REIMAGINING CONTENT: DYNAMIC AND CREATIVE IMAGERY FOR SPECIAL EDUCATION USING AR TECHNOLOGY

by

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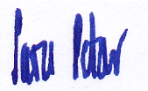

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Dedication

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It gives me great pleasure in writing this acknowledgment. I had been wanting to do my PhD. for many years and finally got to it at the age of 35. I am indeed privileged to have the support of friends, family, and colleagues in the pursuit of this great journey.

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ABSTRACT
REIMAGINING CONTENT: DYNAMIC AND CREATIVE IMAGERY FOR SPECIAL EDUCATION USING AR TECHNOLOGY

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Technology is the new teaching aid. The use of AR technology to enhance learning and engagement has increased tremendously over the years. However, in special education, technology and the use of digital devices are heavily encouraged in the classrooms to provide a deeper, more effective, and more wholesome experience for kids. Personalization for promoting inclusive learning using AR is also a growing area of interest in the learning skills domain. Individuals with special needs are identified to experience deficits in learning categorical vocabularies and using languages in different contexts. This includes learning many subjects, in particular Science and Math. Vocabulary acquisition is very important for independent living and literacy skills and science are considered valuable for individuals with special needs. Hence the requirement for better and more efficient AR imagery to enhance the learning of vocabulary for special students. This proposal looks into the creative quality of the images needed in language, particularly in learning new words for the special child. It delves deep into how language is interpreted by special children on how to bring effective dynamic imagery using AR into the space to make learning effective, simple, and engaging. Quality and type of imagery needed for such children, which

would induce better learning would be looked into, allowing us to create a metric system for the kind of images created for more engaging learning. This could be a set of guidelines for AR image creators for special education purposes. This would not only help educators in classrooms but also help learning and development centers devise more apt learning programs for disabled students using AR tech.

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INTRODUCTION

1.1 Introduction

Education has long been a hot matter of debate among many people. Many of us attribute our success to the manner we were taught or the types of professors we had. However, a sizable portion of the population claims that their current status has nothing to do with the knowledge they acquired during their schooling and college years. We also find that education systems vary greatly around the world, and there are numerous systems within the country as well**.** Is one system better than the rest? Would combining systems work out better overall? Would such systems cater to new-age learning? These are some questions we must ask ourselves as we delve deeper into the learning space.

1.1.1 The Education and Tech playground: Survey Insights, Infrastructure, and Impact

The Center for Universal Education, an institution to improve education worldwide, uses surveys to inform education ministries about local technology use and requirements. Most sectors have been changed by technology, but education has not. Technology should boost instructors' efficiency and content. Ed-tech interventions can alter instructional cores in different systems.

Technology infrastructure and tech-savvy teachers help students study. Educational systems should use internal evaluations, international learner assessments, and student, instructor, and school leader surveys to obtain fresh data. Because no "ed-tech" project works everywhere, policymakers should focus on four ways technology might increase student learning. Cohen and Ball (1999) reported that video lectures met numerous needs in 37 ed-tech intervention studies from 20 countries. They examined general and ed-tech evidence evaluations and their cited papers. Twenty nations provided 37 studies. Technology can assist educators deliver standardized, high-quality information, facilitate remote learning, and distribute preloaded

instructional hardware. Brief instructional films enhanced independent assessment but not high-stakes tests. One study indicated that audio and written resources can improve learning, especially if traditional instruction is poor.

Technology aids remote pupils. Live teaching in rural Ghanaian primary schools improved numeracy and literacy without affecting attendance or class time. Mexico's 1968 staggered deployment of telesecundarias (middle schools with satellite TV classes) boosted graduates' education and income according to the study by Fabregas et al. (2019). Technology could improve word processing, reference materials, games, and student-teacher interactions. Beijing researchers provided third-graders free laptops with remedial software. Arithmetic and computing improved according to the study by Di Mo et al. (2012).

Research found laptops taught youngsters more than textbooks. Laptops are too pricey for students. Software-enabled tablets are promising yet restricted. De Hoop et al. (2020) studied a composite intervention for first-graders in Zambia's Eastern Province that improved reading, spoken language, and numeracy. Technology simplifies differentiated learning, improving education. Students practice at their own pace. Technology can teach students basic skills. CAL software often differentiates only coarsely. Computers improve math and language. Banerjee et al. (2007) tested CAL software in Vadodara, India, whereas Muralidharan et al. (2010) tried blended learning in Delhi which proved to be beneficial in the long term learning process.

Technology helps pupils practice. This helps students who didn't understand the lecture understand homework. Technology helps pupils apply classroom knowledge. Poor countries demonstrate this technology's potential and limitations. In conclusion, engaging students with self-paced video classes, gamifying tasks and regular student assessments done can improve education.

1.1.2 Energizing Learning

Technology can improve student effort and comprehension by engaging delivery methods. Two recent Khan Academy site ratings provide instructional video efficacy insight. After-school, offline Khan Academy sessions, teacher-led regular courses, or equivalent lessons helped by technical supervisors without subject expertise enhanced student performance in 302 elementary schools in Morazán, El Salvador. Studies suggest Khan Academy's diversified teaching works better than instructional videos. Games make learning fun and competitive. In Santiago, Chile according to study by (Roberto Araya , 2018), gamification reduced arithmetic fear, increased motivation, and increased peer collaboration. To increase school technology use, we must first examine current practices and technological acceptance hurdles. Technology enhances student learning by providing quality content, individualized instruction, practice, and engagement. High-quality materials, appropriate practice, and entertaining components like movies or games should help youngsters master core abilities by ten with educational technology. Approach determines education technology reform success. Assess how technology will affect students, instructors, and parents before implementing. Technology programmes succeed when instructors, school authorities, parents, and students communicate. Addressing concerns and putting teacher requirements into programmes helps.

1.1.3 India and Technology

Technology and the internet allow India to give homeschooled kids online education. The Internet expanded students' education. Smart courses, social media, online learning, and remote learning have changed how Indian schools teach pupils. According to the World Economic Forum and The UNICEF Global Annual Results Report 2020, these technologies aid and speed up studying and allow parents to track progress. Educator-created video lessons help students, educators, and management learn quicker and smarter. Technology's many learning alternatives make kids' lives easier.

Many institutions in India are utilizing technology to make education more appealing.

Technology-assisted instruction helps students grasp curriculum, instruction, and pedagogy. Learning outcomes require collaboration across education value chain stakeholders. Community involvement in school management boosts ICT use and accountability for student learning and resources. Education technology requires a comprehensive perspective. This includes improving teaching ability, attitudes, community buy-in, and technology.

Three Indian organizations improved student learning with technology. These organizations provide low-bandwidth online and offline content. The Indian Organization Pratham works with communities, students, teachers, parents, and youth to improve education. Teaching at the Appropriate Level and Annual State of Education Report are unique. TaRL boosted India's kids' essential skills. India reached 30 million children between 2005 and 2008. Pratham's TaRL intervention uses CAMAL and basic course and evaluation mobile apps. Pratham's municipal school CAL programme was short-lived. The organization handed youngsters tablets outside of school and empowered communities to educate their children. Retail fundraisers, Self-Help Organization microloans, and youth organizations fund Pratham's hybrid learning kit. Pratham helps governments increase learning, but it also observes unlearning due to kid resistance. Pratham's community-based approach supported the COVID-19 pandemic's first year. Pratham's Hybrid and Open Learning programmes and open repository helped kids learn.

Educational Initiatives (EI) created Mindspark, a low-resource technology-assisted instruction-based personalized adaptive learning (PAL) application. 350,000 Indian government school students used it. EI's LSEPs help teachers identify misconceptions and critical learning gaps and provide worksheets and lesson plan ideas. Actionable data promotes curriculum changes, systemic assessment, and question generation. EI's evaluation, question-making, children's misconceptions, and educational research shaped Mindspark.

TIDE Learning uses MDML for whole-ecosystem learning and teaching. To improve classroom practices, TIDE supports tablet-based self-paced learning for youngsters. Three years of rigorous teacher training teach excellent pedagogy. TIDE schools educate culture and history

through role plays. Social-emotional skills and class participation are promoted.

India's development collaboration can enhance EdTech. India must create systemic capacities in countries to maintain education technology (ET) ecosystem projects, alongside partnering with entrepreneurs to increase the scope of Ed Tech start ups in the Indian and international domain.

1.2 Research Problem

In the paper 'A Decade of Research on the Effectiveness of AR on Students with Disabilities' (Malek Turki Jdaitawi, Ashraf F Kan'an, 2021), it has been seen that the use of AR has indeed been effective in the disabled sector but has not been used widely enough due to issues such as teacher adaptability, costliness of products, improper teaching environment, lack of interest of teachers to use tech aids, and payroll issues. While talking to special educator, Trishula Jala, in India, it was learnt that special educators are taught to teach different kinds of students who have certain disabilities - from dyslexia to autism to even deafness and dumbness. According to the research paper 'Challenges students identified with a learning disability when using visualization techniques' (Delinda Van Garderen, Amy Scheuermann, Apryl L. Poch, 2020), it was determined that disabled children face a great challenge when it comes to visualization, hence the use of graphs, charts and diagrams that might be a useful aid to a non disabled person, proves to be very tough to comprehend for them. On questioning Trishula further about the impact of the AR on teaching such children, the response received from them was that the children had a weak sense of creative expression and visualization**.** Hence AR could act as an aid to bridge the barrier for the disabled kids by using simpler and more effective visualization techniques that could aid learning.

Autistic children have problems with social affliction. According to 'The fundamental movement skills in children with autism spectrum disorder: A systematic review' (Aditi Gandotra et al., 2020) autistic children suffer from developmental disability caused by differences in the brain. People with ASD often have problems with social communication and interaction, and restricted or repetitive behaviors or interests. People with ASD may also have

different ways of learning, moving, or paying attention. They generally don't maintain eye

contact with people they are interacting with, but according to Trishula, this does not mean that they are not paying attention. In fact, the child could have a greater IQ but their creative thinking skills would be damaged. They like the AI and AR world more to accentuate their sense of expression, visualization and imagination. According to Augmented Reality Education Tool for Children with Learning Disabilities - (Darsheeka Bipin Singh et al., 2015), AR tends to increase the imaginative capacity of the disabled child and encourages lateral thinking.

Trishula reiterated that a lot of vocational and life skill training has to be done for the kids, which would prove very useful. She also mentioned that in Mumbai there is a school that has been built specifically for special kids, there are special buildings that would allow for a more immersive experience for special kids.

Dyslexia - This was also a topic that was touched upon. According to the paper Difficulties in English Language Learning for Students with Dyslexia (Alma V. Lama, 2019), dyslexia makes it hard to recognize and use the sounds in language. Kids might reverse letters, like reading pot as top. Or they might have trouble sounding out new words and recognizing ones they know. Having dyslexia does not mean your child isn't smart. With the right support, dyslexic kids can learn to read and do very well in school.

The research has shown that dyslexia happens because of a difference in the way the brain processes information. Pictures of the brain show that when people with dyslexia read, they use different parts of the brain than people without dyslexia. These pictures also show that the brains of people with dyslexia don't work efficiently during reading. So that's why reading seems like such slow, hard work.

The kids find a lot of difficulty in spelling. There are certain sets of words that the kids find tough.

The E is silent in the words below which the child finds tough.

1. HOME
2. TAME
3. GAME
4. SOME

Below is the discovery of the double L at the end of the word.

SPELL, TELL, BELL, WELL, SHELL

Trishula mentions that repeating while teaching is what drains the teacher the most so if there is a way of allowing AR to reiterate the learning, it would be very helpful for the teachers. According to 'Augmented Reality (AR) in Language Learning: A Principled Review of 2017-2021' (Nermin Punar Ozcelik et. al, 2021), the use of AR in language studies for children would prove to be a reinforcement to what is being taught in the class. Pure AR usage for language studies would not provide a wholesome learning experience for the disabled students as the students need more repetition, human aid, and assessments to make the learning more holistic. **Hence, we look at AR as a sense of reinforcement as opposed to learning itself. The dynamism through AR can act as a reinforcement as opposed to an incentive.** An example of this could be that of an animated character coming on screen to compensate the child for the good work or learning that has been done. We also discussed language and how learning of a simple word could be done through iteration. Eg. Reading the word CAT, AT words would be looked at first, like B- AT, H- AT, and the C- AT would be discovered through the process. The above word would be taught using normal flash cards. Writing the word would be the next step. It was also noted that complex words were more tough for the child to imagine. Eg. Volcanoes, cyclones, and the solar system. The idea of rotation and revolution were not simple terms that could be understood by the child and accounted for. The teachers need to make the kids dramatize it and showcase it by making the kids act out a sun, moon and planets and then explain the terms or use you tube for the same. But this acts as a big burden to the teachers and

if we could immediately have some sort of dynamic image that pops up when a complex word is read, it would be easier for the teacher and faster to grasp and understand for the child.

Rhymes with AR:

According to research paper ‘Rhyming the Rhyme: Rhymes and Songs as Inputs and Instruments for familiarizing Children with the English Language’ (Ramanujam Meganathan, 2016) the use of rhymes, songs and adding movement based techniques to language learning proves to be an effective technique for children to catch onto concepts quicker.

Trishula also reiterated the need for songs and rhymes in the space which could be of great help for the special kids. **Using AR to visualize these rhymes, possibly bodily movements that the child can imitate can be a good learning aid for the kids.**

The ability to incorporate AR in worksheets is also a possibility. The need for the dynamic imagery in the test system could make testing more enjoyable and less daunting for the kids. The kids would be looking forward to the assessments as opposed to being scared. The dynamic imagery would also make it more engaging for the kids and easier to recall concepts during the assessments.

1.3 Purpose of Research

Research Goals

Applying the following approach to special schooling is crucial.

Augmented reality settings help kids with special needs develop independent living skills, reduce behavioral issues, and improve academic performance, excitement, and readiness by immersing them in real-world situations (Recep Kakir, Ozgen Korkmaz, 2018). Users experience virtual reality fully. AR overlays real-world components with digital ones. Students can observe AR lessons. This is crucial because some special needs kids don't like new places. AR would let the particular youngster learn with the teacher's guidance in a safe real-world environment, while VR can scare them.

