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Prioritizing Barriers Influencing Educators in Adoption of Augmented Reality in K-5 Education

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ABSTRACT

Introduction: Indian education system still uses textbooks-based learning or some sort of digital modes for explaining the concepts to the children. These may benefit to some students, but young minds prefer learning in a fun way. Once they start learning complex concepts especially in mathematics, physics, or subjects like history they feel bored and hence they loose interest in the subject. Augmented Reality is a technology that bridges the gap between physical and virtual world and gives immersive experience to the user. Augmented Reality is widely used in higher education but the implementation at primary level is still limited. Therefore, the purpose of this research is to find the critical barriers to augmented reality technology in Indian education sector for K-5 school going children to allow its wider adoption. The objective is to identify the gaps and those hinderences to the wider usage so that obstacles can be handled before developing the AR applications.

Objectives: The objective of this research is to find the influencing factors impacting the adoption of AR in education sector. The study also aims to find the important sub factors influencing the adoption of AR in education sector.

Methods: The paper first identifies different factors influencing the adoption of AR in education sector of India for K-5 school children based on existing literature. After that, they were prioritized using AHP to determine their relative importance. The AHP is a multi-criteria decision making (MCDM) method that incorporates all aspects into a hierarchical model and bases its importance on pairwise comparisons using the Satty scale. Fifteen influencing factors were catergized into four main factors namely Pedagogy (P), Content (C), Technical Resources (TR) and Layout and Design (L&D). A survey containing pair-wise comparisons of factors and sub factors were collected from ten experts working in a higher position in different companies and in the education sector with a minimum of 10 years of experience.

Results: Based on the result obtained, the findings reveal that “Pedagogy” and “Content” are the most important factors which influence the adoption of AR in education sector. Aditionnaly, simplicity/usability in AR mobile applications, proper content matching with school standards, teacher training for new advancements in the technology, and availability of resources are the

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important sub factors to considered before implementing AR applications for the school children.

Conclusions: The study has given the conceptual model which has addressed several factors and sub factors to be taken care of for successful adoption of AR in education among school children. This research assist policymakers, industrialists, and institutional leaders in designing practical augmented reality (AR) initiatives.

Originality/value: Most of the literature focuses on the factors influencing the adoption of AR in different industries and countries but very few studies have focused on K-5 class group children in India. This research plays vital role in those education setups where teaching using latest technoglies is mandatory. The present study also contributes to this area by formulating a research problem as an MCDM problem and by using AHP as a methodology to determine the weigths of factors and sub-factors infleucnign the adoption of AR in education sector.

Keywords: Analytical Hierarchy Planning (AHP), Augmented Reality, Augmented Reality in Education, Mobile Eduction, Multi-Criteria Decision Making (MCDM), Virtual Reality.

INTRODUCTION

Augmented Reality (AR) has transformed various industries by superimposing digital data onto the real environment. Within the field of education, specifically for students in grades K-5, it offers distinct and advantageous possibilities for enriching learning experiences. This study aims to comprehensively analyze and rank the key characteristics that are essential for the widespread acceptance and use of AR technology in early education.

The emergence of Augmented Reality as a technology has made significant advancements in various domains, including the field of education, where it has improved student learning by overlaying digital content over the physical world [1]. This technology can enhance students' attention, engagement, and comprehension of intricate subjects by offering them an immersive and dynamic learning environment [2]. AR presents significant opportunities for cultivating fundamental qualities in pupils, such as teamwork and creativity, which are crucial for their future achievements. Furthermore, AR bridges the gap between real and virtual world to show the results in a more immersive and interactive way [3] which is described in figure 1 below. Augmented Reality (AR) is utilized in a wide range of industries, including manufacturing, healthcare, construction, arts, and military training. AR revolutionizes education by providing enhanced learning opportunities and immersive experiences in the age of advanced technologies. Integrating augmented reality (AR) into primary education, specifically for students in grades K-5, can result in enhanced comprehension of subjects, interactive learning experiences, heightened creativity, improved critical thinking skills, greater memory retention, and more participation and collaboration in classroom instruction [4-7]. The other important feature of this study is it helps students to learn content in 3D ways, learn in immersive way, situation based and collaboration learning, and visualizing the invisible things [3]. Past research has identified several important elements of using AR in the education sector. These aspects include the availability of technical resources, content, pedagogy, and simple design.

