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AN INTEGRATED ACCEPTANCE MODEL FOR VIRTUAL REALITY ADOPTION IN DISTANCE LEARNING: INVESTIGATING MOROCCAN STUDENTS' PERSPECTIVES

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ABSTRACT

Virtual Reality (VR) is a technology with diverse applications across different sectors, such as education, healthcare, psychology, and gaming. In education, VR is being explored as a tool for distance learning. Its use can potentially motivate students to engage with online lessons. The purpose of this research paper was to investigate which variables would influence the use of VR in distance learning among students. Using the Technology Acceptance Model (TAM) as a framework within four factors, a series of hypotheses were formed. Data has been collected from 122 Moroccan students and analyzed using regression. The findings indicate that user support, perceived ease of use (PEOU), perceived usefulness (PU), and attitudes toward technology use (ATU) significantly influenced the behavioral intention (BI) to use VR systems for educational purposes. The study's results can guide decision-makers in developing sustainable distance learning and educational systems in Moroccan universities. This study presents an integrated acceptance model for understanding Moroccan students' perspectives on adopting VR in distance learning. By investigating factors influencing students' acceptance of VR technology, this research contributes to the development of sustainable distance learning systems in Moroccan universities

Keywords: *Distance education, Virtual Reality, Technology Acceptance Model, e-learning, TAM*

1. INTRODUCTION

In recent years, technology has revolutionized the way education is delivered, expanding and challenging traditional ideas of learning environments. One such emerging technology is three-dimensional (3D) virtual worlds that combine desktop virtual reality with a chat environment. Immersive technologies such as augmented reality (AR) and VR have been found to increase student engagement in distance learning [1]–[3]. [4] reviewed 29 studies on virtual worlds in K-12 and higher education and found that they positively impacted student outcomes. Currently, VR has been implemented within classrooms to support lecturers to achieve educational purposes. To evaluate users' intention to utilize VR for distance learning as well as identifying factors influencing technology acceptance, we have employed a modified version of the TAM [5]. The TAM for VR applications has already been investigated within educational and medical fields [6]. However, its implementation for distance learning is still relatively recent. Utilizing VR for distance learning holds significant improvement for the educational sector, optimizing the teaching experience, and resolving difficulties which conventional teaching methods cannot address [7]. Therefore, it is critical that we gain an understanding of which factors affect users' acceptance of VR technology for distance education. For this research, TAM will be employed to gauge the factors that impact users' ability to adopt VR in distance education. The research questions to be answered are:

- What are the factors that motivate the acceptance and usage of VR in distance education by users?
- Many previous studies have implemented the TAM model to gain insights regarding student acceptance of VR in distance education. Nevertheless, additional investigations are required to explore the factors that impact the users' acceptance and adoption of VR technology in

various educational and cultural contexts. Consequently, this research proposal's objective is to perform an empirical investigation applying the TAM model to explore user acceptance of VR in higher education in Morocco. Specifically, this paper addresses the following research questions:

- To what degree would students perceive VR as a useful technology to enhance their learning outcomes?
- To which extent do students perceive VR technology as being easy to use for learning?
- How do perceived usefulness and perceived ease of use impact students' acceptance of VR in their lessons?

The results of this study will contribute to our understanding of the factors that influence user acceptance and adoption of VR technology in higher education in Morocco. The findings will also have practical implications for educators and developers who are interested in designing and implementing VR technology in educational settings. Along with the original TAM factors, we have extended the model with 4 extra features: PU, PEOU, ATU, and BI.

The article contributes by investigating the factors impacting VR adoption in Moroccan distance learning, utilizing the TAM framework extended with additional variables. Its findings highlight the significance of user support, perceived usefulness, ease of use, attitudes towards technology, and behavioral intention in shaping students' acceptance and intention to use VR systems for educational purposes, offering practical insights for enhancing distance learning initiatives in Moroccan universities.

This document has been organized by the following: In Section 2, VR in distance learning, as well as the TAM, were explained. Section 3 outlines the research design. Section 4 provides findings and discussion. Lastly, Section 5 concludes the suggested research model.