AR Developments in Education: A Comprehensive Overview of Research and Uses (Bacca Acosta, Jorge Luis, 2020) says an AR software may add 3D graphics, films, and audio to books and other printed materials. It may also allow educators to simplify content for visually or hearing-impaired students. AR-based personalization for inclusive learning is also increasing. Augmented reality in special education: a meta-analysis of single-subject design research (Reem Baragash, Hosam Al-Samarraie, 2018) discusses how AR helps special children with social, physical, and daily living abilities. The study found that special needs persons struggle to develop communication and social skills in the social skills area (Walton and Ingersoll 2013). In this category, problems are usually noted with intuitive comprehension, social situations, understanding others' actions, initiating and maintaining conversations, and making acceptable eye contact (Lorenzo et al. 2019). So, novel technologies can improve their social abilities and promote positive behavior by helping kids recognise facial expressions, focus on nonverbal social cues, understand social relations, and acquire acceptable greeting replies (Escobedo et al. 2014; Wu et al. 2013). Many special needs individuals struggle with daily living skills, limiting their self-determination and quality of life (Cannella-Malone et al. 2011). AR technology can enable special-needs people to regulate their surroundings and live freely in the community (Chang, Kang, and Huang 2013; Chang, Chang, and Liao 2014). (Cihak et al. 2016; McMahon et al. 2013).

Navigation tasks and bodily movement interactions are among the physical skills that disabled people must learn. The literature suggests that AR can help people with cognitive and developmental difficulties execute some physical activities (Hervás, Bravo, and Fontecha 2014). Innovative technology to teach how to navigate or relocate may lessen social isolation and foster interactions among disabled people (McMahon et al. 2015). Because of their visual information needs, developmental impairments necessitate physical movement in AR (Antonioli, Blake, and Sparks 2014).

Special needs students struggle with categorical vocabulary and language use in different

circumstances. This includes learning new language, science, and math (Cakir and Korkmaz 2019; Kellems, Cacciatore, and Osborne 2019). Literacy, science, and vocabulary are essential for autonomous life for special needs individuals (Browder et al. 2012). Hence, AR can help disabled people learn skills, motivate them, and grasp information (Cakir and Korkmaz 2019).

1.4 Significance of the Study

We have all witnessed the technological revolution. Youtube, apps, and more aid learning. Advanced schools have textbooks, workbooks, and smartboards.
Traditional classes lack technology. Some schools cannot afford them. Schools discourage excessive films and tabs. Digitization still worries many conventional schools. They prefer textbooks, workbooks, and possibly hands-on learning to excessive digital aids. Technology and digital gadgets enhance learning in special education.
Two literature review points suggest AR-based personalisation for inclusive learning is growing. Exceptional needs pupils struggle with categorical vocabulary and multilingualism. New language, science, and math are included (Cakir and Korkmaz 2019; Kellems, Cacciatore, and Osborne 2019). Reading, science, and vocabulary help special needs people live independently (Browder et al. 2012).
Language imagery is important for vocabulary learning, especially for exceptional children.

1.4.1 AR school challenges

According to the paper Challenges, Analysis for Using Augmented Reality in Education: A Review (Ghailan A Al Shafeey , Muhammad Modi Bin Lakulu, 2020) and Educational Augmented Reality Technology for Language Learning and Teaching: A Comprehensive Review (Cemil Gökhan Karacan , Kemal Akoğlu, 2019), it has been observed that the following reasons are causing issues in the space of using AR in the education space specifically for language studies.

1. Insufficient teacher training

2. Not breaking from traditional methods of teaching

3. Institutional neglect.

4. Salary issues for teachers causing disinterest in adapting to new teaching methods

This mechanism teaches technically. Instructing instructors on the importance of employing such a mechanism and making it easy to use in classrooms can do this. Teaching-wise, AR must be consciously and developmentally aligned to the topic, lesson, etc. Technology should aid study, not impress. AR's classroom challenge is accessibility. All kids, regardless of socioeconomic background, need AR's expensive hardware. Few can afford a nice phone.

1.4.3 Special education AR demand

According to the paper 'The effectiveness of augmented reality environments on individuals with special education needs' (Recep Cakir,Özgen Korkmaz, 2019), the use of AR in the field of special education can prove to be extremely beneficial.

Customization is important to special education because kids with special needs have varying abilities, limitations, and interests. Using AR, educators have the potential to accommodate the individual learning styles and limitations of special needs students. Furthermore, AR democratizes special needs learning.

a)AR communication

Words and static images lose meaning. A more creative medium could address this critical challenge educators encounter daily.

Augmented reality visualizes difficult concepts. 360-degree 3D viewing. It may instantly captivate younger students.

b) Engaging AR

Teachers wanted VR and AR in the classroom in a June 2016 Samsung poll - https://insights.samsung.com/2016/07/26/immersive-vr-for-education/. It's reasonable since 86% of teachers think it's hard to keep children motivated, especially with modern technology. AR improves classroom engagement. Entertaining activities might get pupils moving. AR can be utilized in the classroom to create interactive games and quizzes, provide educational models, and enable students to create 3D things connected to the subject. Creative learning accelerates and improves student learning.

c)AR investigating

AR can be used on field trips and other learning activities with a smartphone or tablet. Museums, galleries, and historical places can integrate material. Virtual journeys to Mars or underwater can help kids. Engaged students learn quicker with experience-based learning.

1.5 Research Purpose and Questions

A descriptive research approach was used to describe the characteristics of classroom engagement methodologies. A descriptive survey study assessed the conceptual framework. The study examines how student, instructor, and management traits affect class involvement and student receptivity. The AR prototype was tested in schools to see if it improves student engagement and learning.

Anonymized questionnaires and semi-structured teacher and school management interviews were employed. This provided numerical measurement and in-depth research for prototype creativity. The prototypes were tested on children of equal gender. In-classroom observation and answers to survey questions were employed. This was done across 5 boards- ICSE, CBSE, IGCSE,Stateboard, IB board.

Since this was a hands-on prototype that had to be evaluated, schools were visited to observe

classroom engagement scenarios to gain insights. The following questions were asked.

1. Would we require training programs to clue in teachers on how to use the AR interface?

2. Could we imbibe some sort of speech recognition so as to understand if the answer the child has given is right or wrong, and reward the child if so?

3. Which type of AR do we use?

- Marker-based Augmented Reality– It triggers an augmented experience for users. Generally, it comes in use for retail and marketing purposes.

- Marker-less Augmented Reality– It is a more advanced AR type. It enables users to place the virtual object wherever they want.

- Location-based Augmented Reality– Next, this AR-type combines the virtual content to the generated experience for a particular area.

- Superimposition Augmented Reality– It recognizes the given object in the real space and enhances it to provide an alternate appearance.

- Outlining Augmented Reality– It can identify lines and boundaries in areas that the human eye can't find.

4. Is there a possibility of incorporating VR alongside the AR experience?

5. Is there a way of self-learning that can be induced using AR for the child with minimal intervention of the teacher?

6. How much teacher intervention or aid is needed when AR learning is used?

7. Can we build a storyline where there is a learning curve in the process?

8. Can we have maps or large physical imagery mat over which the child can crawl on the AR can be initiated by the teacher?

9. Would the use of character cards aid the likeness of the game for the children?

1.5.2 Business related questions - product front:

- What is the range of AR opportunities in the industry, and in what sequence should they be pursued?
- How will AR reinforce a company's product differentiation?
- Where will AR have the greatest impact on cost reduction?
- Should the company make AR design and deployment a core strength, or will outsourcing or partnering be sufficient?
- How will AR change communications with stakeholders?

CHAPTER II:

REVIEW OF LITERATURE

2.1 Theoretical Framework

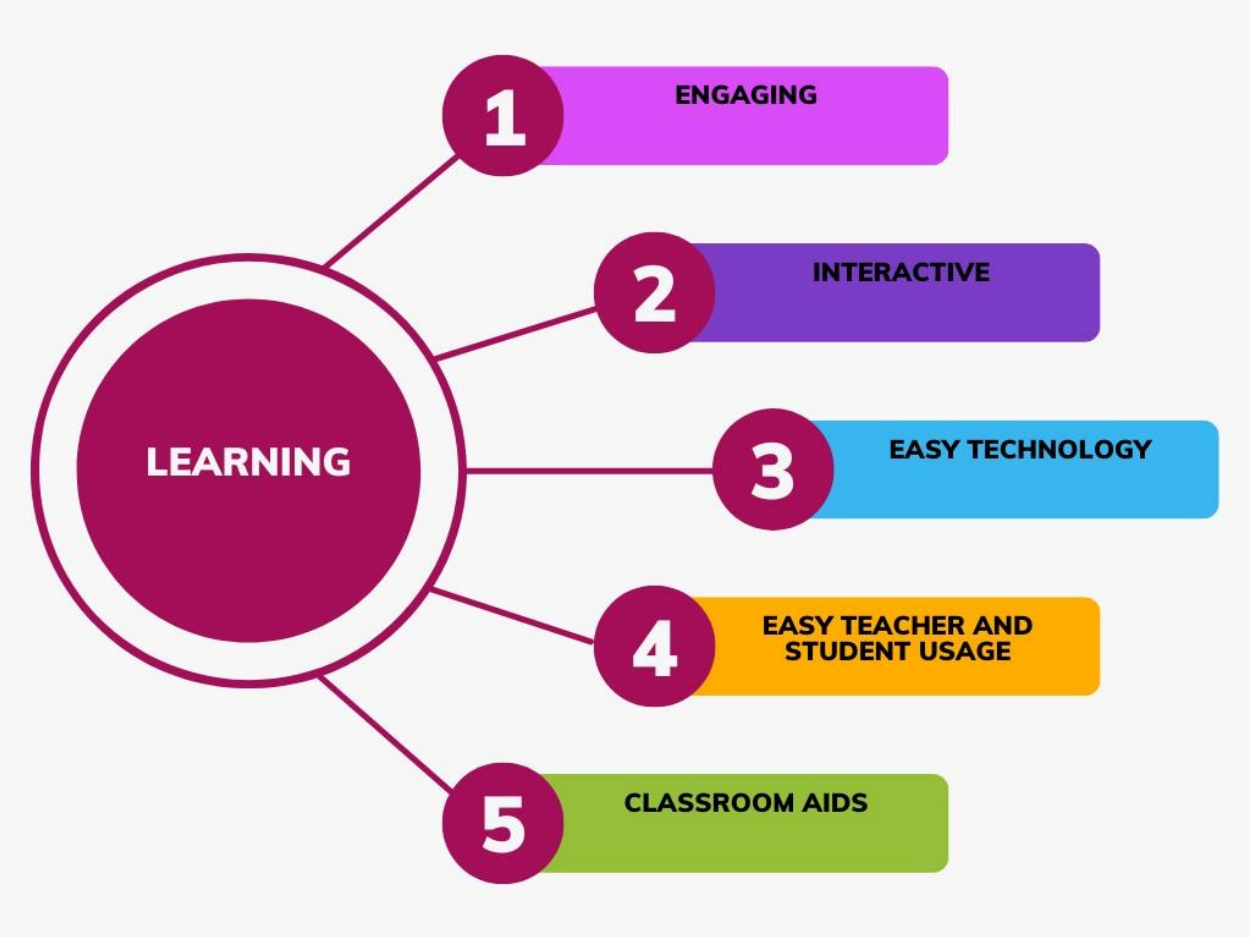

Figure 1.1 Learning Process Needs

By developing new and more engaging methods of delivering material, technology can increase learner effort and understanding. However, there is little evidence on the effectiveness of instructional videos, but two recent evaluations of the Khan Academy portal provide some insight. Students performed better when they received teacher-assisted Khan Academy lessons, teacher-led regular lessons, or similar lessons assisted by technical supervisors with no content expertise in an after-school, offline delivery of the Khan Academy portal in 302 primary schools in Morazán, El Salvador. According to studies, instructional videos work best when

used in conjunction with regular instruction, but the effects of Khan Academy may also be due to its ability to provide differentiated instruction. By presenting exercises as games and encouraging learners to play and compete with others, games can increase learner engagement. In a study conducted in Santiago, Chile, -'Does Gamification in Education Work? Experimental Evidence from Chile' (Roberto Araya, Elena Arias Ortiz , Nicolas Bottan, 2018), gamification increased learner motivation and effort while decreasing math anxiety and decreasing learners' willingness to collaborate with peers.

To increase technology use in schools, we must first understand current practices and potential barriers to technology adoption. According to 'Augmented Reality in Education: Current Status and Advancement of the Field' (Matjaž Kljun, Vladimir Geroimenko, Klen Čopič Pucihar, 2020), when technology is used to increase access to quality content, facilitate differentiated instruction, increase opportunities for practice, or increase learner engagement, it has the potential to accelerate student learning. To ensure that students excel in foundational skills by the age of ten, educational technology should provide high-quality materials, ample practice opportunities, and engaging materials such as videos or games. The approach to education technology reform can have a significant impact on its success. It is critical to consider how technology will affect learners, educators, and parents, rather than imposing programs on them. To ensure that technology programs work as intended, it is critical to communicate with a wide range of stakeholders, including educators, school leaders, parents, and students. Good communication can assist in addressing concerns and ensuring that programs are informed by the needs and concerns of educators.

