the need for physical resources. In addition, they were able to explore other works in a more immersive way. It is important to mention that the works presented were done physically and later digitized to be presented in this virtual space. Finally, the grade obtained by each student was according to rubrics that included both the physical work and the presentation in the virtual space.

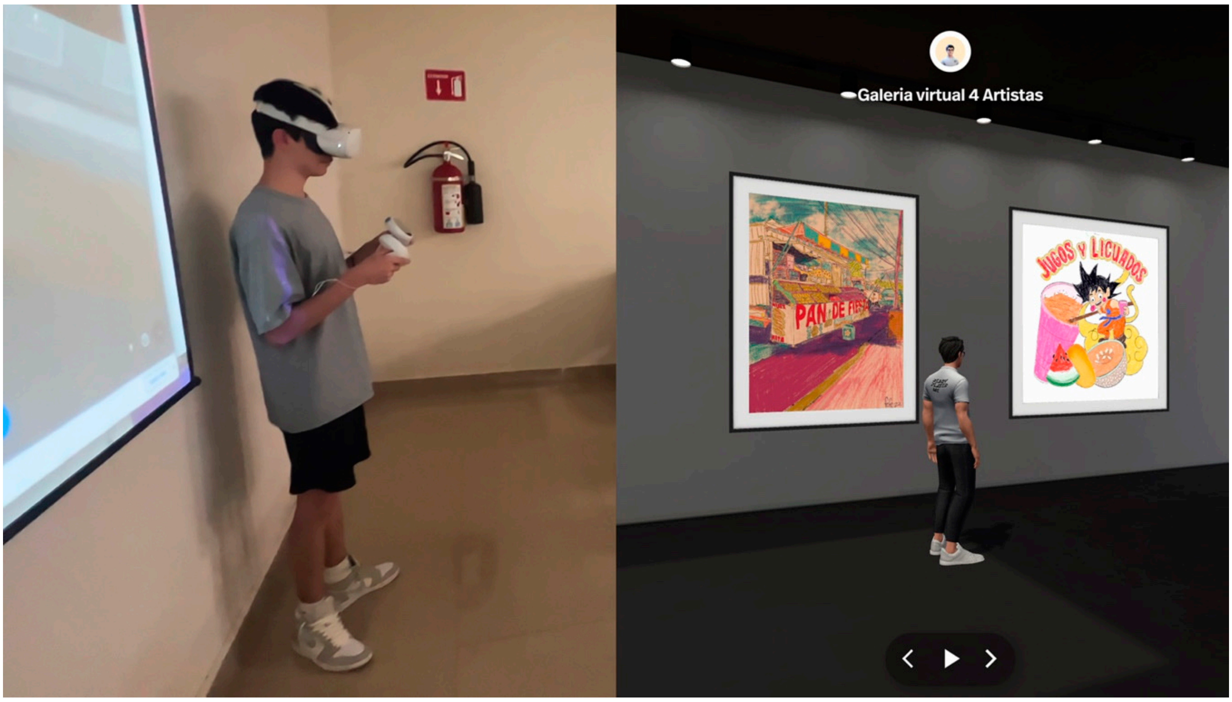

Figure 2. Students using Spatial Virtual Reality Software in Meta Quest 2.

Table 1. Technical Information.

Scope	University of Monterrey	Autonomous University of Nuevo Leon
Universe	Mexican art and design university students	
Courses	1. Foundations of visual cultural 2. Introductory study to visual thinking	1. Management and self-promotion 2. Cultural management and marketing
Method	Questionnaire survey	
Sample size	84 valid surveys	116 valid surveys
Data fieldwork	November 2022	
Statistics	Collinearity statistics, CFA, PLS—SEM, invariance of a measurement instrument,	

Table 1. *Cont.*

Scope	University of Monterrey	Autonomous University of Nuevo Leon
Measures (7-point Likert)	Control	[32,59]
	Ease of perceived use	[75]
	Usability perception	[75]
	Immersion VR	[76]
	Flow experience	[23,77]
	Motivation	[54]
	Curiosity	[78]
	Cognitive benefits	[53]
	Reflecting thinking	[57]
	Perceived value	[59]
Statistic software	IBM SPSS Statistics and Smart PLS 4	