2. LITERATURE REVIEW

2.1 Tam

Davis introduced the TAM in 1985 [8], proposing that one's attitude toward the adoption of technology can be determined by PU and PEOU [5]. PU is the extent to which an individual thinks that the usage of a specific device will enhance his or her work-related productivity, while PEOU refers to the degree to which he or she believes that utilizing a particular technology is effortless [8]. TAM relies on two psychological and social theories: the theory of reasoned action [9] and the theory of planned behavior [10]. TAM suggests that whenever users experience technology as practical and easy to use, they are likely to embrace and employ it [11]. Additionally, the TAM has been widely applied for measuring technology acceptance, due to its greater simplicity and comprehensibility, compared to its more general practicality [12].

As mentioned earlier the TAM is grounded on the TRA, which proposes that people's attitudes towards technology use are designed to predict mobile learning acceptance [13]. This model is widely used to measure the level of technology acceptance among users, largely due to its simplicity and ease of understanding [12]. However, its popularity may not necessarily stem from its practical applicability. The TAM postulates that people are more inclined to embrace a technology which they perceive as practical and easy to use, and as a result, employees are more willing to adopt a novel technology if they trust that it will make their tasks easier to perform [11].

TAM has been also used to forecast the organization's acceptance of new technologies through four main factors: PEOU, PU, ATU, and BI. TAM involves three categories of variables that can be categorized into:

- Personal characteristics, including age and/or prior experience with technology.
- Organizational drivers, which include users' training or assistance.
- Technology factors, such as thoroughness of the information provided.

Numerous studies have emphasized the broad applicability of the TAM to various technologies and contexts, such as online learning [14], Augmented reality in education [14], wireless internet [16], and e-commerce [17], among others. Different literature reviews have examined TAM in various application domains, such as safety training acceptance of virtual reality [18], Pokémon Go technology acceptance drivers [19], factors influencing the use of augmented reality and VR for learning [20], and mixed reality in collaborative learning [21]. The conceptual framework for this research is shown in Figure 1.

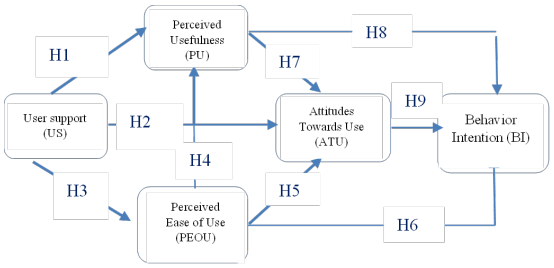

Figure 1: Conceptual framework for the study

The hypotheses for this paper are as follows:

H1: User support positively affects PU of towards using VR in distance learning.

H2: User support positively affects ATU towards using VR in distance learning.

H3: User support positively affects the PEOU of VR in distance learning.

H4: PEOU positively influences PU.

H5: PEOU positively influences students' ATU towards using VR in distance learning.

H6: PEOU positively influences students' BI towards using VR in distance learning.

H7: PU positively influences students' attitudes towards using VR in distance learning.

H8: PU positively influences students' BI towards using VR in distance learning.

H9: ATU towards using VR positively influences students' BI to use VR in distance learning.

After reviewing the literature, it is evident that there is a gap in understanding the factors influencing VR adoption in Moroccan distance learning set-tings. Existing research has primarily focused on technology acceptance in general, neglecting the specific nuances of VR adoption in the Moroccan higher education context. This gap impedes the development of effective strategies for integrating VR technology into distance learning programs. Therefore, there is a pressing need to investigate the factors influencing students' attitudes and intentions towards VR adop-tion in Moroccan universities to inform evidence-based interventions and advance educational practices.

3. METHODOLOGY

3.1 Research Method

The target group for this study consisted of university students. Furthermore, the utilization of technology in the educational procedure of one field of study greatly differs from other fields. The variables used in this paper have been tailored from prior literature to provide validity for all measures. TAM model was adapted to conduct this research consisting of different factors such as PU, PEOU, ATU, and BI. To conduct this research, a survey was constructed and tested. The survey structure could be split into 4 sections. Both parts one and two seek to determine whether the user is generally aware of VR and its usability. Part three focuses on the usage of VR, focusing on ease of use. The last section of the survey concentrates on the requirements of VR for educational applications. All survey items were rated using a 5-point Likert scale, with 1 denoting strong disagreement and 5 indicating strong agreement [1], [17]. There were 122 participants from various fields. There were 59 female and 63 male respondents, and the age ranges between 19 and 66 years old. Additionally, the major of each respondent was recorded. The methodology utilized in this paper is illustrated by a Flowchart (Figure 2).

