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A STUDY ON CONSUMER PERCEPTION AND ADOPTION OF MIXED REALITY SOLUTIONS IN EDUCATION AND TRAINING

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ABSTRACT

Mixed Reality (MR) technology, encompassing Virtual Reality and Augmented Reality, offers immersive and interactive learning environments, yet its adoption in education remains limited. This study investigates consumer perception and adoption of MR solutions in education and training, focusing on two primary objectives: first, to assess the key benefits and challenges influencing MR adoption, and second, to identify underlying factors that shape consumer perceptions of MR effectiveness. A quantitative descriptive research design was employed, collecting data from respondents including educators, students, and professionals in Kozhikode, India, using a structured questionnaire. Descriptive statistics, a Chi-square test, and Exploratory Factor Analysis were used for analysis. Findings revealed that respondents demonstrated a moderate level of familiarity with MR technologies. Perceived benefits included enhanced engagement, improved learning outcomes, and interactive experiences, whereas significant barriers comprised technical difficulties, high device costs, and insufficient content availability. The Chi-square test indicated a significant relationship between occupation and the types of challenges experienced or anticipated. Factor analysis extracted three underlying dimensions: Learning Engagement and Personalization, Usability and Compatibility, and Accessibility and Motivation. The study concludes that while MR is generally perceived as beneficial for education and training, several adoption barriers must be addressed before widespread integration can be achieved.

KEYWORDS: Mixed Reality, Consumer Perception, Technology Adoption, Education Technology, Factor Analysis, Chi-Square Test.

1. INTRODUCTION

Mixed Reality (MR) technology, which seamlessly blends physical and digital worlds, is increasingly recognized as a transformative tool in education and training (Milgram & Kishino, 1994). Unlike Virtual Reality (VR), which creates entirely virtual environments, or Augmented Reality (AR), which merely overlays digital information onto the real world, MR offers an integrated experience where virtual and real objects coexist and interact in real time. This unique capability makes MR particularly valuable in educational settings (Johnson & Lee, 2019). By facilitating realistic simulations and hands-on interactions with holographic content, MR enables experiential learning that was previously impossible or too resource-intensive. Students can, for example, practice surgical procedures, dissect virtual cadavers, or explore engineering prototypes without physical materials. These technologies enhance engagement, personalization, and knowledge retention, addressing many limitations of traditional pedagogical approaches. However, despite these demonstrated advantages, the successful integration of MR into mainstream education depends critically on how consumers—students, educators, and training professionals—perceive its value, usability, and relevance to their specific learning contexts (Gupta & Sharma, 2020).

The current educational landscape is undergoing a rapid digital transformation, accelerated significantly by the COVID-19 pandemic, which forced institutions worldwide to adopt remote and hybrid learning models. During this period, the limitations of traditional two-dimensional digital content became glaringly apparent, as student engagement plummeted and learning outcomes suffered. In response, educational technology investments have surged, with the global MR market in education projected to grow from USD 1.5 billion in 2023 to USD 6.5 billion by 2030 (PwC, 2019). Governments and private institutions are increasingly funding immersive technology initiatives, recognizing that future-ready learners require skills developed through interactive, simulated environments. Yet, despite this momentum, a critical gap remains: most adoption decisions are driven by technological push rather than consumer pull. Institutions often purchase MR hardware and software without adequately understanding the perceptions, hesitations, and practical needs of end-users. Students may find MR devices uncomfortable or distracting; educators may lack confidence in integrating MR into curricula; and training professionals may question whether the learning outcomes justify the high costs (Robinson & Stevens, 2019). Without empirical data on consumer perceptions, well-intentioned MR implementations risk failure, wasting resources and undermining future adoption efforts.

1.1Problem Statement

Despite the growing potential of MR to enhance educational outcomes, many institutions hesitate to adopt it due to concerns regarding usability, accessibility, cost, and effectiveness (Robinson & Stevens, 2019). Current literature lacks comprehensive insights into these perceptions and the barriers to MR adoption. Educators, trainers, and technology developers remain uncertain about which factors most influence adoption decisions. This gap hinders the strategic development and implementation of MR solutions tailored to educational contexts. Therefore, this study addresses these gaps by systematically investigating consumer perceptions of MR technology.