5. Data Analysis and Results

The data was processed in five stages. (1) Descriptive statistics were employed to characterize the sample profile. (2) Additionally, a confirmatory factor analysis (CFA) was performed on the sample to assess the reliability and validity of the measurement instrument. (3) The ensuing step consisted of modeling the structural equations for the subsamples to determine the significant relationships between the variables, in accordance with the analysis sample. Moreover, an analysis was carried out to determine the moderating effect of the flow experience. (4) Next, the measurement instrument was validated with the discriminant validity tested using the Fornell and Larcker criteria. (5) Finally, a goodness-of-fit diagnosis was made to determine if the model was correct and served as an approximation to the real phenomenon.

5.1. Descriptive Statistics

The sample size was 200 valid surveys that were collected from 2 art and design schools in Mexico: the Art and Design School at the University of Monterrey 84 (42%) and the School of Visual Arts at the Autonomous University of Nuevo Leon 106 (58%) whom 169 (84.5) were female, 27 (13.5%) were male and 4 (2%) another. As for the year, 84 (42%) were first-year students, and 116 (58%) were in their second year. None of the participants had previously taken the courses. We used structural equation partial least squares (SEM-PLS), which is a type of multivariate statistical analysis used to model complex relationships between multiple variables [79] since it combines aspects of both structural equation modeling and partial least squares regression, allowing for the modeling of multiple dependent and independent variables with a single analysis [80].

5.2. Confirmatory Factor Analysis

The proposed model was validated with a CFA of the entire sample using PLS Algorithm with Smart PLS4.0. Table 2 shows the main results of the analysis, in addition to the descriptive statistics of the constructs analyzed in the model. (To see the questionnaire, see Appendix A, Table A1. indicators in the measuring instrument).

The standardized loads (β) were over 0.81, which is the ideal scenario. After running Smart PLS 4.0 and IBM SPSS, the Cronbach alpha coefficients were between 0.770 and 0.962, values that, according to the literature, are considered acceptable. The composite reliability of the constructs was over 0.870, and the average value extracted (AVE) was over 0.629 for each construct. Thus, we can confirm the reliability of the constructs of the research model for the whole sample. In addition, the goodness of fit of the research model is as expected, with levels above 0.9 in the NFI indicator with 0.940 and with levels below 0.08 in the SRMR with 0.074.

Table 2. Loadings, Cronbach's Alpha, composite reliability, and AVE values.

Construct	Items	Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Immersion VR	IM1 IM2 IM3 IM4	0.92 0.90 0.88 0.83	0.905	0.934	0.779
Perception of usability	PU1 PU2 PU3 PU4	0.88 0.88 0.90 0.89	0.857	0.905	0.705
Control	CT1 CT2 CT3 CT4 CT5 CT6 CT7 CT8	0.86 0.88 0.86 0.90 0.88 0.94 0.83 0.82	0.954	0.962	0.758
Ease of perceived use	EPU1 EPU2 EPU3 EPU4	0.81 0.91 0.91 0.90	0.906	0.934	0.779
Flow experience	FE1 FE2 FE3 FE4 FE5	0.94 0.91 0.90 0.96 0.94	0.962	0.97	0.867
Motivation	MT1 MT2 MT3 MT4 MT5	0.82 0.87 0.73 0.77 0.77	0.853	0.894	0.629
Curiosity	CR1 CR2 CR3	0.88 0.92 0.89	0.878	0.924	0.801
Cognitive benefits	CB1 CB2 CB3 CB4 CB5	0.92 0.93 0.93 0.93 0.92	0.958	0.968	0.856
Reflective thinking	RT1 RT2 RT3 RT4	0.79 0.85 0.83 0.87	0.858	0.903	0.70
Perceived value	PV1 PV2 PV3	0.92 0.96 0.85	0.770	0.870	0.76

X2 = 12,147; NFI = 0.940; SRMR = 0.074. Note: X2 = chi-square; NFI = normed fit index SRMR = standardized root mean square residual.