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This research makes a valuable contribution to the field of education by building improved applications that may be used to their fullest potential by teachers for young children. Despite the potential of Virtual Reality (VR) and AR to promote positive attitudes, active learning, and engagement, there are still numerous factors affecting its adoption which includes teachers with insufficient training, instructional plans lacking in careful consideration, a paucity of materials, and limited parental engagement. The literature review effectively identifies the primary barriers that hinder the utilization of IT, including insufficient resources, ambiguous policies, inadequate teacher training, and teachers' apprehensions. The integration of Information and Communication Technology (ICT) in education is greatly influenced by the attitudes, knowledge, and training of teachers [8]. Despite receiving positive impressions from instructors and educators, it has been found that ICT often suffers from a lack of necessary training, technical assistance, motivation, and excitement. The study conducted by Green & Ramroop also found certain obstacles preventing the use of Information and Communication Technology. These features encompassed the inadequate proficiency of teachers in properly utilizing the technology, insufficient school infrastructure, and constrictive curriculam. The attitude, skill, and understanding of the teachers utilizing this technology were additional crucial factors [9]. Nevertheless, it is crucial to overcome certain restrictions, such as the ability to use the device with one hand, the tiny size of the screens, and the duration of the battery life, to ensure that primary education children can use the technology smoothly and without interruption. The adaptation of mobile learning in higher education was found to be significantly influenced by factors such as convenience of use, trust, character, and personal attributes. According to research from [10] teachers face difficulties when it comes to incorporating technology into their classroom material and highlights its drawbacks, such as limited research and scarce resources. Mobile devices have the potential to greatly impact on the education industry due to developments in their interface, portability, and touch functionalities. These gadgets can be seamlessly incorporated with other technological applications such as e-books, digital films, podcasts, cloud computing, and social networking sites. This review explores the possibilities of augmented reality (AR) in preschool education. Despite the growing popularity of augmented reality (AR) among older individuals, there is currently a lack of research on the usage of AR by preschoolers due to their cognitive development and challenges in non-realistic environments [11]. Below is the Summary of Prominent factors and sub factors influencing the adoption of AR are given below in Table 1 by different authors:

Table 1. Summary of Factors and Sub -Factors Influencing AR Adoption

Main factors	Sub – factors	References
Pedagogy (P)	Parents' Involvement (PI)	[18]
	Training(T)	[5], [15], [17], [19], [23]
	Efficient Pedagogy (EP)	[13], [4], [7], [12] [18], [19]
	Class Engagement (CE)	[5], [8], [17], [25], [28]
Content (C)	Curriculum Integration (CI)	[8], [18], [24], [29]
	Relevant and appropriate Content (R & AC)	8], [14], [15] [16]
	Learning Enhancement (LE)	[4], [5], [6] [7] [25], [30]
Technical Resources (TR)	Security (S)	[17], [31]
	Available Resources (AR)	[13], [17], [19]

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	Environment (E)	[13], [17]
	Hardware Compatibility (HC)	[7] [14], [23]
	Cost(C)	[17]
Layout and Design (L&D)	Artistic Design (AD)	[4], [8], [13] [15]
	Usability/Simplicity(U/S)	[15], [17]
	Time (T)	[13]

For any education sector to be successful, it must be carefully considered in terms of teachers training, adoption of new technologies, availability of technical resources like internet or wi-fi services, content gaps etc to avoid affects like quality learning, cost, effective learning. Despite the increasing interest of AR technology, several challenges exist and needs to be considered on priority for its widely acceptance. AR has huge potential but due to some barriers its adoption is hampering and that needs to address. Challenges like lack of pedagogy features in AR applications are hampering its adoption and teachers are not ready to accept and swap with the books. Other important barrier includes lack of relevant content as per the school standards. The AR applications are not aligned with the school curriculum so due to this they are not not widely accepted by the educators. Investors who are spending money in this trechnolgy should sit with the educators and teachers to develop the application in such a way that can be widely adopted by schools and parents. Additionally, lack of avalibity of resources is another bigger problem in schools for teachers to adopt this technology. Due to lack of awareness among management, stakeholders, and lack of funding and government policies are some of the problems faced when implementing new education and application based proects [3]. Management should ensure and should invest money in this technology to get maximum benefit out of this technology. Moreover, the layout and design of AR application is also important barrier to be considered before the development. Layout and design should be very simple and should be designed as per the child's age group so that child should not get confused while using this technology. Since working on AR applications child must hold the mobile phone along with learning. Typical designs can lead to confusion and child can lose interest in the specific application. Use of technogly in education is increasing rapidly and to improve the learning of the child at early age, selection of proper technology with play-based curriculum is very important. Therefore, selecting right technogly as early as possible in young generation can lead to higher benefits in future.

OBJECTIVES

The objective of this research is to identify the critical barriers influencing the wider adoption of AR in education sector of India for K-5 school children. Existing literature has identified fifteen barriers including Parents' Involvement, teacher Training, Efficient Pedagogy, Class Engagement, Curriculum Integration, Proper and Relevant Content, Learning Enhancement, Security, Available Resources, Environment, Hardware Compatibility, Cost, Artistic Design, Usability/Simplicity, and time. These factors were then categorized into four main factors which includes Pedagogy, Content, Technical Resources and Layout and Design. The other main objective of this study is to prioritize these factors and sub factors based on weighatage given by the experts using AHP approach.