2.1.2 A brief explanation of the use of technology specifically in India

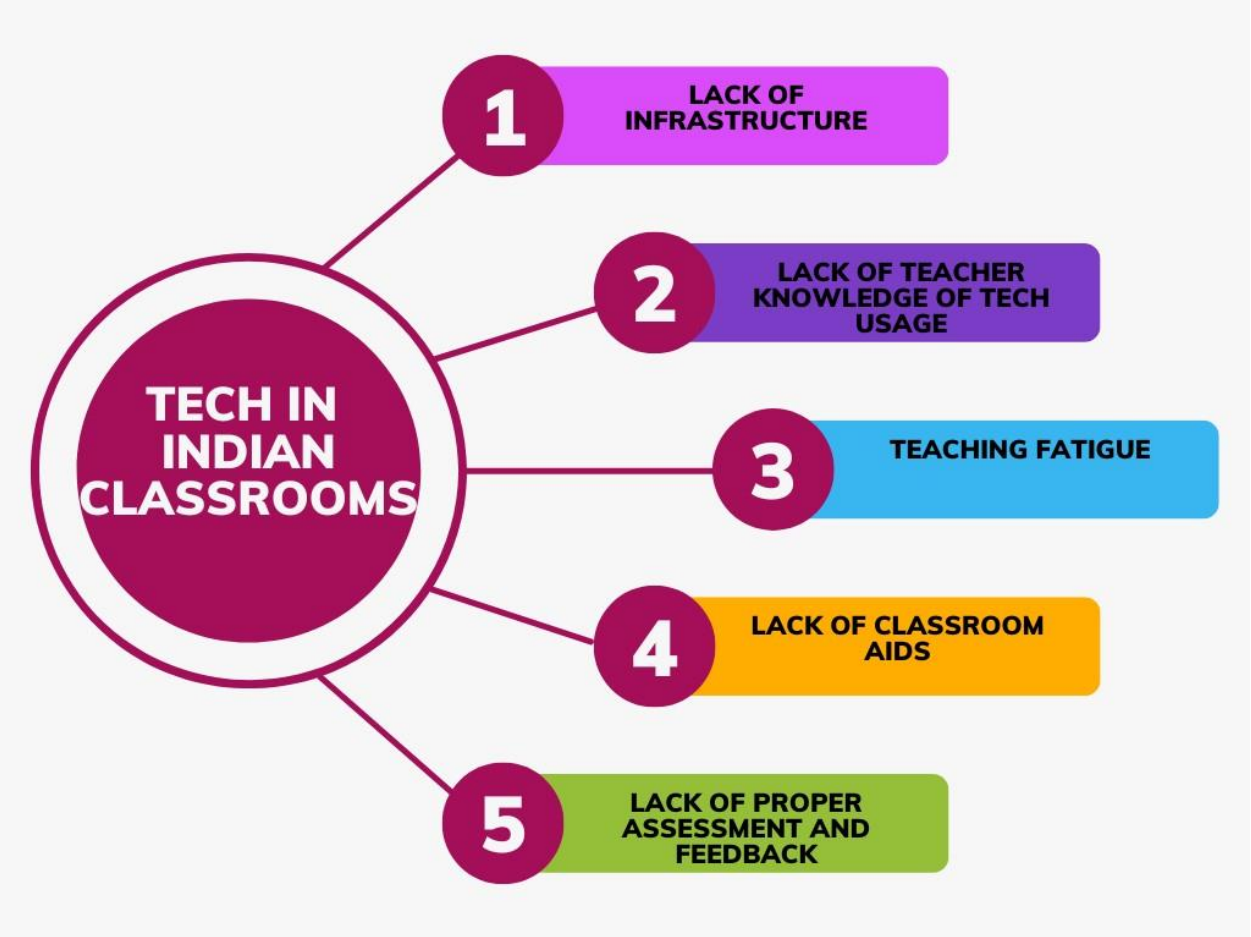

Figure 1.2 Tech in Indian Classrooms

The Indian education system is one of the world's oldest. With the recent advancements in technology and the internet sector, India is now able to provide education online to students who are unable to attend school. Previously, the educational system relied heavily on books and a chalkboard classroom, but the Internet-enabled students to gain in-depth knowledge.

Smart classes, social media, online learning, and distance learning are just a few of the technologies that have changed the way children are taught in Indian schools and colleges. These technologies allow students to learn more quickly, and parents can track their children's progress.

With the help of video lessons prepared by educators, technology has helped students, educators, and management become smarter and learn faster. Technology has also made

children's lives easier by providing a variety of learning opportunities.

In the last 4-5 years, India's education system has grown tremendously, and more schools are incorporating technology to make it more appealing. According to a report by EBEF, the Indian EdTech industry was valued at US$ 750 million in 2020 and is expected to reach US$ 4 billion by 2025 at a CAGR of 39.77%. According to the paper “Rise of EdTech StartUps in India’ (Sikandar M.A., 2022) and ‘Future Scope of Ed Tech Industry in India’ (Priyanka, Mohnani, 2022), the adoption rate of ed tech is expected to increase by 45% to reach 900 million by 2025 due to higher adoption rates in rural and small towns in the country. The widespread use of mobile devices and the internet in rural areas will make it easier for edtech companies to reach a larger customer base and scale their operations.

Such technology-assisted instruction can aid in the bridge between student learning levels and curriculum, instruction, and pedagogy. The education value chain is made up of various stakeholders, all of whom must work together to achieve successful learning outcomes. Community participation and ownership in school management improve accountability for student learning outcomes and school resources while also increasing the use of ICT in education.

The challenges of adopting and scaling up education technology necessitate the resolution of a whole philosophy. This includes developing teacher capacities, changing teacher attitudes, ensuring community buy-in, and providing continuous technical support.

2.1.3 Background: The Value of AR in Education

In addition to videos, gamification, and other tech applications in the Education space, Augmented Reality (AR) can enable teachers to present virtual illustrations of topics and incorporate game components to provide textbook material assistance, making classroom teaching more spectacular and interactive. This will allow kids to learn and memorize knowledge more quickly. Visuals are difficult to forget in human memory. According to ‘A

Review of Research on Augmented Reality in Education: Advantages and Applications' (Nor Farhah Saidin, Noor Dayana Abd halim, Noraffandy Yahaya, 2015), AR has been used across various spaces in the education space. Below are top examples of the same.

Here are some educational Augmented Reality examples:

Users can view 3D dinosaurs by scanning through a collection of flashcards in an AR app named **"Dinosaur 4D+."** Students may see dinosaurs in action and use the app's rotating, zooming, and other functions. In addition, the app provides basic information about each dinosaur.

Another potential example of Augmented Reality in education is the **"Element 4D"** AR software, which makes learning chemistry enjoyable. By simply placing two paper cubes for a special element block, users can find the atomic weight, chemical elements, the reaction between two chemicals, and their names.

Google Expeditions, which allows users to see 3D objects in the classroom such as volcanoes, hurricanes, and even DNA, is another admired example of AR/VR in education. AR programs offer over 100 augmented reality trips covering topics such as technology history, the moon landing, and more.

From the examples given above, it is evident that augmented reality in education has the potential to be a very interesting and effective intervention that will transform education for at least the next 100 years. This will not just affect basic education; it will also affect higher education and training institutions.

Business Trends and Patterns:

USE CASE 1:

The notion of MR (meta reality - virtual + existing reality) led by AR can allow astronauts to receive real-world training and perform duties such as space station maintenance**.** This allows immersed and engaged learning not only at a school level but also at higher professional levels.

NASA's Sidekick project is putting Hololens to the test in order to provide visual graphics and instructions for crew training. Overall, the biggest draw is its application in military training, since it can teach soldiers how to handle equipment in a virtual setting. This is done to keep soldiers from putting themselves in danger while training. AR has been a game-changing innovation. Let's observe how its popularity in eLearning applications has accelerated in 2020-21.

USE CASE 2:

Keeping pupils engaged in lectures is becoming more challenging now that they must learn from home. As a result, eLearning software developers are eager to embrace AR technology. Overall, the advancement of Augmented Reality is increasing its market share.

AR-enabled eLearning programs display the augmented object on the screen and provide 3D examples of ideas for students to study and engage with. Overall, computer graphics are heavily used, allowing an object to be collected and displayed in the augmented environment, as well as rendering searches regarding the object. It implies the app can take a picture of an object in the real world and describe it in great detail. You can also design your own AR-enabled eLearning programs with a unique concept.

In the field of education, augmented reality offers various desirable benefits, including:

A System for Quick and Effective Learning

In education, augmented reality allows pupils to learn through rich visuals and immersion in the subject matter. Furthermore, speech technology engages pupils by giving detailed information about a topic in a voice format. **In a nutshell, the concept of eLearning with AR appeals to a key human sense of information acquisition.**

Anytime, Anywhere Access to Learning Materials

Textbooks, tangible forms, posters, and printed brochures can all be replaced with augmented reality. Mobile learning also lowers the cost of learning materials and makes them more

accessible to everyone.

Practical Immersion Learning

It can also aid in professional development. Imagine being able to prepare meals or pilot a space shuttle without endangering others or wasting millions of dollars.

Engage students and pique their curiosity

The gamification of AR and the educational system has the potential to improve student attitudes. It promotes teamwork and capabilities while making learning fascinating, entertaining, and effortless. Furthermore, it offers numerous chances to make lectures more enjoyable by including unparalleled involvement through a computer-generated environment. Students participate in eLearning in an upgraded environment where they may observe how concepts are implemented. Companies engage developers skilled in AR development to create such applications.

By altering the entire learning experience, Augmented Reality has the potential to revolutionize the existing educational system. Overall, it will increase student interest and efficiency. This will also aid students in comprehending concepts in an immersive environment, simplifying concepts and facilitating learning. Furthermore, by providing an exceptional learning experience through technology, educational institutions would attract enormous attention.

Teachers are the common element in every different educational system, and can affect the integration and acceptance of technology in education. 'Augmented Reality Applications in Education: Teachers Point of View' (Stavroula Tzima et al, 2019) examines the feasibility of AR applications development by teachers and students in school settings. Augmented reality (AR) is a technology that combines the real and virtual worlds at the same time, and allows the user to interact with digital information in a way that makes it appear to be part of the real environment. So, it is a necessity that teachers facilitate this process in a constructive manner. The study focused on augmented reality (AR) technology in recent years. Studies on educational

use of AR have steadily increased since 2007, dramatically increased since 2011, and intensified in 2013 - 2017.

The study focuses on educational use of augmented reality (AR) in all educational levels, including early childhood education, primary and secondary education, university students, adult learners, elderly people, technical and vocational higher education, and students with special needs and how teacher;s perceive technology to be inside the classrooms. They concluded that AR can improve learning motivation and effectiveness as long as the right training is given to the teachers and they are enthused enough to use such aids in the classroom effectively.

2.1.4 Technicalities of AR Implementation: Cause and Effect Analysis

According to 'Augmented Reality as E-learning Tool in Primary Schools' Education: Barriers to Teachers' Adoption' (Mona Alkhattabi, 2017), the barriers to AR adoption include financial cost, lack of tools designed for education, and the lack of built-in monitoring features and assessment tools. Among other features, an ideal AR development platform should contain easy-to-use authoring tools and visual programming environments. For conducting a survey in the class context or in the natural environment, difficulties and limitations must be addressed. These include adequate technological equipment, trained educators, student willingness, school administrations' collaboration, additional lecture time, a small research sample, limited research duration, and use of the application as an information tool. The development of an AR experience is a time-consuming and complex process that requires more than one instructor, skilled instructors, computer specialists, and the use of software for image and video editing and computer graphics creation. This is because teachers are more pedagogically trained than ICT experts. Technical problems and pedagogical issues were overcome by the evolution of technology and the transformation of pedagogical practice, and social acceptance would be a more challenging factor than expected.

The research paper examined issues of diffusion of AR technology, need for continuous

training, 3D modeling, teachers' and students' involvement in AR applications development, and factors that can affect AR application development in school settings. A semi structured interview guided by a questionnaire and the technique of observation were used to interview secondary education teachers in North-Western Greece. The questionnaire included five sections, including questions about teachers' profiles, the diffusion of AR technology, the need for continuous training, 3D modeling, and students' involvement in AR applications development. Teachers were given four sections to respond to, and were then informed about AR technology. They were then given unlimited time to express their views. For the current research, a non-probability sample of 20 teachers was selected based on purposeful random sampling. The data was processed using content analysis and presented in diagrams and tables. A random sample of 20 teachers, 13 women and 7 men, working in secondary education with different specialties and diverse teaching experience was studied. 70% of participants had been certified on ICT skills, 90% use some social media networks, 20% create their own material, and 60% sometimes create material. Based on the answers presented in Table 5, no diffusion of AR technology in teaching was observed, but 50% of the participants state that they have read or heard something about it. Teachers who have traveled abroad for personal reasons or in the context of educational visits had experience of AR technology. Teachers were asked how they were informed about seminars and training. Just over half stated that they were informed systematically. The most important factor for attending a seminar is personal development, followed by professional development. Three out of 15 participants selected personal development as the only reason for training. Most participants considered the available time as the most negative factor in attending a seminar, while financial cost, time of conducting a seminar, and program subject were also important factors. The participants felt that continuous training was necessary because of the rapid changes in technology and the social demand for effective professionals. The researcher observed that a strong personal motivation (personal development) overcomes negative factors (P8 - chemistry teacher, P11 - ICT teacher), and that

although teachers have a positive attitude towards training, the lack of utilization of the already acquired knowledge in teaching ultimately works as a negative factor.

2.1.5 Deeper Findings:

From the above research by (Mona Alkhattabi, 2017), 70% of the participants stated they have never created a 3D model, 10% had created one or two, 5% moderate, 10% enough, 5% very, and 0% had no interest in training in the use of AR.

45% of the teachers mentioned at least one 3D design tool that they know and could use to create digital 3D models.

Participants had mixed feelings about creating a 3D digital model and applying AR to their teaching, with positive feelings coming from the creative process and negative feelings from implementation requirements. 70% of participants were not familiar with AR, but 30% of them used them in teaching. 60% were interested in training in AR.

55% believe that AR application development by teachers and students is feasible in school settings, while 35% have a negative opinion on the matter. Six factors were evaluated by teachers as appropriate for AR application development in school settings.

The technological equipment of the school was not adequate in 20%, 30% a little, 20% moderate and 30% enough, the available laboratory received equal percentages in positive and negative cases, and teachers' ICT skills were adequate.

The most restrictive factor for AR development by teachers and students in the context of teaching is time, which is reduced because the hours of a lesson are spread over different days, interrupting students' workflow and thus losing precious teaching time. The participants prefer to cooperate with other teachers and especially with ICT teachers in the context of subjects that require cooperation of teachers, and to use available AR applications as learning tools. They also prefer to use AR applications themselves or with their students.

Ten percent of teachers were concerned about the use of mobile phones in school, but the

majority thought that students would cooperate if the teacher organized an action based on specific educational focus.

In addition to the above results, teacher's main comments are: (a) necessary disposal of teacher's personal time (artists teacher), and (b) more feasible implementation in specific types of schools (physics teacher, philologist teacher).

According to the study, points of concern included doubtful learning outcomes, inadequate teacher collaboration, poor student collaboration, limitations due to the curriculum, and students' general attitude. Suggestions include selection of students teamed with availability, knowledge and positive attitude, careful choice of co-workers, a good preparation from the previous year, reward for students and teachers. This research aimed to understand teachers' opinions in depth and investigate factors that can affect the implementation of augmented reality applications in school settings in order to contribute to the more effective use of technology in education. The results showed that AR technology is not widespread at social and educational levels, that continuous training is a stressful situation for 60% of the participants, that available time, program and financial cost are the main obstacles, and that teachers have a positive attitude towards training. Teachers believe that AR applications are feasible in junior high schools and model junior high schools, but the limitation of the curriculum is the most restrictive factor. Teachers prefer cooperation with teachers of various specialties. Results show that collaboration among teachers of different specialties and a more flexible course schedule are important factors for the effective use of augmented reality technology in education. The central educational services should also support the use of ready-made applications as a teaching tool.