5.3. Structural Equation Modeling

The hypothesized relationships in the research model were contrasted using bootstrapping analysis via the Smart PLS 4.0 software. The results for the sample are presented in Table 3 and Figure 3, and according to the SEM analysis, all of the relationships proposed in the research model were contrasted successfully.

Table 3. Results of the structural model.

H	Description	β	*t* Value	*p* Value	Decision
H1	Control → Immersion VR	0.649	18.157	0.000	Supported
H2	Ease of perceived use → Immersion VR	0.248	2.938	0.000	Supported
H3	Usability perception → Immersion VR	0.285	2.075	0.038	Supported
H4	Immersion VR → Motivation	0.818	4.982	0.000	Supported
H5	Immersion VR → Curiosity	0.709	6.778	0.000	Supported
H6	Immersion VR → Cognitive Benefits	0.612	6.988	0.000	Supported
H7	Immersion VR → Reflective thinking	0.655	6.181	0.000	Supported
H8	Immersion VR → Perceived value	0.306	2.407	0.000	Supported
H9	Immersion VR → Flow experience	0.910	33.048	0.000	Supported
	Constructs	**R2**			
	Immersion VR	0.839			
	Flow experience	0.828			
	Motivation	0.809			
	Curiosity	0.607			
	Cognitive Benefits	0.453			
	Reflective Thinking	0.518			
	Perceived Value	0.113			