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METHODS

AHP is a MCDM technique used in such areas where multiple factors and sub factors are present to take complex decisions [20]. Previous studies have extensively used the AHP technique to rank or prioritize various factors in different areas like marketing, human resources, and financial management [21]. The AHP method involves the pairwise comparison of factors and calculation of their priorities (ranks). AHP is considered the best technique for MCDM problems [21]. Figure 1 below demonstrates the methodology used in this study by identifying the obstacles that affect the successful implementation of AR in education based on expert opinions and a survey of literature. Firstly, the barriers were identified from the existing literature and from the expert opinion. Detailed interview was conducted to finalize these barriers. To prioritize the barriers in this complex situation, the MCDM approach was later chosen once the primary determinants and subfactors were identified. A pairwise questionnaire matrix was created and completed by ten experts to determine the impact of one factor on another. The priority of the components and sub-factors was then determined by calculating the local and global weight. Factors with higher weights are more important and priority should be given to them as per their weights.

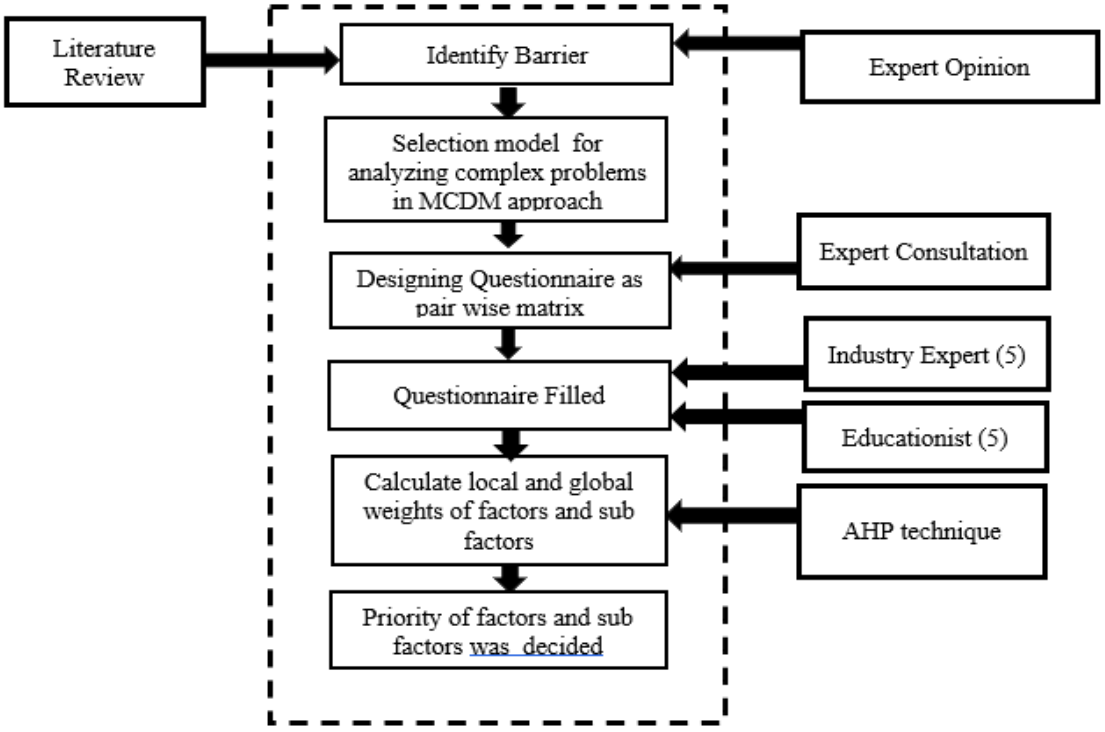

Figure 1. Research Methodology

Model Selection and Creating the AHP Hierarchy

AHP is a MCDM technique used for analysing and solving complex decision-making problems. It analyses relevance of identified factors and give rank according to the importance. There are many MCDM techniques like DEMATEL, ANP, and Fuzzy Logic. AHP is the best technique over other MCDM techniques for solving complex problems and generating rank among the identified factors [9], [20-24]. Firstly, factors were selected from the

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literature and finalized by different experts. Then these factors were examined by the AHP approach to find the relevance with rank between them. Establishing the AHP hierarchy involves structuring a decision problem into a hierarchical model. AHP is a decision-making technique to be useful for prioritizing and making complex decisions. Firstly, the goal was identified to prioritize the factors that influence the design and development of AR in primary education. Next, the step was to identify the primary factors which include pedagogy, content, layout, design and technical resources. The study was conducted by 10 experts (5 Educationist and 5 Industrialist) of this domain to find the key factors which influence the adoption of AR in education and the results of AHP technique proved that Pedagogy is most crucial factor followed by Content, Resources and Design. The AHP method is used in scenarios where it divides the problem into 3 main levels. Level 1 identifies the objective of the study; level 2 shows the main factors and level 3 into sub factors. The AHP Hierarchy model is shown in figure 2 below.