1.2Scope of the Study

This study focuses on consumer perceptions and adoption of MR solutions specifically within education and training settings in Kozhikode, India. The research examines the perspectives of three key consumer groups: students, educators, and employed professionals. Key variables investigated include perceived benefits, challenges, usability, accessibility, cost, and compatibility with existing tools. The study does not evaluate technical specifications of MR devices nor compare competing MR brands. Findings are limited to the geographical region and sample size of 120 respondents.

1.3Objectives of the Study

1. To assess the key benefits and challenges influencing the adoption of Mixed Reality (MR) solutions in education and training.
2. To identify the underlying factors that shape consumer perceptions of the effectiveness of MR solutions in educational environments.

1.4Hypothesis (for Chi-square test)

- Null Hypothesis (H0): There is no significant association between occupation and the challenges faced or anticipated when using MR solutions in education and training.
- Alternative Hypothesis (H1): There is a significant association between occupation and the challenges faced or anticipated when using MR solutions in education and training.

2. Literature Review

Johnson and Lee (2019) explored how MR technologies influence student engagement in higher education, finding that MR tools significantly enhance interactive learning by making complex concepts more accessible. However, they identified challenges such as high implementation costs and the need for faculty training. Similarly, Gupta and Sharma (2020) examined AR and VR use in K-12 education, highlighting that technological infrastructure, teacher preparedness, and curriculum alignment are essential for successful adoption. While students responded positively, widespread use was limited by budgetary constraints.

Williams and Thomas (2021) focused on MR in STEM education, noting that success depends heavily on content quality and integration with existing curricula. Patel and Kumar (2019) found that MR fosters collaborative learning by providing shared virtual spaces for problem-solving, but pedagogical strategies must be adapted. Zhang and Wang (2020) demonstrated that MR can significantly enhance critical thinking skills by allowing students to interact with complex data in real-time.

Robinson and Stevens (2019) identified barriers to MR adoption in secondary education, particularly in economically disadvantaged areas, including high device costs, lack of technical support, and teachers' attitudes toward technology. Liu and Chen (2021) conducted a longitudinal study showing that students who used MR tools regularly showed improved knowledge retention and deeper understanding, but these benefits depended on consistent use and curriculum integration. Collectively, the literature confirms MR's potential but highlights persistent barriers related to cost, content, and usability (PwC, 2019; Deloitte, 2020).

3.Research Methodology

Research Design: This study adopted a quantitative, descriptive, and analytical research design. Data were collected using a structured questionnaire adapted from previous studies on technology adoption in education.

Sample Design: The population comprised educators, students, and professionals in Kozhikode, India. The sampling frame included individuals engaged in the education sector with potential to use or adopt MR technology. A convenience sampling method was used, selecting 120 respondents who were easily accessible and familiar with or interested in VR/AR/MR technologies.

Data Collection: Primary data were collected through an online and in-person structured questionnaire covering demographics, familiarity with MR, perceived benefits, challenges, and Likert-scale statements on MR effectiveness (1=Strongly Disagree to 5=Strongly Agree).

Secondary data were sourced from industry reports and academic journals (PwC, 2019; Deloitte, 2020).

Statistical Techniques: Data were analyzed using SPSS. Descriptive statistics (frequencies, percentages) summarized demographic and perception variables. For inferential analysis:

- **Univariate test:** Chi-square test of independence was used to examine the association between occupation and anticipated challenges (categorical variables).
- **Multivariate test:** Exploratory Factor Analysis (EFA) with Principal Component Analysis and Varimax rotation was used to identify underlying factors shaping consumer perceptions of MR effectiveness. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity confirmed data suitability for factor analysis.