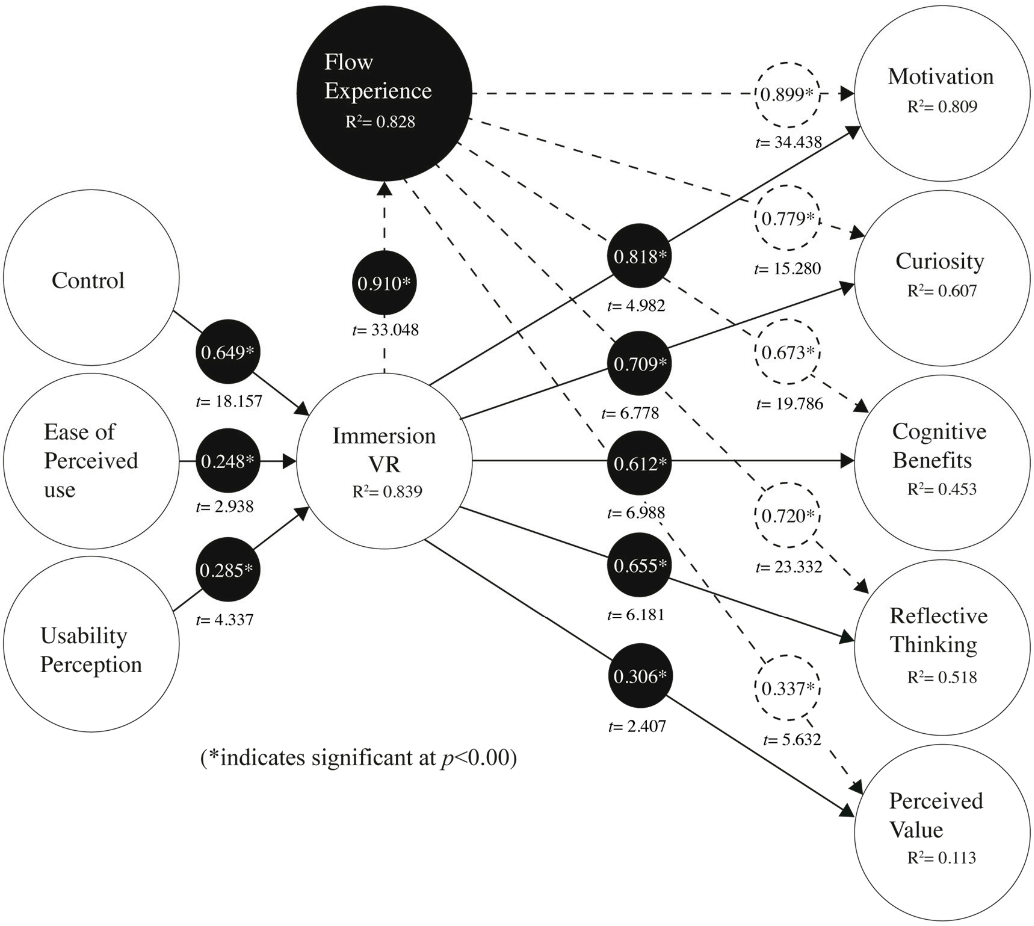

Figure 3. Results of the conceptual model.

In order to measure the mediating effect of the flow experience, the indirect effect was measured, which can be formulated as the difference between the total and direct effect [81]. Table 4 shows that the results were significant; however, having a significant result in the direct effect, the flow experience was approved as a complementary partial mediator variable, approving with them hypotheses H10, H11, H12, H13, and H14.

Table 4. Mediating effects of the flow experience.

H	Mediator	Independent Variable	Dependent Variable	β	*t*-Value	*p*-Value	Type of Mediation
H10	Flow experience	Immersion VR	Motivation	0.899	34.438	0.000	Complementary (partial mediation)
H11	Flow experience	Immersion VR	Curiosity	0.779	15.28	0.000	Complementary (partial mediation)
H12	Flow experience	Immersion VR	Cognitive benefits	0.673	19.786	0.000	Complementary (partial mediation)
H13	Flow experience	Immersion VR	Reflective thinking	0.72	23.332	0.000	Complementary (partial mediation)
H14	Flow experience	Immersion VR	Perceived value	0.337	5.632	0.000	Complementary (partial mediation)

5.4. Validation of the Measuring Instrument

The discriminant validity was tested using the Fornell and Larcker criteria, which was constructed, and in the diagonal, we inserted the AVE values to compare them with the other factors of the correlation coefficient. The results show values greater than 0.5, which confirms the discriminant validity of all the factors (Table 5).

Table 5. Discriminant validity—Fornell and Larcker criterion.

	CB	CN	CR	FE	IM	MT	PV	EPU	RT	PU
CB	**0.852**									
CN	0.793	**0.851**								
CT	0.695	0.758	**0.871**							
FE	0.626	0.817	0.756	**0.812**						
IM	0.771	0.888	0.84	0.899	**0.723**					
MT	0.657	0.864	0.818	0.898	0.893	**0.714**				
PV	0.541	0.44	0.575	0.28	0.37	0.367	**0.815**			
EPU	0.672	0.649	0.58	0.637	0.723	0.665	0.367	**0.796**		
RT	0.843	0.793	0.877	0.695	0.773	0.738	0.514	0.782	**0.786**	
PU	0.784	0.789	0.743	0.704	0.83	0.785	0.467	0.728	0.782	**0.853**

The VIF collinearity statistics were verified, which indicates that there were no problems with the partial least squares estimates (Table 6).

Table 6. VIF values structural model.

	Immersion VR	Flow Experience	Motivation	Curiosity	Cognitive Benefits	Reflective Thinking	Perceived Value
Control	2.302						
Ease of perceived use	2.298						
Usability perception	2.296						
Immersion VR		2.711					
Flow experience			2.246	1.835	2.086	1.914	1.437

5.5. Goodness-of-Fit Diagnosis

A method to calculate the goodness of global adjustment (GoF) is proposed by Tenenhaus, Amato, and Esposito Vinzi [82]. *GoF* is a measure of how well a model fits a set of observed data. It was calculated by comparing the observed values with the values predicted by the model. The method considers both the quality of the measurement model and the structural model [83]. The goodness of global statistical adjustment (*GoF*) was calculated using the following equation:

$$GoF = \sqrt[2]{\overline{AVE} * \overline{R^2}}$$

The calculated global goodness of adjustment (*GoF*) was 0.66, which exceeded the threshold *GoF* recommended >0.36 suggested by Wetzels, Odekerken-Schröder, and Can Oppen [84]. Thus, this study concludes that the research model provides a general goodness of fit.