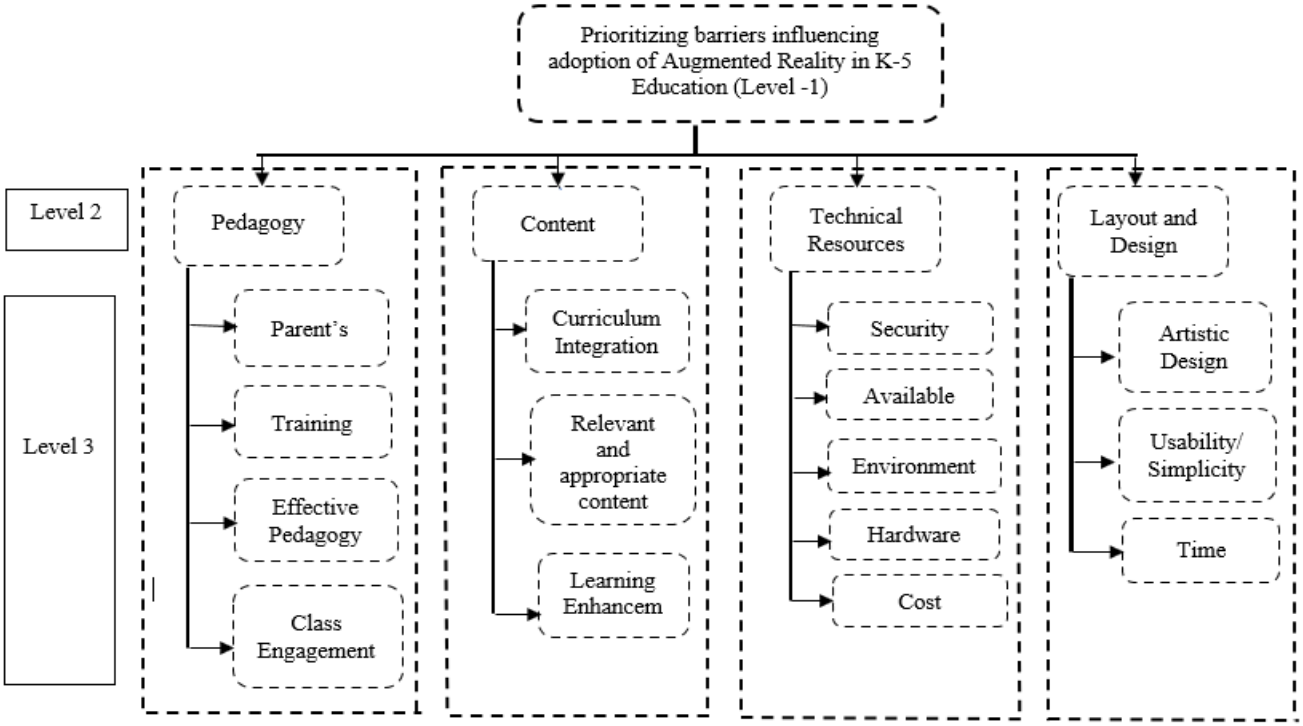

Figure 2. Hierarchy model representation for prioritizing the factor

Creating Pair-Wise Comparison Matrice

Next is to create pairwise comparisons. At each level in the hierarchy, we conducted pairwise comparisons to assess the relative importance of elements compared to each other. We have used Saaty scale to show the relative importance, such as 1 to 9 scale, where 1 indicates equal importance and 9 indicates extremely more important [20]. Table 2 below shows Random Index (RI) based on Saaty scale.

Table 2. Random Index (RI) based on Saaty scale

N	1	2	3	4	5	6	7	8	9	10	11	12	13
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.58	1.56

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In the present study, 10 experts having more than 10 years of experience including 5 educationists and 5 industry experts were contacted to give their expert opinion on the importance of all factors influencing the adoption of AR in the education sector. Detailed interview was conducted with each expert to understand the barriers and to measure the importance of the barriers using AHP technique. Table 3 below shows the background of respondents of the study.

Table 3. Responders' background

S. No.	Designation	Experience
1	School Head	15
2	Principal	12
3	School In charge	13
4	School senior teacher	19
5	School senior teacher	12
6	Software Developer	11
7	Software Engineer	13
8	Architect	13
9	Quality Analyst	10
10	Senior Engineer	11

Calculating Priorities (weights)

Once we have priority weights, we have given rank and synthesize the alternatives based on their relative importance and suitability in achieving our goal. This enables us to make an informed and rational decision, selecting the best alternative according to the priorities we have established.