The questionnaire asked participants' gender, specialty, additional studies, years of teaching experience, ICT certification, social media use, digital media used in teaching, need for continuous training, 3D modeling, and teachers and student’s involvement in AR applications development.

2.1.6 Current Digital Transformation in Education – The Pandemic Times

This year is the year of digital change. According to a poll conducted by Fujitsu in 2018, 68 percent of respondents believe that people and artificial intelligence would collaborate in the future. The role of technology in digital transformation is a prevalent misperception. True, technology plays a role in digital transformation, but the most important aspect is how one uses technology to transform. Consider the current pandemic. In the future, several firms have forecast a digital revolution. When the pandemic struck, however, we were obliged to make a digital transformation by working from home. We achieved this by adapting existing technologies to the current situation. Although the process was rushed, with some bumps along the way, it was a significant step toward digital transformation. Now that corporations have adapted and are gradually transitioning digitally, we will see this transformation spread to other industries, such as healthcare and education. For education, smart classroom technology and wireless networking options are available.

2.1.7 Intelligent Classrooms

While the pandemic has resulted in only a small fraction of futuristic schooling being implemented, this sector has so much more promise. According to Statistica, the global e-learning market is expected to exceed 243 billion dollars by 2022. We are looking at the possibility of smart classrooms as early as two years from now, thanks to developing technology like artificial intelligence and virtual reality. A smart classroom is a technologically equipped classroom that offers a wide range of teaching and learning approaches. It might be as simple as incorporating audio and visual elements into a lesson, as many classes are now doing (and have done so in the past as well). It could also be something more advanced, such as employing virtual reality to practice medical procedures. A smart classroom also assists the instructor by utilizing technology. There are tools that can help teachers with lesson planning or even save an online taught class for future reference. In education, smart classroom technologies and wireless solutions

2.1.8 What Benefits Does a Smart Classroom Offer?

According to ‘A Survey of Smart Classroom Literature’ (Avneet Kaur, Munish Bhatia and Giovanni Stea, 2019), having a smart classroom has both advantages and disadvantages. The largest benefit is remote learning, which is a big task in today's environment. With the online classes that are now available, we are on the verge of smart education. We saw several uses before COVID, such as pre-recorded classes for students with conflicting schedules or interactive learning. According to the study, artificial simulations are also used by several colleges in engineering subjects like automotive and aerospace. Students can mimic their models of various automotive components using artificial intelligence, allowing them to test out motor parts without having to build them. They can proceed to develop a prototype once the simulation passes a test. This saves them time and resources, resulting in a more efficient learning experience.

2.1.9 Are there any drawbacks to using a smart classroom?

According to the study, many parents and university students may be concerned about smart classrooms' collaborative and social aspects. Because most communication is based on technology, there could be a communication barrier. Some experts, however, believe that working in an atmosphere that includes interactive learning via technology really increases teamwork through debate and group projects.

One big problem of smart classrooms or technology taking over the education sector is that kids in rural locations have restricted internet connectivity. Physical constraints (for example, hills) and restricted growth and resources are among the many obstacles to providing internet to rural areas.

2.1.10 Is the Future of Education Really Smart Classrooms?

We're developing digitally, and smart classrooms could be the future of education if we can solve the problem of internet connectivity in rural areas. Although we are now considering

remote education, it is not the future of education. Through augmented reality, artificial intelligence, and virtual reality, smart classrooms can be implemented while students are present in the classroom.

It's worth noting that smart classrooms can also be accomplished without the use of advanced technology. Returning to the start of this article, digital transformation occurs as a result of how we use technology. Some educational players employ readily available technology, like computers, to construct simulation software on desktops and teach students using it, which is also a type of smart classroom. It all boils down to the technological tools we have at our disposal and how we might use them to create a smart environment. Different industries, including education, will continue to adapt and become "smart" in their own ways as technology advances.

2.1.11 SMART classrooms: Applying AR inside and outside the classrooms: Existing examples and scenarios

1. Using augmented reality to bring science concepts to life. We can now employ augmented reality to build a tornado and then bring the funnel right into the classroom, allowing students to witness these deadly storms up close. Students can also take an augmented reality tour of a beehive to learn about its inner workings and how bees collaborate to help the community.

2. The SkyView app allows students to use AR overlays of the night sky to study the universe. Anyone may use SkyView to identify stars, constellations, planets, and even satellites by pointing their mobile device upward.

3. Students can now use the Froggipedia app's augmented reality technology to explore a frog's interior organs as opposed to dissection.

4. Microsoft Corporation Medical students and professionals can learn about the human body via mixed reality thanks to HoloLens. Students can stroll within the human body, flow through the bloodstream, isolate, enlarge, and even walk through the components to learn not only

anatomy but also how to cure various medical disorders.

5. 1943 Berlin Blitz in 360°, produced for the BBC by Immersive VR Education, uses real-life footage from a Nazi Germany nighttime bombing to help pupils comprehend what it was like to live through a key historical event.

6. Most teachers can't take their kids to Mount Everest Base Camp or the Louvre, but they can do both with Google Expeditions' series of highly immersive school trips.

7. If you've ever wished you could rehearse giving a speech in front of a virtual audience before taking the stage in front of a live audience, you can now do so with virtual reality goggles. VirtualSpeech provides immersive, realistic virtual reality simulations to help you enhance your public speaking skills.

8. The VR Museum of Fine Art on Steam allows players to get up and personal with world-class paintings and sculptures, including the Mona Lisa, without having to deal with crowds or protective glass.

9. Extended reality can be used in professional contexts by training businesses. To make streets safer for civilians and policemen alike, police departments are now utilizing virtual reality to educate cops to deal with riots or arrest people in certain situations.

10. While reading books can make learning languages feel extremely theoretical, virtual reality educational software firms like Mondly can deliver an immersive language-learning experience without the need to travel to another nation. You can have genuine discussions with real people in Mondly's VR settings, making your language learning more potent and likely to remain.

2.1.12 Adaptation of students to AR

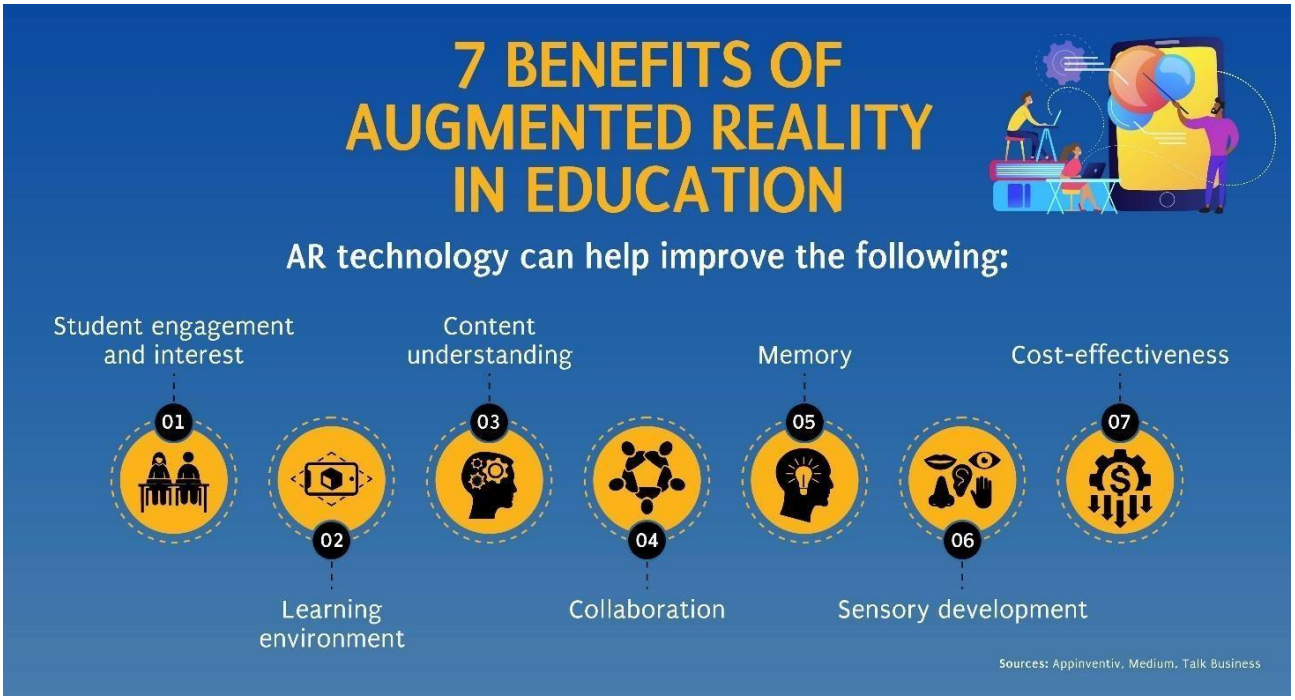

Figure 1.3 Augmented Reality Benefits (Source : Medium, Talk Business)

According to 'The Impact of an Augmented Reality Application on Learning Motivation of Students' (Tasneem Khan et al. 2019), AR has the potential to significantly impact learning environments in the following ways.

Student engagement and interest: When students have the opportunity to participate in the creation of educational content, their interest skyrockets. AR technologies can help them expand their curriculum, create virtual worlds, and discover new interests.

Learning environment: AR-enhanced classes can help students become more involved. An interactive learning environment allows for the implementation of hands-on learning approaches, which can increase engagement, improve the learning experience, and encourage students to learn and practice new skills.

Understanding content: Teachers who are hesitant to use augmented reality in education have expressed concern about a lack of quality content that is focused on education rather than entertainment. Existing AR technology, on the other hand, allows teachers to create

immersive educational experiences on their own to ensure their students understand curriculum content.

Collaboration: Because AR content is digital, it is simple to share. A group of teachers, for example, can work with their students to constantly improve the content. Students are more motivated to learn in a collaborative learning environment because they are actively involved in the creation of educational content.

Memory: AR is a fantastic tool for bringing lessons to life and assisting students in remembering important details. Instead of simply displaying photographs of Colonial America on a projector, a teacher can use AR technology to create memorable interactive stories.

Sensory development: AR technology can assist teachers in developing lesson plans that include multisensory experiences. Immersive virtual content that incorporates an experiential learning style in which students perform physical activities rather than watching a demonstration benefits the students. This method can aid in sensory development. The cost of AR equipment is frequently cited as a barrier to adoption. However, as smartphone use among young Americans continues to rise, and because smartphones are already equipped with the hardware required to run AR apps, augmented reality in education is becoming more cost-effective to implement. AR can also help to reduce educational costs by replacing expensive textbooks.

2.1.13 Learning Methodologies: Pedagogy study

The term pedagogy to be introduced here is to give adequate importance to the fact that the learning methodology is also extremely important when it comes to incorporating tech into the Special Educational space. According to ‘Why Pedagogy Matters: The Importance of Teaching In A Standards-Based Environment’ (Susan Entz, 2020), pedagogy is the study of how educators teach and influence students, it is the methodology practiced to allow children to effectively be receptive to what is taught in class. A well-thought-out tech-infused pedagogy is critical for assisting students in learning more effectively, even in tech-induced spaces. A

detailed guide for teachers, structured and whole-class group work, guided learning, assessment practice, and individual activity are all components of the most effective pedagogies. These pedagogies emphasize higher-order thinking and metacognition. Because schools are always pressed for time, teachers must develop learning resources that promote active learning in the classroom. This method of pedagogy gets to the heart of student thinking. The Structural Learning community is a global community with diverse teaching approaches.

The Rosenshine principles of instruction provide schools with a list of evidence-based modern teaching methods with the use of tech tools as a part of their curriculum. The rise of organizations like the Education Endowment Foundation has enabled teachers to make better decisions about their teaching practices. Teachers should provide opportunities for students to grapple with the problem at hand in order to deepen student understanding.

Social pedagogy is a comprehensive approach to working with children and their families that promotes their development, well-being, and education. It also refers to the educational system that addresses common social issues concerning human needs. Critical pedagogy is a teaching philosophy that encourages students to critique oppressive and power structures. It can be used in a variety of ways, such as audio-visual material, analyzing and exploring power issues in families, and searching for statements that are biased toward the media. Culturally responsive teaching takes into account cultural contexts and adapts pedagogical practice to meet the needs of the child. A culturally responsive teaching approach promotes and considers different races, beliefs, ethnicities, and backgrounds. Cooking classes, political studies, and legal studies are all examples of culturally responsive teaching. The Socratic Method entails a conversation between the instructor and the students. The teacher would ask probing questions to elicit the underlying beliefs that shape the students' perceptions and views.

Socratic pedagogy entails a process in which students can improve their psychological and social skills in order to become active members of a democratic society. This procedure entails anonymous peer review, collaborative instructions, comparative context, and critical thinking.

Traditional teaching methods emphasized teacher lecturing and discouraged group work and student-created knowledge. Student-centered learning methods are centered on the learner and promote deep learning.

In a multicultural society, educators must accept and celebrate different learning styles while also creating an equitable learning environment for all students. Action research projects provide teachers with the tools they need to document evidence of impact when experimenting with new teaching approaches, as well as boost teacher confidence and career advancement.

2.2 Theory of Reasoned Action

According to 'Augmented Reality And Virtual Reality To Aid Students With Learning Disability: A Review' (Carolyn Joseph, 2020), the use of augmented reality (AR) in education is currently gaining a lot of traction, especially in special education. Students with specific needs demand various approaches, but AR's flexibility and versatility make it easier to satisfy their requirements. Because there are so many different types of disabilities, it's critical for you as a teacher to cater to each student in order to meet their learning objectives. AR can accommodate these learning experiences, allowing you to personalize your classes to their specific needs. AR for ASD students have been shown to be useful in a variety of ways, including increasing attention span, practicing social and physical skills, and learning new activities and vocabulary.

1.Recognize facial expressions

AR makes it feasible for ASD pupils to recognize other people's emotions through facial expressions, which is difficult for them. People with ASD were offered stories and images regarding a certain feeling in one study. On an AR mirror system, they were then asked to choose the proper feeling. The outcome was intriguing: AR was shown to increase their awareness of other people's emotions.