4. RESULTS & DISCCUSSION

4.1 Demographic Characteristics and MR Familiarity

A descriptive analysis of the sample demographics and familiarity with mixed reality (MR) solutions was conducted (see Table 1). The majority of respondents were aged 25 to 34 years (39.2%) and 18 to 24 years (26.7%). Regarding educational attainment, most participants held a Bachelor's degree (35%) or a Master's degree (31.7%). In terms of occupation, employed individuals comprised the largest segment of the sample (44.2%), followed by students (24.2%). Familiarity with MR solutions was moderate among respondents, with 37.5% reporting being moderately familiar and 18.3% indicating they were very familiar.

Table 1: Demographic Characteristics and MR Familiarity of Respondents. (n = 120)

Characteristic	n	%
Age		
18-24	32	26.7
25-34	47	39.2
35-44	12	10
45-54	12	10
Under 18	10	8.3
55 and above	7	5.8
Educational Level		
Bachelor's Degree	42	35
Master's Degree	38	31.7
Diploma	19	15.8
Ph.D.	12	10
High School	9	7.5
Occupation		
Employed	53	44.2
Student	29	24.2

Entrepreneur/Business owner	21	17.5
Unemployed	17	14.2
Familiarity with MR Solutions		
Moderately familiar	45	37.5
Slightly familiar	27	22.5
Very familiar	22	18.3
Extremely familiar	15	12.5
Not at all familiar	11	9.2
Note. MR = Mixed Reality.		

4.2 Perceived Benefits and Challenges of MR Solutions

Respondents' perceptions of the benefits and challenges associated with using MR solutions in education and training were also examined (see Table 2). Regarding benefits, the majority of respondents valued enhanced engagement (56.7%) and improved learning outcomes (52.5%). Additionally, nearly half of the participants appreciated the interactive and immersive experiences offered by MR (47.5%), while flexibility in learning was valued by 35.8% of respondents. In terms of challenges, technical issues were the most frequently cited barrier (42.5%), followed closely by the high cost of devices (41.7%). A lack of content specifically designed for MR in education and training was reported by 39.2% of respondents, while the learning curve (31.7%) and limited access to devices (24.2%) were also identified as notable obstacles.

Table 2: Perceived Benefits and Challenges of MR Solutions in Education and Training (n = 120)

Variable	n	%
Benefits		
1. Enhanced engagement	68	56.7
2. Improved learning outcomes	63	52.5
3. Interactive/immersive experience	57	47.5
4. Flexibility in learning	43	35.8
Challenges		
1. Technical issues	51	42.5
2. High cost of devices	50	41.7
3. Lack of content	47	39.2
4. Learning curve	38	31.7
5. Limited access to devices	29	24.2

Note. MR = Mixed Reality. Respondents could select multiple options; therefore, percentages do not sum to 100.

4.3 Univariate Analysis: Chi-Square Test for Occupation and MR Challenges

A chi-square test of independence was conducted to examine the association between occupation (student vs. employed) and the types of challenges faced or anticipated when using mixed reality (MR) solutions in education and training. A significant association was found between occupation and perceived challenges, $\chi^2(4, N = 82) = 11.432$, $p = .022$ (see Table 1 and Table 2). Employed individuals reported substantially more challenges related to lack of content (n = 23) compared to students (n = 4). Technical issues were also more prevalent among employed individuals (n = 13) than among students (n = 4). In contrast, both groups reported similar levels of challenges regarding high cost of devices (employed: n = 22; students: n = 21), learning curve (employed: n = 9; students: n = 8), and limited access to devices (employed: n = 8; students: n = 8). No cells had expected counts below 5, satisfying the assumption for chi-square test validity. The likelihood ratio also supported the significant association ($\chi^2(4) = 12.297$, $p = .015$), while the linear-by-linear association was not significant ($\chi^2(1) = 0.069$, $p = .793$), indicating no consistent linear trend between the variables. Therefore, the null hypothesis was rejected, concluding that occupation is significantly associated with the type of challenges individuals face or anticipate when adopting MR solutions in education and training.