Checking Consistency Ratio

Consistency ratio (CR) was calculated for every comparison matrix and accepted if CR is less than 0.10 [9]. The CR is determined using the following formula: -

$$CR = \frac{\text{CI}}{RI} \quad (1)$$

Here, CI is the consistency index, and RI is the random consistency index. For a matrix of order n, CI is calculated using Equation (2) and RI is obtained from Table 2.

$$CI = \frac{\lambda\text{max}-\text{n}}{n-1} \quad (2)$$

λmax is calculated using Equation (3) where A is the comparison matrix and W is the corresponding weight vector.

$$AW = \lambda\text{maxW} \quad (3)$$

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Data Collection

AHP is non-statistical in nature, a significantly large sample size is not required for its implementation. Likewise, the AHP methodology prioritizes the decisions made over the decision makers themselves thereby reducing the necessity for large sample sizes [26]. In this study, sample data was collected from top 10 educational professionals employed in various educational institutions in India. To gather the data, we have prepared a proper and structured questionnaire that consisted of questions related to the pairwise comparisons of factors influencing the design and development of Augmented Reality applications in primary education. The respondents had to answer and give the relative importance of two factors at a time using Saaty's nine-point scale.

RESULTS

The facts gathered from the pairwise comparisons of factors were joined using the geometric mean method [27]. We employed MS Excel to apply the AHP technique for data analysis. For detailed analysis of the weights assigned to the factors, along with their sub-dimensions, mentioned below in table 4-8. Local as well as global weights of the factors and their sub-dimensions is shown in Table 4 below.

'Pedagogy' (weight = 0.42) is ranked as the topmost factor that influences the designing and developing of Augmented Reality application in primary education. Pedagogy is the most important factor as it ensures a learning centered approach, meaningful and authentic experiences, differentiated instruction, collaboration and social learning and assessment and feedback. By incorporating pedagogical principles, AR applications can enhance educational experience and foster positive learning outcomes for primary students. This is followed by 'content 'and 'technical resources' with weights equal to 0.37 and 0.14 respectively. Content is the second most important factor. This is because content ensures educational relevance and engagement. Well-designed content enhances understanding and bridges the gap between abstract concepts and real-world contexts. By delivering compelling and personalized experiences, AR applications support meaningful learning for primary students.

Technical resources are crucial and found to be the 3rd important factor in designing AR applications for primary education, as they determine hardware capabilities, software development tools, and network infrastructure. Access to appropriate technical resources ensures optimal performance, seamless experiences and ongoing support for AR applications. By considering these technical aspects, AR applications can effectively enhance primary education with immersive and interactive learning experiences. Within 'pedagogy, training got the maximum weight (local weight = 0.41), followed by class engagement (local weight = 0.31), efficient pedagogy (local weight = 0.22) and parents' involvement (local weight = 0.06). Within 'content', learning enhancement got the greatest weight score (local weight = 0.34), followed by curriculum integration and proper & relevant content (each having a local weight of 0.33). In 'technical resources', available resources got the greatest weight (local weight = 0.49), followed by Cost (local weight = 0.35), hardware compatibility (local weight = 0.23), environment (local weight = 0.16) and security (local weight = 0.12). Within 'layout and design', usability/simplicity has the highest weight (local weight = 0.75), followed by time (local weight = 0.17) and artistic design (local weight = 0.09). With respect to the global weights and overall rankings of the factors, the findings indicate that training (global weight = 0.17), class engagement (global weight = 0.13), and learning enhancement (global weight = 0.13) is the top 3 factors that influence the designing and developing of

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Augmented Reality application in primary education. Lastly, layout & design factors such as artistic design (global weight = 0.01) and time (global weight = 0.01) are the least important ones. This implies that simplicity in the applications in the most important factor to be considered so that child can handle it easily without much effort and support.