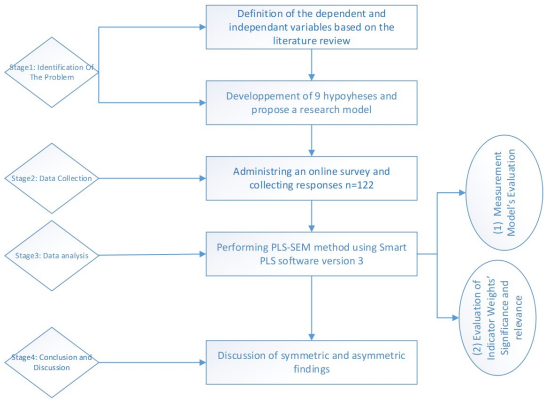

Figure 2: Research flowchart

3.2 Data Collection

To address the hypotheses, a Web-based questionnaire was administered among a random sample of students. The use of an online questionnaire allowed for a larger and more diverse sample to be collected, as participants could respond from anywhere with internet access. It also allowed for the data to be easily collected, stored, and analyzed. The inclusion of socio-demographic characteristics in the questionnaire allowed for the examination of potential differences in responses based on gender and age. The questionnaire comprised 15 items, which includes variables regarding user support, PU, PEOU, ATU toward

using VR, and BI to use VR. Sociodemographic attributes were also incorporated within the final part of the survey. After designing the first version of the questionnaire, third-party validation was sought to ensure the accuracy of the data collected and the quality of the results. The results of the pilot test were analyzed, and necessary adjustments were made to improve the reliability and validity of the questionnaire. The findings of the pre-test were examined and the required adaptations were implemented in order to strengthen the questionnaire's reliability and validity. Further, to assure the reliability of the questionnaire, a Cronbach's alpha measure was conducted for all research items. The findings of the survey were analyzed using regression analysis to evaluate the association between the variables.

Table 1 presents data on the age groups of a sample population. The first column, titled "Age Groups," lists six age ranges, from 17-25 to 58-65. The second column, titled "Frequency," displays the number of individuals in the sample that fall into each age range. The third column shows the percentage of the sample that falls into each age range. For example, 50.8% of the sample falls into the 17-25 age range.

Table 1. Participant's age groups

Age		
	Frequency	Percentage
17-25	62	50,8
26-33	47	38,5
34-41	9	7,4
42-49	2	1,6
50-57	1	0,8
58-65	1	0,8
Total	122	100

Table 2 presents data on the gender distribution of a sample population. The first column, titled "Gender" lists two gender categories: Male, and Female. The second column, titled "Frequency," displays the number of individuals in the sample that fall into each gender category. The third column titled shows the percentage of the sample that falls into each gender category. For example, 51.6% of the sample is male.

Table 2. Participants gender distribution

Experience using VR		
	Frequency	Percentage
Yes	71	58,2
No	51	41,8
Total	122	100

Table 3 presents data on whether individuals in a sample population personal experience have using virtual reality. The first column, titled "Do you already have personal experience using virtual reality?" lists two response options: No and Yes. The second column, titled "Frequency," displays the number of individuals in the sample that selected each response option. The third column, titled "Percent," shows the percentage of the sample that selected each response option. For example, 58.2% of the sample responded "Yes."

Table 3. Participants experience using virtual reality

Gender		
	Frequency	Percentage
Male	63	51,6
Female	59	48,3
Total	122	100

4. RESULTS

When handling the study data, we first checked for the absence of multicollinearity in the predictors and the validity of the measurement model. To check for multicollinearity, we examine the values of the variance inflation factors (VIF). These values are all smaller than 5, suggesting that our measurement model does not suffer from multicollinearity issues. Analysis of factor loadings, Cronbach's alpha, composite reliability, and average variance extracted (AVE) allows us to estimate the validity of the measurement model.