6. Discussion

In this work, the effect of immersion VR in art and design university students on the perception of learning mediated by the flow experience was analyzed and verified. A bootstrapping analysis was performed to analyze the different relationships between the variables.

Firstly, for the explanation of the immersion VR, we found that the control variables, perception of ease of use, and perception of usability impact the student's immersion VR. These results coincide with other works in the literature that are shown in Table 7.

Table 7. Authors who support the immersion VR construct.

Constructs	Authors Support
Control → Immersion VR	[32–36]
Ease of perceived use → Immersion VR	[37–39]
Usability perception → Immersion VR	[42–44]

Once the independent variable of immersion VR was explained, its positive relationship with the variable's motivation, curiosity, cognitive benefits, reflective thinking, and the perceived value that explained the university student's perception of learning was verified. Likewise, the relationship between immersion VR and the flow experience was verified. These results coincide with other works in the literature, as shown in Table 8.

Table 8. Authors who support the experiential learning construct.

Constructs	Authors Support
Immersion VR → Motivation	[5,45–47]
Immersion VR → Curiosity	[48,50,51,69]
Immersion VR → Cognitive Benefits	[52–54]
Immersion VR → Reflective thinking	[55–57]
Immersion VR → Perceived value	[58–62]
Immersion VR → Flow experience	[14,63–65,68]

Finally, this study also verified the mediating effect of the flow experience variable between the relationships of immersion VR with motivation, curiosity, cognitive benefits, reflective thinking, and value perception. These results coincide with other works in the literature shown in Table 9.

Table 9. Authors who support the moderating effect of the flow experience between immersion VR and the experiential learning construct.

Constructs	Authors Support
Immersion VR → Flow Experience → Motivation	[5,45–47]
Immersion VR → Flow Experience → Curiosity	[48,50,51,69]
Immersion VR → Flow Experience → Cognitive Benefits	[52–54]
Immersion VR → Flow Experience → Reflective thinking	[55–57]
Immersion VR → Flow Experience → Perceived value	[58–62]

7. Implications of Results

This study found the relationship of immersion through VR technology in an educational way through the variables of motivation, curiosity, cognitive benefits, reflective thinking, and the perception of value. Likewise, within the proposed model, the mediating effect of the flow experience variable was confirmed.

Additionally, it is important to mention that this study is focused on the perception of learning in art and design students in Mexico, so this study brings new ideas to both academics and researchers in the use of this model in other areas of study.

Within the academic aspect, this study makes a significant contribution to the development of new experiential learning prediction models. In particular, the results shown in this study show that the use of VR technology hardware in classrooms enhances students' motivation, curiosity, cognitive benefits, reflective thinking, and perceived value.

8. Limitations

High cost: VR technology is still expensive and may be out of reach for many schools of art and design.

Limited accessibility: VR technology may not be accessible to all students due to physical disabilities or lack of access to the necessary equipment.

Limited content: The content available for use in VR technology is still limited and may not provide the detailed instruction and feedback that an in-person art class could provide.

Lack of interaction: Virtual reality is a platform that stimulates virtual collaboration, and in this project, it had a positive impact due to the design of our activities in teams. However, it is also important to mention that in some circumstances virtual reality can also cause student isolation given the immersion that they experiment with.

Technical difficulties: Issues with hardware and software are common problems with VR learning, which can be sources of frustration for both teachers and students.

9. Future Research

Flow experience in VR technology is a rapidly growing field, and its potential applications in higher education are exciting. In the future, universities could use VR technology to create immersive learning experiences to generate a state of flow. By providing students with engaging and challenging tasks at the edge of their abilities, they can be pushed to their limits and find themselves in a state of optimal performance.

The possibilities for flow experience in VR technology are endless. Universities could use VR technology to develop interactive learning environments that encourage students to explore and discover. By providing an immersive and engaging experience, students can be pushed to reach their full potential and achieve a state of flow.