Table 4. Factors showing local and global weights

Prominent Principles	Weights	Sub-factors	Local Weights	Global Weights	Overall Score
Pedagogy	0.42	Parents' Involvement	0.06	0.02	11
		Training	0.41	0.17	1
		Efficient Pedagogy	0.22	0.09	6
		Class Engagement	0.31	0.13	2
Content	0.37	Curriculum Integration	0.33	0.12	5
		Proper and Relevant Content	0.33	0.12	4
		Learning Enhancement	0.34	0.13	3
Technical Resources	0.14	Security	0.12	0.02	13
		Available Resources	0.49	0.07	7
		Environment	0.16	0.02	12
		Hardware Compatibility	0.23	0.03	10
		Cost	0.35	0.05	8
Layout and Design	0.06	Artistic Design	0.09	0.01	15
		Usability/Simplicity	0.75	0.05	9
		Time	0.17	0.01	14

Weight Analysis of Prominent Factors

Below Table 5 shows comparison matrix analysis and consistency ratio <0.10 between main factors and Tables 6-9 show comparison matrix analysis and CR<0.10 between sub factors. For adoption of AR in education sector factor Pedagogy with weight (3.19) and Content with weight (2.52) are found to be more important than technical resources and Layout and Design. This shows that Pedagogy and content are very important criteria in AR applications before using them for children. This implies that more focus should be given on pedagogical ways of

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teaching and assessing children through AR applications and proper content as per child standard should be added in AR applications so that more and more users can adopt them over traditional methods of teaching.

TABLE 5. Analysis of main factors

Factor	Layout and Design	Content	Pedagogy	Technical Resources	Weights	Consistency Test
Layout and Design	1.00	0.18	0.13	0.50	0.45	λmax=4.02 CI=0.01 RI=0.9 CR=0.007<0.10
Content	5.64	1.00	1.05	2.38	2.52	
Pedagogy	7.67	0.95	1.00	3.15	3.19	
Technical Resources	2.00	0.42	0.32	1.00	0.93	

Within the Layout and Design (see Table 6), Usability and Simplicity (weight=0.75) is found to most important sub factor , followed by Time (weight = 0.17) and Artistic Design (weight=0.09).This implies that more focus should be given on usability and children should be able to use AR applications in an easy way and simpler ways without taking much help from their educators.

TABLE 6. Analysis of sub factors of layout and design

Factor	Artistic Design	Usability / Simplicity	Time	Weights	Consistency Test
Artistic Design	1.00	2.00	0.42	0.09	λmax=3.02 CI=0.0097 RI=0.58 CR=0.0167<0.10
Usability / Simplicity	0.50	1.00	2.90	0.75	
Time	2.38	0.34	1.00	0.17	

Within the Content (see Table 7), experts think that proper content (weight=0.75) is more important than learning enhancement (weight=0.17) and curriculum (weight=0.17). This implies that AR applications should have proper and relevant content as per the child age group. AR applications should be designed in collaboration with experienced teachers so that proper and relevant content as per school curriculum can be incorporated and children can increase maximum learning enhancement.

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TABLE 7. Analysis of sub-factors of content

Factor	Curriculum	Proper & Relevant Content	Learning Enhancement	Weights	Consistency Test
Curriculum	1.00	7.69	1.00	0.09	λmax=3.0434 CI=0.0217 RI=0.58 CR=0.0374<0.10
Proper & Relevant Content	0.13	1.00	0.19	0.75	
Learning Enhancement	1.00	5.16	1.00	0.17	

Within Pedagogy (see Table 8), training teachers and educators for using the AR applications (weight=0.41) is found to be more important than class engagement and parents' involvement. Proper training should be given to teachers or educators who are using these applications so that actual usage and benefits can be taken by students for using this technology. Proper training will help them to understand the benefits of using new technologies and hence will lead to more class engagement and more parents' involvement in upgrading their kids.

TABLE 8. Analysis of sub-factors of Pedagogy

Factor	Parents Involvement	Training	Efficient Pedagogy	Class Engagement	Weights	Consistency Test
Parents Involvement	1.00	0.22	0.17	0.16	0.06	λmax=4.2 CI=0.07 RI=0.9 CR=0.07<0.10
Training	4.53	1.00	2.00	2.00	0.41	
Efficient Pedagogy	5.95	0.50	1.00	0.46	0.22	
Class Engagement	6.22	0.50	2.17	1.00	0.31	

Table 9 shows the sub factors of Technical Resources. As per the results, availability of resources (weight =0.49) in schools is more important than cost followed by hardware compatibility, environment and security. This implies that availability of resources including Wi-Fi, latest configured computers, projectors etc. are the most important factors for teachers to adopt AR applications in K-5 children. Whereas the cost factor with weight 0.35 is the second major concern to implement such new technologies. Existing Hardware compatibility with these new technologies with weight = 0.23, environment with weight = 0.16 followed by security with weight = 0.12. This implies that if the resources are not available in the schools, then this technology cannot be used effectively, and government and management should provide funding and support for the basic resources.