4.1 Model validity

User Support: It represents the User Support construct and lists three items (US1, US2, and US3) used to measure it. The loadings for the items range from 0.457 to 0.700, with US1 having the highest loading. The Cronbach's alpha coefficient for this construct is 0.707, indicating good internal consistency. The AVE for User Support is 0.641, which means that the items measuring this construct explain 64.1% of its variance. The CR value for User Support is 0.381, indicating that the items in this construct are moderately reliable.

PEOU: It represents the PEOU construct and lists three items (PEOU1, PEOU2, and PEOU3) used to measure it. The loadings for the items range from 0.673 to 0.764, with PEOU3 having the highest loading. The Cronbach's alpha coefficient for this construct is 0.857, indicating

excellent internal consistency. The AVE for PEOU is 0.762, which means that the items measuring this construct explain 76.2% of its variance. The CR value for PEOU is 0.517, indicating that the items in this construct are moderately reliable.

PU: It represents the PU construct and lists three items (PU1, PU2, and PU3) used to measure it. The loadings for the items range from 0.564 to 0.651, with PU1 having the highest loading. The Cronbach's alpha coefficient for this construct is 0.843, indicating good internal consistency. The AVE for PU is 0.638, which means that the items measuring this construct explain 63.8% of its variance. The CR value for PU is 0.371, indicating that the items in this construct are moderately reliable.

ATU: This represents the ATU construct and lists three items (ATU1, ATU2, and ATU3) used to measure it. The loadings for the items range from 0.765 to 0.813, with ATU2 having the highest loading. The Cronbach's alpha coefficient for this construct is 0.913, indicating excellent internal consistency. The AVE for Attitude Towards Use is 0.826, which means that the items measuring this construct explain 82.6% of its variance. The CR value for ATU is 0.614, indicating that the items in this construct are moderately reliable.

BI: This represents the BI construct and lists three items (BI1, BI2, and BI3) used to measure it. The loadings for the items range from 0.722 to 0.772, with BI1 having the highest loading. The Cronbach's alpha coefficient for this construct is 0.894, indicating excellent internal consistency. The AVE for BI is 0.784, which means that the items measuring this construct explain 78.4% of its variance. The CR value for BI is 0.548, indicating that the items in this construct are moderately reliable. age is significantly Correlated with the depression attribute with a value of 0.1, although other attributes such as number of children, total number of members, and durable goods exhibited a weak correlation with the output.

Table 4. Composite reliability, loadings, and convergent validity

Constructs	Items	Loadings	Cronbach's Alpha	AVE	CR
US	US1	0,7	0,707	0,381	0,641
	US2	0,666			
	US3	0,457			
PEOU	PEOU 1	0,717	0,857	0,517	0,762
	PEOU 2	0,673			
	PEOU 3	0,764			
PU	PU 1	0,61	0,843	0,371	0,638
	PU 2	0,564			
	PU 3	0,651			
ATU	ATU 1	0,765	0,913	0,614	0,826
	ATU 2	0,813			
	ATU 3	0,771			
BI	BI 1	0,772	0,894	0,548	0,784
	BI 2	0,726			
	BI 3	0,722			

4.2 Model validity

The standard beta coefficient for the first hypothesis is 0.430, suggesting that it is a positive association between user support and PU of distance learning. The p-value for this hypothesis is 0.000, which is below the 0.05 level of significance. This implies that the relationship between user support and perceived usefulness is statistically significant. From these findings, it can be deduced that user support positively influences the PU of distance learning.

The standard beta coefficient for hypothesis 4 is 0.451, which indicates that there is a positive association between PEOU and PU. Also, the t-value for this hypothesis is 5.536, which is significant at the 0.05 level. This suggests that the relationship between PEOU and PU is statistically significant. Based on these results, we can conclude that PEOU positively influences PU.

The nine hypotheses are all supported at the significance level of $p < 0.05$, having standardized betas ranging from 0.430 to 0.609 and p-values all equal to 0.000 (meaning they are highly significant). This suggests the existence of a positive association between user assistance, PU, ATU towards the use of VR in distance learning, PEOU of VR in distance learning, and students' BI to use VR in distance learning. In addition, PEOU and PU positively influenced students' ATU toward using VR, and students' BI to use VR was positively influenced by their ATU toward using it.