2. Work on social skills

In California, public schools employed an augmented reality program called MOSOCO to teach students with and without special needs about social skills such as eye contact, communicating with others, asking questions, and sharing interests. Furthermore, augmented reality can be utilized to learn about nonverbal social signs. Children can see a video flashed up on each social cue utilizing an AR app through a narrative. Not only did the children show curiosity, but they also showed an improved ability to recognize facial emotions

3. Develop motor skills

According to research, AR has been shown to improve children's fine motor skills. In a pleasant and engaging environment, they were able to learn stronger self-control movements!

4. Introduce new words

For children with ASD, learning new words is another issue. AR, on the other hand, breaks the barrier: they were able to learn science-related vocabularies in a shorter amount of time while improving their effectiveness and efficiency.

5. Improve kids' attention spans

Because AR allows students to see a popped-up visualization, they demonstrated increased involvement, engagement, enjoyment, and motivation to study. According to one study, AR increased students' participation in learning about object discrimination by 62 percent. AR can help children with a variety of problems, not only psychological ones. Students with hearing or speech impairments, for example, can use AR apps on their smartphones to improve their ability to interact, communicate, and understand. Additionally, AR might be a useful tool for children who struggle with coordination. They can interact with the come-to-life objects through 3D objects and photos of geographical areas, exposing them to diverse cultures, landscapes, and habitats.

AR-based education apps can be used to provide interactive and interesting lessons for students with math learning difficulties, such as dyscalculia. AR can also help individuals with language

difficulties improve their fluency and pronunciation in a specific language.

2.2.1 What kinds of augmented reality apps can you use?

Although AR headsets are certainly viable, AR smartphone apps are invariably much more convenient and accessible; not only for teachers but also for students. Furthermore, AR apps allow you to transcend place and time, which is very useful during a pandemic. In certain ways, augmented reality experiences allow students to be entertained while learning, despite the fact that they are doing so remotely. Assemblr EDU is one of many AR-based smartphone apps that is well worth your time.

2.2.2 Finding opportunities for AR in the area of Special Education

Being in the education field for many years there has come a realization of the jump it has taken in terms of the technological advancements that people are looking at. We have Youtube videos, online platforms, apps, etc. that act as an aid to the system and learning. In the school systems, we have textbooks, workbooks and in some advanced schools, we have smart boards.

At regular schools only a certain level of technology is entertained. And not all schools have the money for such facilities. And the use of too many videos and tabs in schools is not always encouraged. In fact, a lot of regular schools still don't want to digitize too much as they feel this could be corrupting the generation rather than helping it. Hence, they still stick to the traditional style of teaching using textbooks, workbooks and possibly hands on learning, instead of excessive digital aids.

However, in the area of special education technology and use of digital devices is encouraged in the classrooms to provide a deeper, effective and more wholesome experience for kids.

Two pointers are to be reiterated from the literature review which lead to a final conclusion:

Personalization for promoting inclusive learning using AR is also a growing area of interest.

(And)

In the **learning skills domain,** individuals with special needs are identified to **experience deficits in learning categorical vocabularies and using languages in different contexts. This includes learning many subjects, in particular science and math, and new words** (Cakir and Korkmaz 2019; Kellems, Cacciatore, and Osborne 2019). **Vocabulary acquisition is very important for independent living and literacy skills and science are considered valuable for individuals with special needs** (Browder et al. 2022).

Since vocabulary acquisition is very important, my proposal is to look into the quality and the creativity of the images needed in the areas of language, particularly, learning of new words for the special child.

2.2.3 Obstacles to overcome while implementing AR in Schools

There are a few obstacles when it comes to implementing AR in schools and educational institutions. According to 'Difficulties in the Incorporation of Augmented Reality in University Education: Visions from the Experts' (Julio Barroso Osuna, Rubicelia Valencia Ortiz , Juan Jesús Gutiérrez-Castillo, 2019), the following are the problems when it comes to implementing AR tech for inclusive classrooms.

1. Lack of teacher training and improvement
2. The few educational experiences found
3. Lack of conceptual foundation
4. Limited educational research
5. Lack of institutional support

From a technical point of view the use of such a mechanism was used as a great teaching aid. A good way to approach this is to provide the teachers with training on the importance of the use of such a mechanism and providing an easy and quick way of use in classrooms. Starting from the paper, it has been said that-

From a teaching point of view, the biggest issue (as with any tool or process) is tying AR to the unit, lesson, etc. in an intentional and developmentally appropriate way. The absolute worst uses of tech in the classroom are for tech's sake---technology should be used to enrich, enhance, or extend learning--not just as an intriguing demo.

By far the biggest issue with AR in the classroom is equity of access. Since AR depends on decent (and expensive) hardware, it's key that each child has equal access to the toolset--regardless of socioeconomic circumstance. For some of us, a decent phone is a normal part of our budget, but this is an impossible luxury for many.

According to the study, AR is being used extensively in the classroom and in textbook presentations. A teacher can readily help students comprehend things that would otherwise take a long time to memorize. In the case of language, you may bring images of objects to life, improving both the teaching and learning experience. Consider the alphabets. You can make Apple come alive while teaching 'A' and Ball appear for 'B' by using augmented reality. This makes learning enjoyable and engaging. In AR, as in other tech-assisted platforms in education, content reigns supreme. By employing a symbol as a marker, the teacher can load explanations for crucial topics, and students can see the content come alive as dynamic imagery when they scan it.

Certain misconceptions have been investigated when it comes to teaching language in Special Education as per the article Language Disabilities: Myths and Misconceptions vs. Reality (George Mouzakitis, 2012) as stated below.

Myth 1: To teach these students, you need to be a specialist psychologist or a properly qualified instructor.

You don't have it. It will, of course, assist you in learning more about SENs and seeking assistance from experts in the field, but effective teaching practice, particularly in the areas of classroom management, planning, and task setting, benefits learners with SENs. Learners with SENs, for example, require clear, consistent rules and directions, short, doable tasks that provide a sense of accomplishment, a sense that the teacher cares for them and knows them as individuals, and multi-sensory presentation and practice of content. Without specialized understanding of SENs, good instructors can perform all of these things.

Myth 2: When students with SENs are taught, other students in the class make less progress.

No, it is not always the case. Children with SENs can teach empathy, understanding of differences, and other key social and learning skills to other children. Children are naturally

aware that some students require additional assistance. Adults must comprehend and work with this. Inclusion in the classroom can benefit students and enrich their learning experience.

Myth 3: Students with special needs cannot learn languages

No, this doesn't need to be true. Many children with SENs benefit from learning English because it allows them to practice crucial skills such as listening, taking turns, cooperating with others, waiting for attention, recognizing details about others, understanding social language, and expressing their thoughts. These are abilities that can be practiced in a fun, non-threatening approach during English language learning exercises. Reading and writing stories can allow students to address challenges in a safe and creative environment. Learners with SENs may have a distinct classroom experience if they learn English in this way.

Myth 4: It necessitates a significant amount of additional time and planning.

No. Although all teachers are limited on time, having students with special needs in your class should not require much planning. It will need planning for various learning styles, considering your pupils' interests and strengths, incorporating some task modifications, and carefully presenting the work. This form of planning, on the other hand, will benefit all of the students in your class. If more students participate in the task at an earlier stage and with better outcomes, it can actually save you time.

Myth 5: Because a teacher cannot "cure" a student's situation, there is nothing I can do

Certainly not the case. There is no need to 'correct' the learner. This mode of thinking looks at the student's difficulties from a medical standpoint, as if the learner is 'broken' and has to be fixed. We all need to understand more about the struggles and uniqueness of others in order to live in a more inclusive society. Teachers can learn a lot from students with special needs, and schools must change their teaching and thinking in order to foster inclusion. Instead of seeking a professional to work with the child, the specialist could assist with teacher training to better understand how to work with the youngster.

2.2.4 Developing Inclusive Classrooms:

According to ‘Research about inclusive education: Are the scope, reach and limits empirical and methodological and/or conceptual and evaluative?’ (Brahm Norwich, 2022), the following suggestions were given to make classrooms more inclusive.

1. Focus on the learner rather than the label. Learners with SENs have distinct personalities. Every dyslexic individual, for example, is unique. The learner could be an introvert, an extrovert, creative, not creative, amusing, not amusing, musical, not musical, and so on. Get to know your student.

2. Always encourage and implement activities in your classroom that promote empathy and understanding. Many ELT tasks, for example, entail guessing or remembering something about your partner, as well as identifying similarities and differences. Use this form of verbal engagement to your advantage.

3. Create a learning contract that emphasizes the inclusive ethos. Set guidelines, for example, that clearly describe your classroom's fundamental beliefs, such as

• We assist one another

• We pay attention to one another.

• We recognize that everyone is different.

4.Provide opportunities for students to present and practice language in a variety of ways and contexts.

5. Establish a peer mentoring or buddy system in which students assist one another and share expertise.

6. Consider how you communicate instructions. Make your instructions clear, succinct, and step-by-step. Give them in the order you want them done and in a straightforward manner. Sequencers should be avoided. Say 'look at the board, then open your books,' rather than 'look at the board, then open your books.' Check by giving an example and asking the students for one.

7. Use positive language in the classroom. Not what you don't want them to do, but what you want them to do. Instead of saying, "Don't keep turning around," say, "Look at the board."

8. Reinforce rules and routines with pictures. Prepare a series of illustrations depicting several aspects of your lesson - hearing (ear), speaking (mouth), writing (pen), and reading (book) – and post them on the board at the beginning of the class to demonstrate the day's order.

9. Consider your students' needs and create a seating layout. Hearing-challenged students should sit near the teacher, whereas ADHD students should sit away from distractions like windows and radiators.

10. Don't be reluctant to seek help from others, including parents/caregivers, other experts, and, most importantly, the learner. They will be aware of what works.

Make it a fun learning experience rather than a scary one.

2.3 Human Society Theory

Learning theories:

According to 'The use and application of learning theory in learning analytics: a scoping review', (Mohammad Khalil, Paul Prinsloo & Sharon Slade , 2022), there are 5 primary educational learning theories: behaviorism, cognitive, constructivism, humanism and connectivism. Additional learning theories include transformative, social and experimental.

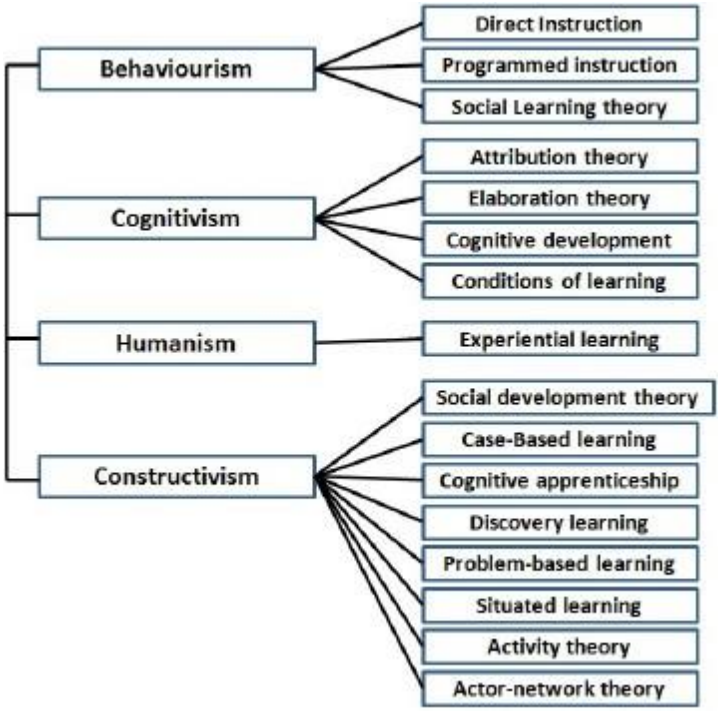

Figure 1.4 Learning Methodology Types (Source: researchgate.net)

Educational theorists that have researched the science of learning have developed a wide variety of educational approaches to teaching and learning. Teachers base their lesson plans and curricula on five generally acknowledged theories of learning. With the conflict between behaviorist theory and cognitive psychology around the turn of the 20th century, theories of education really got going. There are now five main theories of learning. Learning theories have been the focus of careers for scientists, psychologists, and thought leaders. This explains why teacher preparation programs devote so much effort to teaching prospective teachers about human development and various learning theories. Although promoting a certain learning theory isn't always necessary in most teaching jobs, most instructors tend to do so. There are various theories of learning, such as experiential learning theory, social learning theory, and transformative learning theory. These theories can be used to instruct students on how to acquire knowledge and how to use it in practical settings. Different educational ideas have an impact on learning. Finding the appropriate strategy can make a huge difference.

A classroom experience is impacted by applied learning theories in a variety of ways, including by giving pupils structure and a calm, consistent setting, assisting educators, administrators, students, and parents in identifying common objectives, and by empowering teachers. Since the time of Socrates and the founders of behaviorism and cognitivism, educational philosophies have developed. This growth can be advantageous to both teachers and students.

Learning Theories:

Today, much research, study, and debate have given rise to the following five learning theories:

THEORY	EXPLANATION	APPLICATION
Behaviorism	As Simply Psychology puts it: "Behaviorism is only concerned with observable stimulus-response	Learning is based on a system of routines that "drill" information into a student's memory bank, as well as

	behaviors, as they can be studied in a systematic and observable manner."	positive feedback from teachers and an educational institution itself. If students do an excellent job, they receive positive reinforcement and are signaled out for recognition.
Cognitivism	Learning relies on both external factors (like information or data) and the internal thought process.	Developed in the 1950s, this theory moves away from behaviorism to focus on the mind's role in learning. According to the International Bureau of Education: "In cognitive psychology, learning is understood as the acquisition of knowledge: the learner is an information-processor who absorbs information, undertakes cognitive operations on it and stocks it in memory."
Constructivism	The learner builds upon his or her previous experience and understanding to "construct" a new understanding.	"The passive view of teaching views the learner as 'an empty vessel' to be filled with knowledge," explains Simply Psychology, "whereas constructivism states that learners construct meaning only through active engagement with the world (such as experiments or real-world problem solving)."