Table 3: Cross-Tabulation of Occupation by Challenges Faced or Anticipated With MR Solutions.

Challenge	Student (n = 29)	Employed (n = 53)	Total (N = 82)
High cost of devices	21	22	43
Lack of content	4	23	27
Technical issues	4	13	17
Learning curve	8	9	17
Limited access to devices	8	8	16
Total	45	75	120

Table 4: Chi-Square Test Results – Occupation vs. Challenges.

Test	Value	df	p
Pearson Chi-Square	11.432	4	0.022
Likelihood Ratio	12.297	4	0.015
Linear-by-Linear Association	0.069	1	0.793
N of Valid Cases	120		

4.4 Multivariate Analysis: Factor Analysis of MR Perception Statements

An exploratory factor analysis was conducted to identify the underlying dimensions of consumer perceptions regarding mixed reality (MR) solutions in education and training. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.931, indicating excellent suitability for factor analysis. Bartlett's Test of Sphericity was significant, $\chi^2(36) = 1907.445$, p < .001, confirming that the correlation matrix was not an identity matrix and that the variables were sufficiently intercorrelated for factor extraction.

Principal Component Analysis (PCA) with Varimax rotation was employed to extract factors. Three factors with eigenvalues exceeding 1.0 were retained, collectively explaining 94.65% of the total variance after rotation. The rotated component matrix revealed a clear factor structure, with all factor loadings above the threshold of 0.45 (see Table 3). Communalities for all nine items were high, ranging from 0.918 to 0.974, indicating that the extracted factors explained a substantial portion of the variance in each variable.

Table 5: Pattern Component Matrix , Eigen Values and Total Variance Percentage for Components obtained by Principal Componenet Analysis with Varimax Rotation Method.

Statement	**Component**		
	1	**2**	**3**
MR solutions enhance learning engagement	0.836		
MR solutions provide a more personalized learning experience	0.741		
MR solutions improve the quality of education	0.697	0.585	
MR solutions are easy to use		0.773	0.47
MR solutions are compatible with existing educational tools	0.599	0.684	
MR solutions are accessible and available		0.468	0.76
MR solutions have a positive impact on student motivation	0.647		0.6
Eigen values	7.812	2.22	1.05
Percentage of total variance	78.12	22.2	10.5
Note: Factor loadings <.45 have been omitted from the table.			

The first factor, labeled Learning Engagement and Personalization, accounted for 41.4% of the variance after rotation and included three items with strong loadings: MR solutions enhance learning engagement (0.836), provide a more personalized learning experience (0.741), and improve the quality of education (0.697). This factor reflects the perceived pedagogical value of MR in creating engaging and tailored educational experiences.

The second factor, labeled Usability and Compatibility, accounted for 29.3% of the variance and consisted of two items: MR solutions are easy to use (0.773) and MR solutions are compatible with existing educational tools (0.684). This factor captures the practical considerations related to the integration of MR into existing educational infrastructures.

The third factor, labeled Accessibility and Motivation, accounted for 23.9% of the variance and included two items: MR solutions are accessible and available (0.760) and MR solutions have a positive impact on student motivation (0.600). This factor represents the combined influence of resource availability and affective outcomes on MR adoption.

Overall, the three-factor solution demonstrated a robust and interpretable structure, explaining nearly all (94.65%) of the shared variance among the nine perception items, with each factor representing a distinct yet complementary dimension of consumer perceptions toward MR in education and training.