Table 5. Hypothesis Testing

Hypothesis	Std.Beta	T-Value	P Value	Decisions	R-Square
Hypothesis 1	0,43	5,211	0,000	Supported	0,185
Hypothesis 2	0,572	7,643	0,000	Supported	0,327
Hypothesis 3	0,587	7,932	0,000	Supported	0,344
Hypothesis 4	0,451	5,536	0,000	Supported	0,203

Hypothesis 5	0,578	7,753	0,000	Supported	0,334
Hypothesis 6	0,578	7,768	0,000	Supported	0,335
Hypothesis 7	0,513	6,54	0,000	Supported	0,263
Hypothesis 8	0,445	5,437	0,000	Supported	0,198
Hypothesis 9	0,609	8,419	0,000	Supported	0,371

5. DISCUSSION

The results of the study indicate that there is a significant positive relationship between various factors that influence the use of VR in distance learning. The study finds that user support, PU, ATU towards using VR, PEOU, and BI to use VR are all positively related to each other. This suggests that the more students feel supported, find the technology useful, and have a positive ATU towards using VR, the more likely they are to intend to use it.

In addition, the study finds that PEOU and PU have a positive influence on students' ATU toward using VR in distance learning. This indicates that if students perceive VR as easy to use and useful, they are more likely to have a positive ATU toward using it in their distance learning. Furthermore, the study finds that students' ATU towards using VR has a positive influence on their BI to use it.

These findings are important for educators and administrators who are considering implementing VR technology in their distance learning programs. By providing user support, highlighting the usefulness of VR, and addressing concerns related to ease of use, educators can improve students' attitudes towards using VR and increase their intention to use it. This can ultimately lead to improved engagement and learning outcomes for students in distance learning programs.

These findings align with previous research [21,22] indicating a positive relationship between user support, perceived usefulness, attitudes towards technology use, and intention to use VR in various contexts, including education. Moreover, the study contributes to existing literature by specifically examining these relationships within the context of distance learning, thereby expanding our understanding of VR adoption dynamics in this domain. Additionally, the study underscores the importance of perceived ease of use in influencing attitudes towards VR adoption, which complements prior research emphasizing the significance of usability perceptions in technology acceptance. Overall, these findings reinforce the importance of addressing user concerns and highlighting the benefits of VR technology to promote its effective integration into distance learning environments.

6. CONCLUSION AND FUTURE SCOPE

This research aimed to investigate the association between user support, PU, PEOU, and ATU towards the use of VR and BI to use VR in distance learning among students. The study results indicated that there was a positive association between all these variables, indicating that students with greater support were likely to have a more positive ATU towards the use of VR, to find it more useful and easier to use, and to have a greater intention to use it. In addition, the study revealed that PEOU and PU positively influenced students' ATU toward using VR and that students' BI to use VR was positively influenced by their ATU toward using VR. These findings have significant implications for educators and instructional designers, as they highlight the importance of providing user assistance and designing VR tools that are perceived as useful and easy to use to improve students' ATU and intention to use VR in distance learning.

These findings underscore the importance of providing adequate user support, highlighting the practicality of VR technology, and addressing usability concerns to promote its effective integration into distance learning programs. Educators and administrators can leverage these insights to design interventions aimed at enhancing students' attitudes towards VR adoption, thereby fostering engagement and improving learning outcomes in distance learning contexts. Furthermore, the study primarily focused on student perspectives, overlooking the viewpoints of educators and administrators who play pivotal roles in the implementation of VR technology in distance learning. Future research should aim to incorporate multi-stakeholder perspectives to provide a comprehensive understanding of VR adoption dynamics in Moroccan universities. Moreover, the study employed a cross-sectional design, which precludes the establishment of causal relationships between the variables examined. Longitudinal studies are warranted to explore the long-term effects of VR integration on student engagement, learning outcomes, and satisfaction in distance learning contexts. Lastly, while efforts were made to control for potential confounding variables, there

may still be unaccounted-for factors influencing students' attitudes and intentions towards VR adoption. Future research could benefit from employing more robust statistical techniques to address these confounding variables. Overall, while this study contributes valuable insights into VR adoption in Moroccan distance learning, researchers should interpret the findings within the context of these limitations and exercise caution when generalizing the results.

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