Humanism	A “learner-centric approach” in which the potential is the focus rather than the method or materials.	With the understanding that people are inherently good, humanism focuses on creating an environment conducive to self-actualization. In doing so, learners’ needs are met and they are then free to determine their own goals while the teacher assists in meeting those learning goals.
Connectivism	Informed by the digital age, connectivism departs from constructivism by identifying and remediating gaps in knowledge.	Strongly influenced by technology, connectivism focuses on a learner’s ability to frequently source and update accurate information. Knowing how and where to find the best information is as important as the information itself.

Table 1.1 Learning Theories

Educational theories influence learning in a variety of ways. For teachers, learning theory examples can impact their approach to instruction and classroom management. Finding the right approach (even if it is combining two or more learning theories) can make the difference between an effective and inspiring classroom experience and an ineffective one.

Applied learning theories directly impact a classroom experience in a variety of ways, such as:

- Providing students with structure and a comfortable, steady environment.
- Helping educators, administrators, students, and parents align on goals and outcomes.

- Empowering teachers to be, as Bates says, “in a better position to make choices about how to approach their teaching in ways that will best fit the perceived needs of their students.”
- Impacting how and what a person learns.
- Helping outsiders (colleges, testing firms, etc.) determine what kind of education you had or are receiving.
- Allowing students, a voice in determining how the class will be managed.
- Deciding if the instruction will be mostly teacher-led or student-led.
- Determining how much collaboration will happen in a classroom.

Delving deeper into the humanism theory

According to ‘Humanistic Learning Theory’, (Andrew Jhonson, 2022), humanistic teachers believe that knowledge and feelings go hand in hand in the learning process. Cognitive and affective learning are both important to humanistic learning. Lessons and activities should focus on the whole student and their intellect and feelings, not one or the other. A safe learning environment.

Because humanistic learning focuses on the entire student, humanistic educators understand that they need to create a safe environment so students can have as many of their needs met as possible. They need to feel safe physically, mentally, and emotionally in order to be able to focus on learning. So humanistic educators are passionate about the idea of helping students meet as many of their needs as possible.

The role of teacher and student in humanistic learning theory.

According to the research, the humanistic learning theory, teachers and students have specific roles for success. The overall role of a teacher is to be a facilitator and role model, not necessarily to be the one doing the teaching. The role of the teacher includes:

- Teach learning skills. Good teachers in humanistic learning theory focus on helping students develop learning skills. Students are responsible for learning choices, so helping them understand the best ways to learn is key to their success.
- Provide motivation for classroom tasks. Humanistic learning focuses on engagement, so teachers need to provide motivation and exciting activities to help students feel engaged in learning.
- Provide choices to students in task/subject selection. Choice is central to humanistic learning, so teachers have a role in helping work with students to make choices about what to learn. They may offer options, help students evaluate what they're excited about, and more.
- Create opportunities for group work with peers. As a facilitator in the classroom, teachers create group opportunities to help students explore, observe, and self-evaluate. They can do this better as they interact with other students who are learning while they are.

Some examples of humanistic education in action include:

- Teachers can help students set learning goals at the beginning of the year, and then help design pathways for students to reach their goals. Students oversee their learning, and teachers can help steer them in the right direction.
- Teachers can create exciting and engaging learning opportunities. For example, teachers trying to help students understand government can allow students to create their own government in the classroom. Students will be excited about learning, as well as be in-charge of how everything runs.

- Teachers can create a safe learning environment for students by having snacks, encouraging students to use the bathroom and get water, and creating good relationships with students so they will trust speaking to their teacher if there is an issue.
- Teachers can utilize journaling to help students focus on self-evaluation and their feelings as part of learning. Using prompt questions can help students better understand their feelings and progress in learning.

2.4 Summary

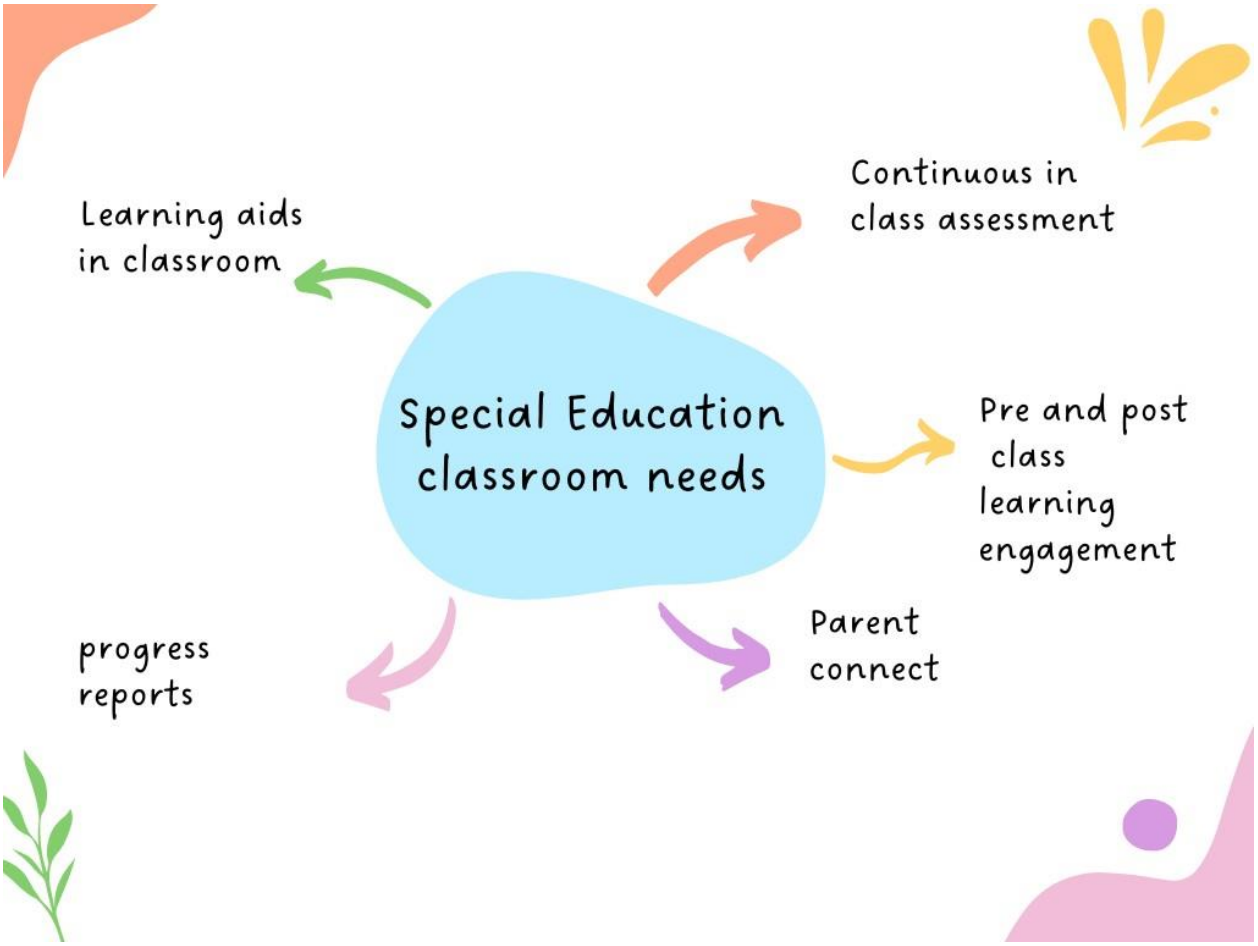

Figure 1.5 Special edu classroom needs

Digging deeper into the topic, the need of the hour is to apply this methodology to the field of special education.

The effectiveness of augmented reality environments on individuals with special education

needs (Recep Kakir, Ozgen Korkmaz, 2018) shows that AR enables students with special educational needs to gain independent life skills, reduce behavioral problems and increase their level of academic achievements, enthusiasm, and readiness by bringing them in real-life experiences. Virtual reality fully immerses users in the digital world. On the other hand, AR superimposes digital elements in a real-world environment. External observation of an AR lesson is possible by students. This is very important, as some children with special needs don't respond well to new environments. A Virtual Reality -VR system might be a bit daunting for the special child as it puts him/her in a virtual space which could feel like an unsafe space for them, whereas AR would be an aid to the learning, with the support of the teacher in a safe real-world space.

Augmented Reality Trends in Education: A Systematic Review of Research and Applications (Bacca Acosta, Jorge Luis, 2019) states an AR app would be capable of bringing books and other printed resources to life by adding 3D images, videos, and audio. It might also give educators the option to modify text to make information easier to understand for students with visual or hearing impairments. **Personalization for promoting inclusive learning using AR is also a growing area of interest.**

Augmented reality in special education: a meta-analysis of single-subject design studies (Reem Baragash, Hosam Al-Samarraie, 2018) talk about the helpfulness of using AR in for special children in the social, physical and daily living skills domain. According to the study, in the social skills domain, individuals with special needs are known to have problems in developing their communication and social skills (Walton and Ingersoll 2013). In this domain, difficulties are mostly reported with intuitive comprehension, social situations, lack of ability to understand the behavior of others, initiating and maintaining conversations, and making appropriate eye contact (Lorenzo et al. 2019). Therefore, providing them with innovative tools may improve their social skills and promote positive behavior, mainly through the recognition of facial expressions, focusing attention to nonverbal social cues,

comprehension of social relations, and learning appropriate greeting responses (Escobedo et al. 2014; Wu et al. 2013). In the daily living skills domain, many individuals with special needs are likely to encounter difficulties, which limits their self-determination and may negatively affect their overall quality of life (Cannella-Malone et al. 2011). AR technology could help teach individuals with special needs the necessary living skills (Chang, Kang, and Huang 2013; Chang, Chang, and Liao 2014) by helping them have control over their environment and live independently within the community (Cihak et al. 2016; McMahon et al. 2013).

In the physical skills domain, there is a range of body motion-related activities that any individual with a disability needs to acquire and develop, such as navigation tasks and physical movement interactions. The application of AR in this domain has been viewed in the literature as a way to provide individuals with cognitive and developmental disabilities the guidance and support they need to perform certain physical activities (Hervás, Bravo, and Fontecha 2014). It is believed that using innovative technologies to teach how to navigate or relocate from one place to another can help reduce social isolation and promote relationships among individuals with disability (McMahon et al. 2015). Furthermore, physical movement is often a key component where AR is considered for individuals with developmental disabilities owing to their visual information requirements (Antonioli, Blake, and Sparks 2014).

In the **learning skills domain,** individuals with special needs are identified to experience deficits in learning categorical vocabularies and using languages in different contexts. This includes learning many subjects, in particular science and math, and new words (Cakir and Korkmaz 2019; Kellems, Cacciatore, and Osborne 2019). Vocabulary acquisition is very important for independent living and literacy skills and science are considered valuable for individuals with special needs (Browder et al. 2012). **Hence, using AR can be effective in facilitating skills acquisition learning, provide the means for individuals with disabilities to enhance their motivation and help them to understand information**

(Cakir and Korkmaz 2019).

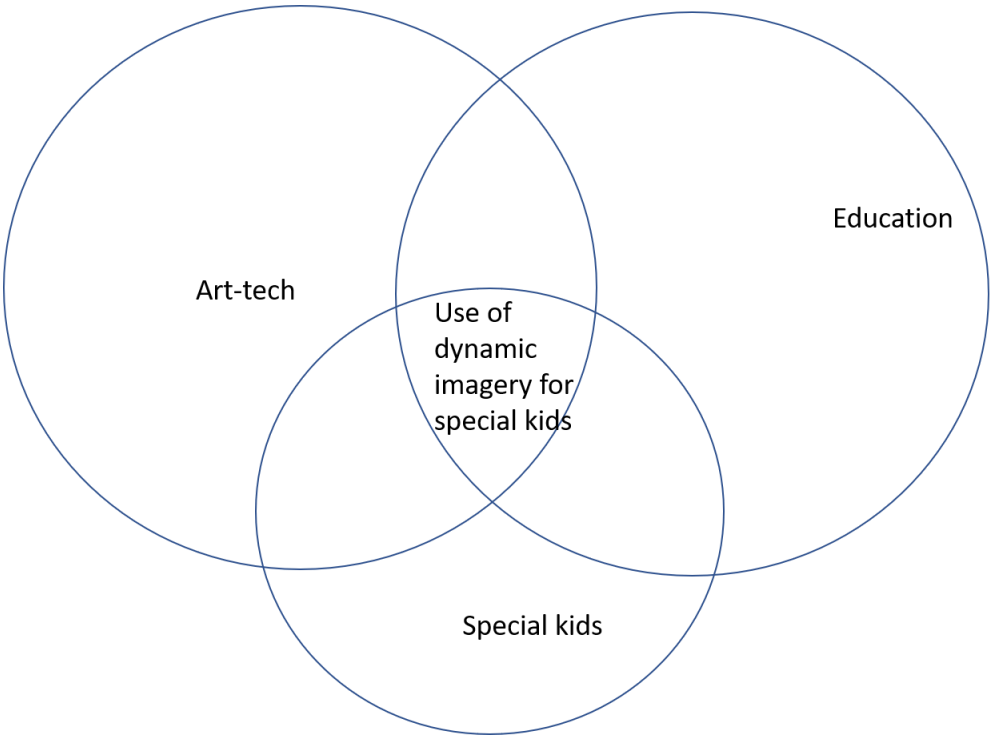

Figure 1.6 Intersection Diagram

Market potential and opportunities: In the reviewed studies of Exploiting Augmented Reality Technology in Special Education: A Systematic Review (Cleo et al., 2022) the country that mostly explored the contribution of AR in Special Education was the USA, with three studies, while Ecuador and Turkey had conducted two studies each. India, Canada, Taiwan, Spain, Greece, and Ireland were following with one study each.