4.5 DISCUSSION

The findings of this study provide meaningful insights into consumer perception and adoption of Mixed Reality (MR) solutions in education and training, aligning with and extending previous research. Regarding the first objective, which focused on the benefits and challenges influencing MR adoption, descriptive results confirmed that enhanced engagement (56.7%) and improved learning outcomes (52.5%) are the most valued benefits of MR. This supports the work of Johnson and Lee (2019) and Williams and Thomas (2021), who found that MR makes complex concepts more accessible and increases student motivation. However, technical issues (42.5%) and high device costs (41.7%) emerged as the most significant barriers, a finding consistent with Robinson and Stevens (2019) and Gupta and Sharma (2020). The lack of MR-specific content (39.2%) further hinders adoption, echoing the concerns raised by Patel and Kumar (2019). Collectively, these findings suggest that even when consumers recognize the educational value of MR, practical and financial constraints continue to limit widespread use. Furthermore, the chi-square test revealed a significant association between occupation and perceived challenges ($p = .022$). Employed individuals reported more challenges related to lack of content and technical issues compared to students. This pattern may reflect that employed professionals, such as corporate trainers, hold higher expectations for specialized, job-relevant MR content and face more complex technical integration into existing workflows, whereas students may use MR in more structured, simplified academic settings where content is pre-selected and technical support is readily available. This novel finding adds important nuance to the literature by demonstrating that adoption barriers are not uniform across user groups, and that occupation-specific strategies may be necessary to facilitate MR adoption. Finally, the factor analysis extracted three latent factors that together explained 94.65% of the total variance in consumer perceptions. The first factor, labeled Learning Engagement and Personalization, confirms that consumers perceive MR as effective for creating engaging, tailored learning experiences, supporting Zhang and Wang (2020), who documented the role of MR in enhancing critical thinking and enabling personalized learning pathways. The second factor, Usability and Compatibility, highlights the importance of ease of use and seamless integration with existing educational tools, a finding emphasized by Liu and Chen (2021), who noted that even effective technologies fail if they are not user-friendly or compatible with current systems. The third factor, Accessibility and Motivation, underscores that device availability and motivational impact are distinct but interrelated concerns, aligning with Deloitte (2020) on the need for adequate infrastructure to support immersive learning. The high loadings observed across all three factors indicate that no single dimension dominates consumer perception; rather, a holistic combination of engagement, usability, and accessibility collectively shapes adoption decisions. This multidimensional understanding provides a more complete framework for educators, developers, and policymakers seeking to promote MR integration in educational environments.

5. CONCLUSION

Mixed Reality solutions are perceived by consumers as highly effective for enhancing engagement, personalization, and learning outcomes in education and training. However, technical issues, high device costs, and lack of content remain critical barriers to adoption. A significant association exists between occupation and perceived challenges, with employed individuals facing more content and technical difficulties. Factor analysis confirms that learning engagement, usability, and accessibility are three distinct but interconnected dimensions shaping consumer perceptions. To facilitate wider adoption, developers should reduce costs, expand content libraries, and ensure compatibility with existing educational tools, while institutions should provide technical support and training for educators.

REFERENCES

1. Deloitte. (2020). *The future of virtual and augmented reality in education*. https://www2.deloitte.com
2. Gupta, R., & Sharma, P. (2020). Integration of augmented and virtual reality in K-12 education. *Journal of Educational Technology*, 45(3), 234-251.
3. Johnson, A., & Lee, H. (2019). Investigating the effect of mixed reality on student engagement in higher education. *Higher Education Technology Review*, 22(4), 112-128.
4. Liu, F., & Chen, M. (2021). Assessing the long-term impact of mixed reality on student learning outcomes. *Educational Psychology Review*, 33(2), 401-419.
5. Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE Transactions on Information and Systems*, 77(12), 1321-1329.

6. Patel, N., & Kumar, S. (2019). The role of mixed reality in enhancing collaborative learning. *Computers & Education*, 138, 98-115.
7. PwC. (2019). *Seeing is believing: How VR and AR will transform business and the economy*. https://www.pwc.com
8. Robinson, J., & Stevens, R. (2019). Barriers to the adoption of mixed reality in secondary education. *British Journal of Educational Technology*, 50(6), 3120-3137.
9. Williams, K., & Thomas, S. (2021). Enhancing STEM education through mixed reality. *STEM Education Journal*, 12(1), 45-67.
10. Zhang, Y., & Wang, X. (2020). Evaluating the impact of mixed reality on critical thinking skills. *Thinking Skills and Creativity*, 38, 100-118.