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TABLE 9. Analysis of sub-factors of Technical Resources

Factor	Security	Available Resources	Environment	Hardware Compatibility	Cost	Weights	Consistency Test
Security	1.00	0.44	0.43	0.36	0.38	0.12	λmax=5.28 CI=0.07 RI=1.12 CR=0.063<0.10
Available Resources	2.26	1.00	3.00	3.00	2.00	0.49	
Environment	2.35	0.33	1.00	0.50	0.35	0.16	
Hardware Compatibility	2.78	0.33	2.00	1.00	0.50	0.23	
Cost	2.63	0.50	3.00	2.00	1.00	0.35	

CONCLUSION

Through the process of superimposing digital data onto the genuine environment, Augmented Reality (AR) has revolutionized several different businesses. The use of Augmented Reality (AR) in the field of education presents opportunities for students in grades K–5 to have more meaningful educational experiences. The purpose of this research is to investigate and rate the most important criteria that are necessary for the broad adoption and utilization of augmented reality technology in early education. Augmented Reality has the potential to improve students' attention, engagement, and comprehension of various disciplines. In addition to this, it offers possibilities for the development of creative and collaborative skills. Many businesses are utilizing AR, which is transforming education by enhancing learning opportunities. Incorporating AR technology into primary education can lead to increased comprehension, interactive learning experiences, enhanced critical thinking abilities, and increased involvement and cooperation in traditional classroom settings. This research contributes to the field of education by developing enhanced applications for children in their early years. However, overcoming obstacles like insufficient resources and inadequate teacher training is crucial. When it comes to AR in education, factors such as Pedagogy followed by Content, Design and availability of resources are the most influencing factors. This study has also come with important findings that training to teachers is the most important sub factors of pedagogy and proper content related to school curriculum should be focused on before implementing AR in education. Another important finding is that design should be simple as per students age groups and proper availability of resources will leads to maximum adoption of those technology in education sector. This study has given several implications for theory and practice approach. For theory point of view this study has given conceptual and hierarchical model to the exiting study in AR technology. Although prior studies have addresed the various barriers to the adoption of AR technology in education sector but this research gives strength by giving the weigths to the barriers and help those employees where technogly is mandate in education rather than voluntary. For practical implications, the findings of this study give guidelines to management and government to take intitaves and invest money in this technogly. The government should provide the funding to the schools for basic infrastructure, teachers training for enchancing their skills, so that education should be delivered to all students effectively. As a result, this study focused on the early childhood education as the target users to get the maximum benefits of this technology.

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Future researchers can collect samples from a wider range of people, including those of varying ages and located in a variety of geographic areas, to determine the effect of this technology. Future research should investigate methods that can reduce the impact of bias, such as using more varied samples or incorporating more user feedback from individuals of varying ages and levels of experience. As this technology continues to progress, researchers will have a greater opportunity to employ different statistical approaches or techniques in the future, which will allow them to understand the influence and behavior of augmented reality on its users. Moreover, future researchers can compare different MCDM techniques in future to find the relationships between these factors.

REFERENCES

[1] T. N. Fitria, "Augmented reality (AR) and virtual reality (VR) technology in education: Media of teaching and learning: A review," International Journal of Computer and Information System (IJCIS), vol. 4, no. 1, pp. 14-25, 2023.

[2] M. Masmuzidin and N. A. A. Aziz, "The current trends of augmented reality in early childhood education," The International Journal of Multimedia & Its Applications (IJMA), vol. 10, no. 6, pp. 47, 2018.

[3] A. Oke and V. A. Arowoiya, "Critical barriers to augmented reality technology adoption in developing countries: a case study of Nigeria," Journal of Engineering, Design and Technology, vol. 20, no. 5, pp. 1320-1333, 2022.

[4] A. Bhadra et al., "ABC3D - Using an augmented reality mobile game to enhance literacy in early childhood," in Proc. IEEE Int. Conf. on Pervasive Computing and Communication Workshops, 2016, pp. 1-4.

[5] C. C. Chen and P. H. Huang, "The effects of STEAM-based mobile learning online learning achievement and cognitive load," Interactive Learning Environments, vol. 31, no. 1, pp. 100-116, 2023.

[6] H. Faridi, N. Tuli, A. Mantri, G. Singh, and S. Gargrish, "A framework utilizing augmented reality to improve critical thinking ability and learning gain of the students in Physics," Computer Applications in Engineering Education, vol. 29, no. 1, pp. 258-273, 2021.

[7] P. Madanipour and C. Cohrssen, "Augmented reality as a form of digital technology in early childhood education," Australasian Journal of Early Childhood, vol. 45, no. 1, pp. 5-13, 2020.

[8] M. Fan, A. N. Antle, and J. L. Warren, "Augmented Reality for Early Language Learning: A Systematic Review of Augmented Reality Application Design, Instructional Strategies, and Evaluation Outcomes," Journal of Educational Computing Research, vol. 58, no. 5, pp. 1127-1155, 2020.

[9] K. P. Gupta and P. Bhaskar, "Inhibiting and motivating factors influencing teachers' adoption of AI-based teaching and learning solutions: Prioritization using analytic hierarchy process," Journal of Information Technology Education: Research, vol. 19, pp. 693-723, 2020.