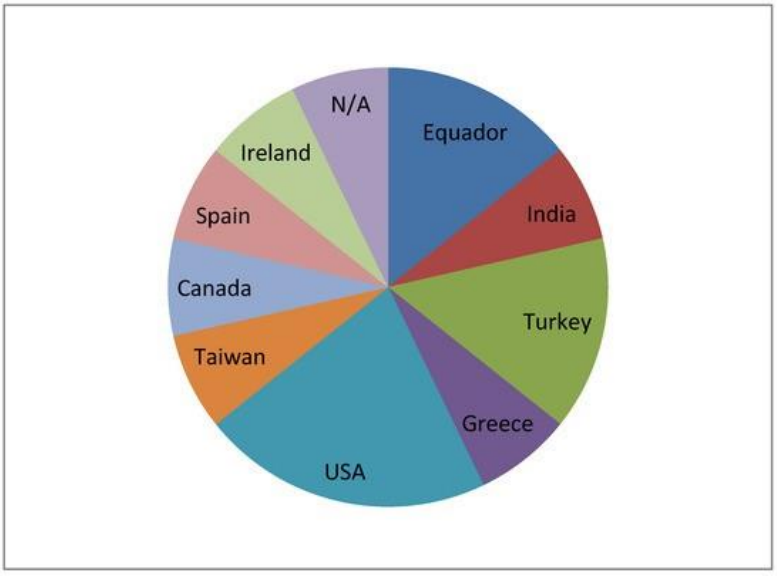

Fig 1.7 Use of AR across countries

Concerning the level of education of the participants in the experiments, it appeared that the majority of studies (57%) involved Primary education students, while Secondary education students (22%) were the second most commonly preferred learner type. Postsecondary, and Diverse population (aged 11–40) education represented a lower percentage (7%). In one study, the educational level of the participants was not mentioned. Thus, researchers were interested in exploring the affordance of AR in several levels of special education, but there was a tendency towards Primary education students. Since we see that less than 30% of the classrooms on an average don't use AR tech, we find this as a business opportunity to leverage into.

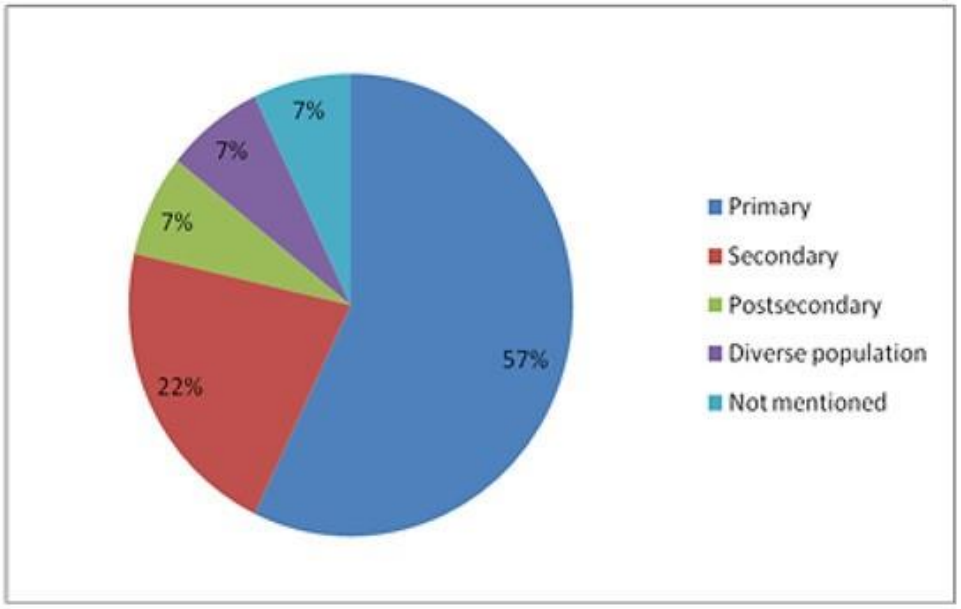

Fig 1.8 Grade wise use of AR

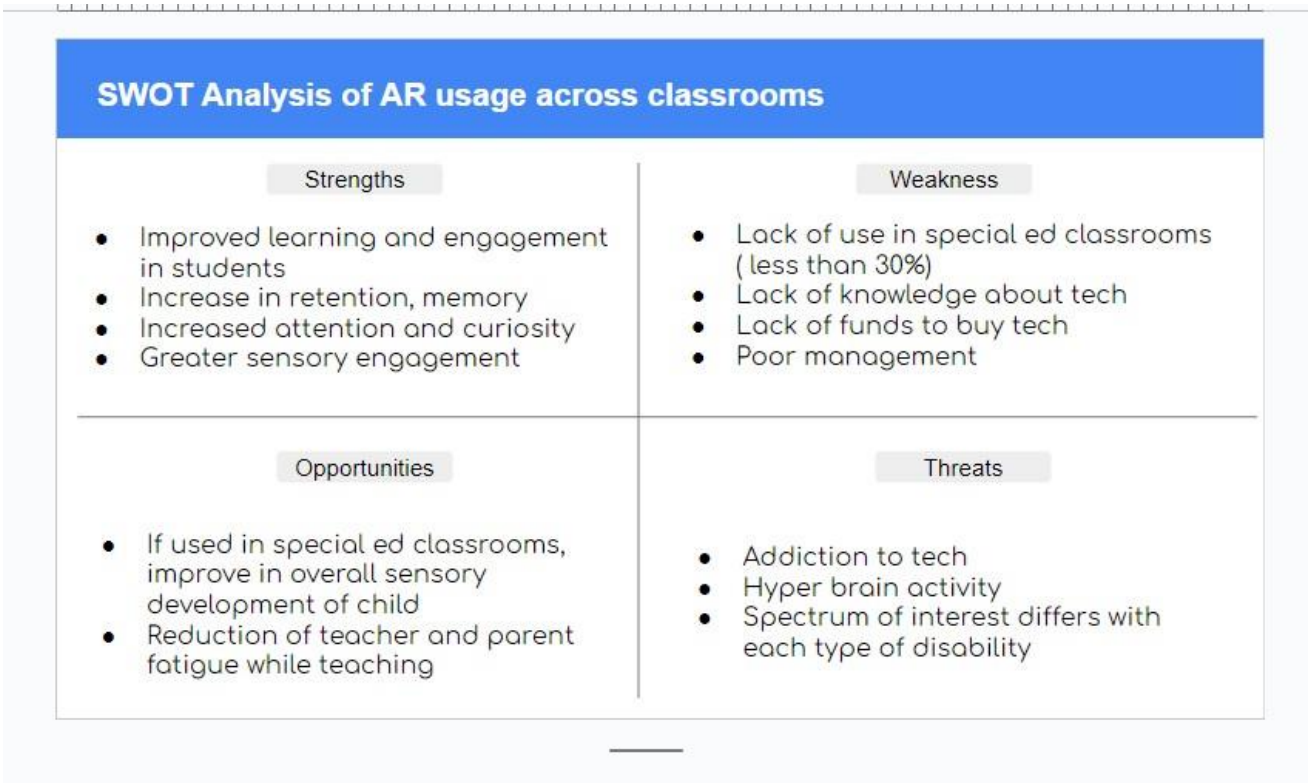

Fig 1.9 SWOT Analysis

LR TABLE:

Author/Date	Topic/ Focus/ Question	Concept Theoretical Model	Context setting/ Sample	Findings	Future Research
2020 Neil Selwyn Thomas Hillman Rebecca Eynon Giselle Ferreira Jeremy Knox Felicitas Macgilchrist	What's next for Ed-Tech? Critical hopes and concerns for the 2020s	The constructivist curriculum mod el	Schools around the world continue to face deficiencies in resourcing, significant inequalities of educational opportunity, alongside poor-quality teaching, curriculum, and school organization. How can tech help alleviate some of these pressing issues? SAMPLE: The statistics of the number of increased online learning during and post pandemic.	New forms of digital in/exclusion Platform economics in an age of artificial intelligence 'Divisions of learning' across humans and machines IT industry actors as a leading educational force Reimaging forms of EdTech suitable for an age of climate change.	An additional task for researchers in critical EdTech is to develop shared spaces for international discussion. **Critical EdTech research will undoubtedly profit from cross-cultural dialogue** to not only better identify and understand broad issues, but also to create alternatives to the globalized (and globalizing) forms of

				Finding alternatives: solidarity economies, convivial technology, respectful design	education being advanced by commercial interests.
Ben Williamson , Rebecca Eynon & John Potter 2020	Pandemic politics, pedagogies, and practices: digital technologies and distance education during the coronavirus emergency	Honey and Mumford Learning Styles	Political maneuvering in relation to the pandemic, from misinformation and economic measures to policies of social distancing, quarantining and isolation; the use and misuse of large-scale data, statistics and visualizations; new forms of digitally mediated work, culture and personal life; surveillance systems for 'contact tracing'; the use of predictive epidemiological modeling; the development of techniques for better public understanding of science; and the political use of behavioral economics as a public pedagogy of population management. SAMPLE: The statistics of the number of increased online learning during and post pandemic.	Education has become an emergency matter, and along with it, educational technologies have been positioned as a frontline emergency service. Outlets have responded to the rapid switch to online education with useful guidance, advice, and references to extant research from promising studies that might support educators to make the best of this new educational emergency.	Pandemic education may also illuminate something of longer-term changes in the relationship between technology and society. But the need remains for critical reflection on the planetary pivot to digitally mediated remote and distance education. Technology ha s for many years been confronting questions and challenges of the political economy of edtech, digital inequalities, spaces, and futures of learning, and datafication of education. The coronavirus emergency has intensified and expanded these.
Daniel Rodriguez-Segura 2022	EdTech in Developing Countries: A Review of the Evidence		The emergence of educational technology ("EdTech") in developing countries has been received as a promising avenue	The overall success of interventions rests on the thoughtful customization of the EdTech solution to the	The most effective EdTech initiatives are those that emphasize self-led learning and

			to address some of the most challenging policy questions within educational systems. Classification of studies into four thematic categories based on the type of EdTech intervention analyzed: Access to technology; technology-enable d behavioral interventions; improvements to instruction; and self-led learning. SAMPLE: Review of India, Africa, Bangladesh, Sri Lanka's increase in Ed tech start ups and interventions over the last three years.	policy constraints at hand. EdTech interventions across all thematic areas can and should act as complements by leveraging their respective comparative advantages to address deficiencies within educational systems in developing countries.	instructional improvements. Similar to technology-en abled behavioral interventions, which often have low marginal costs, they are less likely to produce big benefits yet are very cost-effective nonetheless. Increasing access to technology is a critical first step for various other sorts of interventions even though it is not enough to increase learning on its own.
Aras Bozkurt 2020	Educational Technology Research Patterns in the Realm of the Digital Knowledge Age		The review showed that after 1993, there was a sudden increase in the number of educational technology publications, and that in terms of subject areas, social sciences dominate the field, which suggests that there is a need for more interdisciplinary research. The following themes from over the course of almost three decades were identified: 1993–1999 multi media learning and instructional design; 2000–2004 convergence of educational technology, distance education	While there has been rising awareness about the ethical side of educational technology, especially after 2015, ethics had been only a minor concern for a long time. Now there is an urgent call to further develop the research area of educational technology and ethics. Considering that learning is social, contextual, and goes beyond observed behaviors, what's needed	The analysis of subject areas indicated that the educational technology field is dominated by three areas, social sciences, computer science and engineering, with social sciences leading the pack at 50% of all contributions. . It would be worthwhile here to revisit earlier questions: Should we learn with technology or learn from technology? Some are lured

			and online learning environments, and educational technology integration in traditional learning settings; 2005–2009 revisin g curriculum for educational technology, educational technology in higher education and distance education, and the bottleneck of the significant differences in educational technology research; 2010–2014 online learning and higher education, integration of ICT and full potential of educational technology; and 2015–2019 data-d riven, smart educational technology, big data, and learning analytics. **While critical views are increasing, this study also observed that some discourse, such as arguments that EdTech will change education and replace teachers, are constantly articulated throughout the literature.**	is technology adaptation, which is a smooth and natural process, as opposed to integration, which is more about combining two things and involves a planned series of events.	by the technology, whereas others blame technology for making humans fools. The fact that the same terminology and discourse mark each of the periods examined gives one the sense of deja vu and is a reminder that history repeats itself, and apparently, will continue to repeat itself.
Rodriguez-Segura, Daniel 1 2020	Educational Technology in Developing Countries: A Systematic Review		Certain studies review the evidence for EdTech interventions in developed countries, there is currently no equivalent study for developing	A key component of some EdTech products which has not been evaluated in isolation is the optimal degree of adaptability,	The “self-led learning” studies focused more on a direct link connecting students to learning through technology

			contexts, in spite of the rising number of studies being produced. Studies are classified into four thematic categories based on the type of EdTech intervention analyzed: (1) access to technology, (2) technology-enabled behavioral interventions, (3) improvements to instruction, and (4) self-led learning. EdTech interventions centered around self-led learning and improvements to instruction are the most effective forms of EdTech at raising learning outcomes. Similarly, technology-enabled behavioral interventions are less promising for generating large effects but highly cost-effective given their typically low marginal costs. While expanding access to technology alone is not sufficient to improve learning, it is a necessary first step for other types of interventions.	i.e. the potential for the product to auto identify and adjust the level of difficulty to a student's specific achievement level. Given the wide variation in achievement distributions within classrooms in many developing countries, this feature is one of the most enticing characteristics of EdTech, and it is hard to imagine that it would be anything but beneficial for each student's learning path. **Therefore, the key empirical question around adaptability is not whether it works or not, but rather what the optimal degree of adaptability is.** This is relevant since there are certainly higher development costs to creating deeper question banks with different difficulty levels, and to the idea of more sophisticated algorithms to precisely place students	like apps or educational software. At the same time, "technology-enabled behavioral interventions" also seems to be particularly effective at solving problems of informational-asymmetries, accountability and enforcement of duties, while also being particularly cost-effective and prone to scalability. The studies under "access to technology" did not show a pattern of raising learning, only students' acquaintance with technology. However, interventions that facilitate access to technology are a first and necessary step to implement other EdTech solutions like educational software, especially in many remote and deprived areas. Most importantly, there is a need for researchers and policymakers to move away from a dogmatic adherence to one of the four areas, and to

				within the performance bin that the EdTech product would target.	embrace the fact that all four areas can act as mutually complementary in addressing deficiencies within educational systems. Another important lesson that emerged from the four thematic areas is the importance for an EdTech intervention to be thoughtfully designed around a carefully identified contextual issue.
Alex FERNANDO BATISTA Marcello THIRY Rafael QUEIROZ GONÇALVES Anita FERNANDES 2020	Using Technologies as Virtual Environments for Computer Teaching: A Systematic Review		Augmented Reality, Virtual Reality and Mixed Reality technology applications in the learning process of relevant content to the Computer Science area. This systematic review aims to identify applications that use technologies to represent virtual environments and support the teaching and learning of Computer Science subjects. It was found that virtual environments show potential to teach basic content in courses related to Computer Science. In addition, the application of virtual environments in this educational	We must look into a set of good practices for instructional design when it comes to mixed reality. Future studies may also investigate if the adoption of AR, VR, and MR can increase the motivation of students to learn, as well, what is its impact on their learning effectiveness. Moreover, in the long run we also can investigate the impact of this approach on the students' dropout rate.	There is still not a clear vision of how to integrate technologies as AR and VR in a stable way into an educational process. There are difficulties like the resistance of traditional learning environments to integrate educational innovations, the opposition of teachers to adopt new technologies out of their comfort zone, and the costs involved to implement and maintain these technologies. The point is not simply about using virtual