10. Conclusions

VR technology is quickly becoming a powerful tool for learning in schools. By immersing students in a 3D environment, VR can help them develop a better understanding of difficult concepts and gain a deeper appreciation for the creative process. It can also be used to create interactive experiences that bring the classroom to life, allowing students to explore and interact with their environment in new and exciting ways.

VR technology can be used to create a virtual art studio where students can experiment with their projects. This allows them to work at their own pace and explore different techniques without worrying about making mistakes. Similarly, VR can simulate historic art and design pieces, enabling students to view them in detail and gain a better understanding of their context.

Beyond the classroom, VR technology can also create experiential learning opportunities outside the traditional school setting. Through VR technology, students can visit virtual museums, galleries, and art shows, allowing them to explore the works of artists from around the world.

As VR technology advances, it will continue revolutionizing the way art and design schools teach their students. By providing immersive and interactive learning experiences, VR technology can help students develop a deeper appreciation for the creative process, allowing them to reach their full potential.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Appendix A

Table A1. Indicators in the measuring instrument.

Construct	Items	
Immersion VR	IM1	The immersion VR experience motivates me to learn.
	IM2	The immersion VR experience makes learning more motivating and interesting.
	IM3	Immersion VR experience helps me improve my understanding.
	IM4	The immersion VR experience helps me concentrate.
Perception of usability	PU1	The use of VR technology increases my performance in class.
	PU2	Using VR technology improves efficacy within the class.
	PU3	VR technology allows me to learn at my own pace.
	PU4	VR technology gives me new tools to use in class.
Control	CT1	The ability to change the position of the views of 3D objects allows me to learn better.
	CT2	The ability to change the display position of 3D objects makes learning more motivating and exciting.
	CT3	The ability to manipulate objects (for example, collect, cut, and change size) within the virtual environment makes learning more motivating and exciting.
	CT4	The ability to manipulate objects in real-time helps improve my understanding.
	CT5	VR technology allows me to be more receptive and active in learning.
	CT6	VR technology allows me to have more control over my learning.
	CT7	VR technology promotes learning at my own pace.
	CT8	VR technology helps me get involved in the learning activity.

Table A1. *Cont.*

Construct		Items
Ease of perceived use	EPU1	It is easy to use this VR technology program in my design projects.
	EPU2	I control this VR technology program when developing my design projects.
	EPU3	It is easy to master this VR technology program in my design projects.
	EPU4	This VR technology program is clear and understandable.
Flow experience	FE1	Enjoy experience through VR technology.
	FE2	I found the gratifying VR experience.
	FE3	I felt in total concentration during the experience.
	FE4	I felt that time passed too fast.
	FE5	This class through VR technology exceeds my expectations.
Motivation	MT1	It is interesting to use VR technology in class.
	MT2	My performance was good using VR technology in class.
	MT3	After using VR technology for a while, I felt competent.
	MT4	I was very relaxed while using VR technology in class.
	MT5	I am skilled while I use VR technology in class.
Curiosity	CR1	I like to explore the tools provided by VR technology in class.
	CR2	I like to know the VR software trends.
	CR3	I like to explore VR software options.
Cognitive benefits	CB1	VR technology facilitates my understanding.
	CB2	VR technology facilitates my memorization.
	CB3	VR technology helps me better apply my knowledge and skills.
	CB4	VR technology helps me better analyze problems.
	CB5	VR technology helps me to have a better overview of my classes.
Reflective thinking	RT1	Using VR technology in class, I could reflect on how I learn.
	RT2	Using VR technology in class, I could link new knowledge with my previous knowledge and experiences.
	RT3	Using VR technology in class, I could become a better student.
	RT4	Using VR technology in class, I could reflect on my understanding.
Perceived value	PV1	After assisting in using VR technology in my classes, I recognize the contributions of VR technology compared to the face-to-face method.
	PV2	I prefer the functionalities that working in class with virtual reality gives me than the face-to-face method.
	PV3	I think my creative process performs better through VR technology than the traditional method.

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