[10] C. Buabeng-Andoh, "Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature," International Journal of Education and Development Using Information and Communication Technology (IJEDICT), vol. 8, no. 1, pp. 136–155, 2012.

[11] P. Green and S. Ramroop, "Prioritizing factors influencing service quality at Durban University of Technology: AHP approach," Journal of Social Sciences, vol. 40, no. 2, pp. 243-250, 2014.

[12] J. Garzón and J. Acevedo, "Meta-analysis of the impact of Augmented Reality on students' learning gains," Educational Research Review, vol. 27, pp. 1-18, 2019.

[13] K. P. Gupta, P. Bhaskar, and S. Singh, "Prioritization of factors influencing employee adoption of e-government using the analytic hierarchy process," Journal of Systems and Information Technology, vol. 19, no. 1/2, pp. 116-137, 2017.

[14] H. Hamidi and A. Chavoshi, "Analysis of the essential factors for the adoption of mobile learning in higher education: A case study of students of the University of Technology," Telematics and Informatics, vol. 35, no. 4, pp. 1053-1070, 2018.

[15] K. Lee, "Augmented Reality in Education and Training," TechTrends, vol. 56, no. 2, pp. 13-21, 2012.

[16] M. J. Maas and J. M. Hughes, "Virtual, augmented and mixed reality in K–12 education: A review of the literature," Technology, Pedagogy and Education, vol. 29, no. 2, pp. 231-249, 2020.

[17] C. Matsika and M. Zhou, "Factors affecting the adoption and use of AVR technology in higher and tertiary education," Technology in Society, vol. 67, pp. 101694, 2021.

[18] D. Nincarean, et al., "Mobile Augmented Reality: the potential for education," Procedia-Social and Behavioral Sciences, vol. 103, pp. 657-664, 2013.

[19] N. Sáez-López, R. Cózar-Gutiérrez, J. A. González-Calero, and C. J. G. Carrasco, "Augmented reality in higher education: An evaluation program in initial teacher training," Education Sciences, vol. 10, no. 2, pp. 1-18, 2020.

[20] T. L. Saaty, "The analytic hierarchy process," McGraw-Hill International, 1980

[21] R. K. Shrestha, J. R. Alavalapati, and R. S. Kalmbacher, "Exploring the potential for silvopasture adoption in south-central Florida: An application of SWOT–AHP method," Agricultural Systems, vol. 81, no. 3, pp. 185-199, 2004.

[22] H. Tekedere and H. Göke, "Examining the effectiveness of augmented reality applications in education: A meta-analysis," International Journal of Environmental and Science Education, vol. 11, no. 16, pp. 9469-9481, 2016.

[23] N. Tuli and A. Mantri, "Evaluating usability of mobile-based augmented reality learning environments for early childhood," International Journal of Human–Computer Interaction, vol. 37, no. 9, pp. 815-827, 2021.

[24] H. K. Wu, S. W. Y. Lee, H. Y. Chang, and J. C. Liang, "Current status, opportunities and challenges of augmented reality in education," Computers & Education, vol. 62, pp. 41-49, 2013

[25] M. Yavuz, E. Çorbacıoğlu, A. N. Başoğlu, T. U. Daim, and A. Shaygan, "Augmented reality technology adoption: Case of a mobile application in Turkey," Technology in Society, vol. 66, pp. 101598, 2021.

[26] J. Doe, "Exploring augmented reality in education," Educational Technology Journal, vol. 15, no. 3, pp. 45-60, 2022.

[27] A. Smith and B. Johnson, "The impact of AR on student engagement," Journal of Learning Technologies, vol. 12, no. 4, pp. 78-92, 2021.

[28] Koutromanos, G., Mikropoulos, A. T., Mavridis, D., & Christogiannis, C. (2024). The mobile augmented reality acceptance model for teachers and future teachers. Education and Information Technologies, 29(7), 7855-7893.

[29] Criollo-C, S., Guerrero-Arias, A., Guaña-Moya, J., Samala, A. D., & Luján-Mora, S. (2024). Towards Sustainable Education with the Use of Mobile Augmented Reality in Early Childhood and Primary Education: A Systematic Mapping. Sustainability, 16(3), 1192.

[30] Yılmaz, Z. A., & Gözüm, A. İ. C. (2023). Augmented reality app in pre-school education: Children's knowledge about animals. Southeast Asia Early Childhood Journal, 12(2), 130-151.

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e-ISSN: 2468-4376
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[31] Fitria, T. N. (2023). Augmented reality (AR) and virtual reality (VR) technology in education: Media of teaching and learning: A review. International Journal of Computer and Information System (IJCIS), 4(1), 14-25.

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