			scenario has provided positive effects on the learning process, such as increased interactivity, easier content absorption, increased motivation and interest in the subjects, providing greater understanding and improving efficiency in content transmission.		environments to support education but how to produce effective instructional designs to integrate them so that the educational goals are achieved. **Encouraging a sense of lifelong learning can assist in several positive aspects in building learning, increasing the understandin g of the content addressed, the chance of retention of content in memory, the performance of physical tasks, collaboration, motivation, creativity, critical thinking, satisfaction, enthusiasm, among others.**
Carmen berenguer, Inmaculada Baixauli, Soledad Gomez, Maria De El Ping Andres, Simona De Stasio 2020	Exploring the Impact of Augmented Reality in Children and Adolescents with Autism Spectrum Disorder: A Systematic Review		Autistic Spectrum Disorder (ASD) is a neurodevelopment al condition characterized by persistent difficulties in communication and social interaction along with a restriction in interests and the presence of repetitive behaviors. The development and use of augmented reality technology	A shortcoming of this review relates to the sample characteristics, as most of the included works that met the inclusion criteria had samples of children and adolescents with high-functioni ng autism. Despite the increasing rate of this	Based on the results obtained, AR technologies seem to have a positive effect on improving different domains such as social interaction, social communicatio n skills, verbal and nonverbal communicatio n, facial emotion recognition

			for autism has increased in recent years. However, little is known about the impact of these virtual reality technologies on clinical health symptoms. The aim of this systematic review was to investigate the impact of augmented reality through social, cognitive, and behavioral domains in children and adolescents with autism.	subgroup of children with ASD 2, it would be necessary to analyze more studies that consider a greater heterogeneity of the disorder in order to generalize the results. **But studies of the smaller samples do show that these technologies may really help children with ASD improve social interactions or emotion recognition over time and in different developmenta l contexts.**	procedures, attention skills, or functional life in children and adolescents with autism.
Kendall Hartley and Alberto Andujar 2021	Mobile Learning in Pre-Service Teacher Education: Perceived Usefulness of AR Technology in Primary Education		Mobile learning is a resource that can enhance the teaching-learning process of students and improve the training of future teachers. Specifically, augmented reality (AR) technology allows for immersive and experiential learning without the need to leave the classroom. The purposes of this paper were to apply AR technology in the training of future Primary Education teachers and to analyze the perceived usefulness of AR	Effective use of the virtual resources will undoubtedly promote an improvement of the current practice in the classrooms, which will allow us to attract more students' attention towards the teaching subjects. As a result of this idea, the present study aimed to test whether experimentatio n with AR has a real influence on student motivation. As	The implementatio n of technological resources in higher education classrooms is beginning to be consolidated as a practice that improves student motivation. Through this paper, we have tried to continue strengthening the path towards educational innovation within the classrooms, betting on an education that is updated to

			in the classroom by future teachers. SAMPLE: A quantitative approach was used based on a design with a control group and two experimental groups with a post-test using a sample of 171 second-year students studying an education degree. **The results showed that experimentation with AR promoted a good increase in student motivation.** Finally, the findings allowed us to establish that the implementation of resources such as AR does not differ in the opinion of future teachers about the inclination to implement AR in the classroom.	well as measuring whether the experimentation with this type of resource encouraged receptive attitudes towards the future applicability of technological resources on the part of the students, and whether these were different from those students who were not participants in the experience. In this line, data showed that experimentation with AR promoted a slight increase in student motivation. In this sense, we continue in the line of research on contrasting experiences about the application of AR and the increase in student motivation rates. Furthermore, both the control group and the experimental groups agreed that the operation of this resource is not an obstacle to its future applicability. Finally, the correlative analysis extracted some	the current context from the application of mobile computing. The results of this research made it possible to determine that the implementation of resources such as AR does not differ in their perception. Likewise, future teachers involved in research have perceived in the AR a powerful resource whose didactic usefulness is considerable. In this way, they present a favorable attitude to the applicability of technological resources in the near future, although no significant differences were found between groups. Mobile learning is an opportunity to advance teaching and learning, since future teachers find mobile devices attractive and show favorable attitudes towards teaching that incorporates these resources that they can later

				relationships between the sets of variables that made up the study, such as the strong link observed between perceived utility and future applicability. These are variables that undoubtedly increase the importance of teachers providing new and useful resources that attract the attention of students. Similarly, the high level of correlation obtained between future applicability and motivation, as well as between motivation and perceived usefulness towards AR, made it possible to corroborate this idea and to emphasize the link between functional education and the motivation index	implement in the classroom. Furthermore, university administrators can organize training programs in emerging technologies for instructors on augmented reality, virtual reality and the use of mobile devices in the classroom, so that active ICT training policies are generated, with the aim of training university teachers and providing the institution with resources. Thus, it is possible to advance in the technological development of schools and society. In turn, data is collected in this study with which teachers could consider the AR applied in the classroom, without having previously conducted experimentation with AR, as it has been shown that there is no difference in motivation and positive perception of students' previous use of AR.

Table 1.2 LR Table

Overall common findings observed:

Encouraging a sense of lifelong learning can assist in several positive aspects in building learning, increasing the understanding of the content addressed, the chance of retention of content in memory, the performance of physical tasks, collaboration, motivation, creativity, critical thinking, satisfaction, enthusiasm, among others.

The need for community when it comes to Educators to learn from each other and support each other through the learning process. The importance of the teacher in the learning process.

The need for online and offline methodologies of teaching and learning.

According to Representing Young Children With Disabilities in Classroom Environments (Favazza et al., 2020) at least 1 in every 59 children across the globe has one or several learning disabilities. 1 in 5 children in India have learning and thinking differences such as ADHD or Dyslexia.

Around 7.62 percent of India's total population with disability was children, at approximately 2.04 million children out of 26.8 million of disabled people.

As of 2021, 2.8 million kids are actively getting services involving special education.

Augmented reality (AR) has become a potential technology tool to improve the skills of students with learning disabilities. Customization is important to special education because kids with special needs have varying abilities, limitations, and interests. Using AR, educators have the potential to accommodate the individual learning styles and limitations of special needs students. Furthermore, AR democratizes special needs learning.

Concerning the level of education of the participants in the experiments, it appeared that the majority of studies (57%) involved Primary education students, while Secondary education students (22%) were the second most commonly preferred learner type. Postsecondary, and Diverse population (aged 11–40) education represented a lower percentage (7%). In one study, the educational level of the participants was not mentioned. Thus, researchers were interested in exploring the affordance of AR in several levels of special education, but there was a tendency towards Primary education students.

Hence the **business problem** we have a hand is the following:

Special education teachers have an especially difficult job of not only teaching and managing their students, but also handling the paperwork and making sure accommodations and modifications are being met in the classroom.

There is a lack of intervention when it comes to tech(AR) in such classrooms which could greatly aid teaching, reduce fatigue and improve learning outcomes.

I am	Looking into the learning needs of special children of primary grades and classroom aids/needs for teachers
I am trying to	Help classrooms and households with special children to improve learning and engagement using AR products
But	The use of AR and tech is very less in inclusive classrooms and households
Because	Teacher fatigue, financial issues, management issues, lack of knowledge, lack of training
Which makes me feel	A simple tech intervention is needed to break the stigma and lack of use of tech

The following business goals have to be looked into as we proceed towards the research phase:

- Reach out to teachers and parents to test the product on their students and children
- Identify the right boards and schools which allow for funding of the product created
- Set the costing of the product right
- Identify number of schools and households willing to buy the product
- Scale the usage of the product across cities
- Profit margin results across the years.

CHAPTER III:

METHODOLOGY

This chapter describes the research process, elaborates on the sampling design, and explains the process of questionnaire design. Then the chapter explains the process of data collection followed by the statistical tools used.

3.1 Overview of the Research Problem

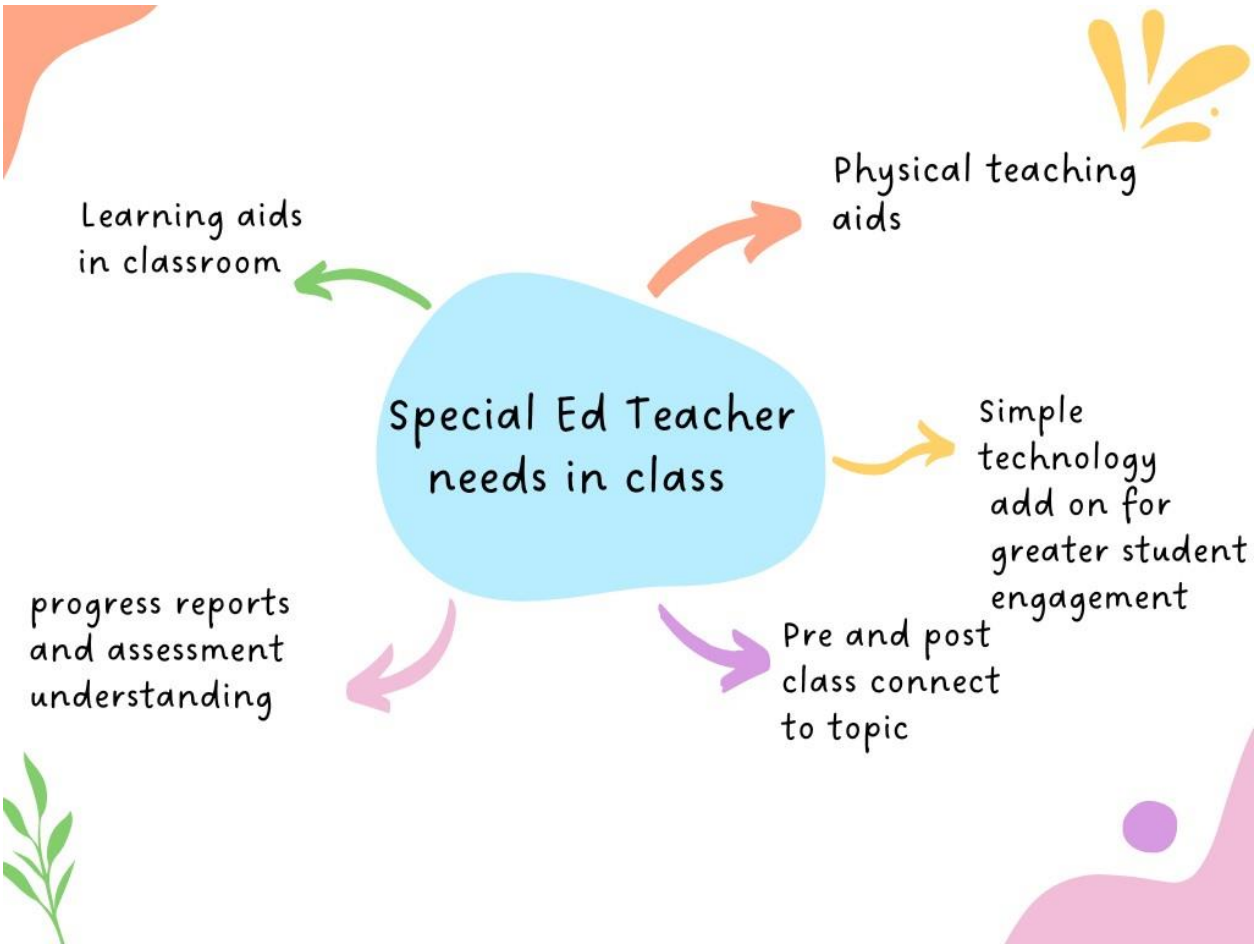

Figure 1.7 Special Ed Teacher needs

The Special Education Teachers Under Stress journal (Kokkinos, Davazaglou, 2018) used a self-report questionnaire to assess job stress, perceived sources, and demographic and

professional factors in a national sample of 373 special education teachers. Despite the fact that the participants' jobs were moderately demanding in general, they were especially worried about the special needs child's progress, safety, and social development. According to more than half of the teachers, educating children with autism creates greater stress than teaching students with behavioral and emotional disorders. **According to regression analysis, the implementation of the special educational curriculum was the most important predictor of job stress, followed by children's social and intellectual growth.** The implications of these findings for pre-service and in-service teacher preparation, support, and boosting job stress awareness are discussed.

According to the article "Overworked and underappreciated: special education teachers report stress and attrition," rising attrition rates and a shortage of highly qualified special education instructors have a negative impact on students and school districts (Hester, Bridges, 2018). This viewpoint was shared by the teachers who were interviewed. They complained about being tired of having to explain concepts to the kids. Teachers became exhausted as a result of the mental pressure, and a more casual style of teaching was adopted at times. This shows that the teacher's would require some sort of in-class aid which would help them make learning engaging, fun and less stressful for them.

The 'Overworked and Underappreciated' study goes into open-ended questions that were part of a larger mixed-method analysis to uncover the viewpoints of current special education instructors from all around the world. Teachers identify work-related difficulties and use their own words to explain why they left special education. In general, the data reveal that administrators do not support teachers and that their jobs have a detrimental impact on their overall quality of life, resulting in burnout.

This was also brought up by the Indian teachers who were questioned, with over half of them claiming that they were forced to leave the profession due to a lack of support. They now believe that the administration should have provided more support in the classroom, as they did not appear to have any special aids for these students. They also believed their mental health

was at jeopardy because the amount of labor required to teach was immense, far larger than that required of a regular pupil, resulting in a loss of motivation to continue.

Teacher shortages have been a problem for a long time. The retention rate is higher when teachers are satisfied. Teachers' health should be prioritized since it will lead to a more positive attitude toward teaching students. It also helps to overall school cohesion and the heightened status of the teaching profession. **The use of AR in such scenarios could greatly aid the teachers and reduce teaching fatigue.**

3.2 Operationalization of Theoretical Constructs

The constructs being looked at when it comes to the use of AR technology in a classroom of disabled students:

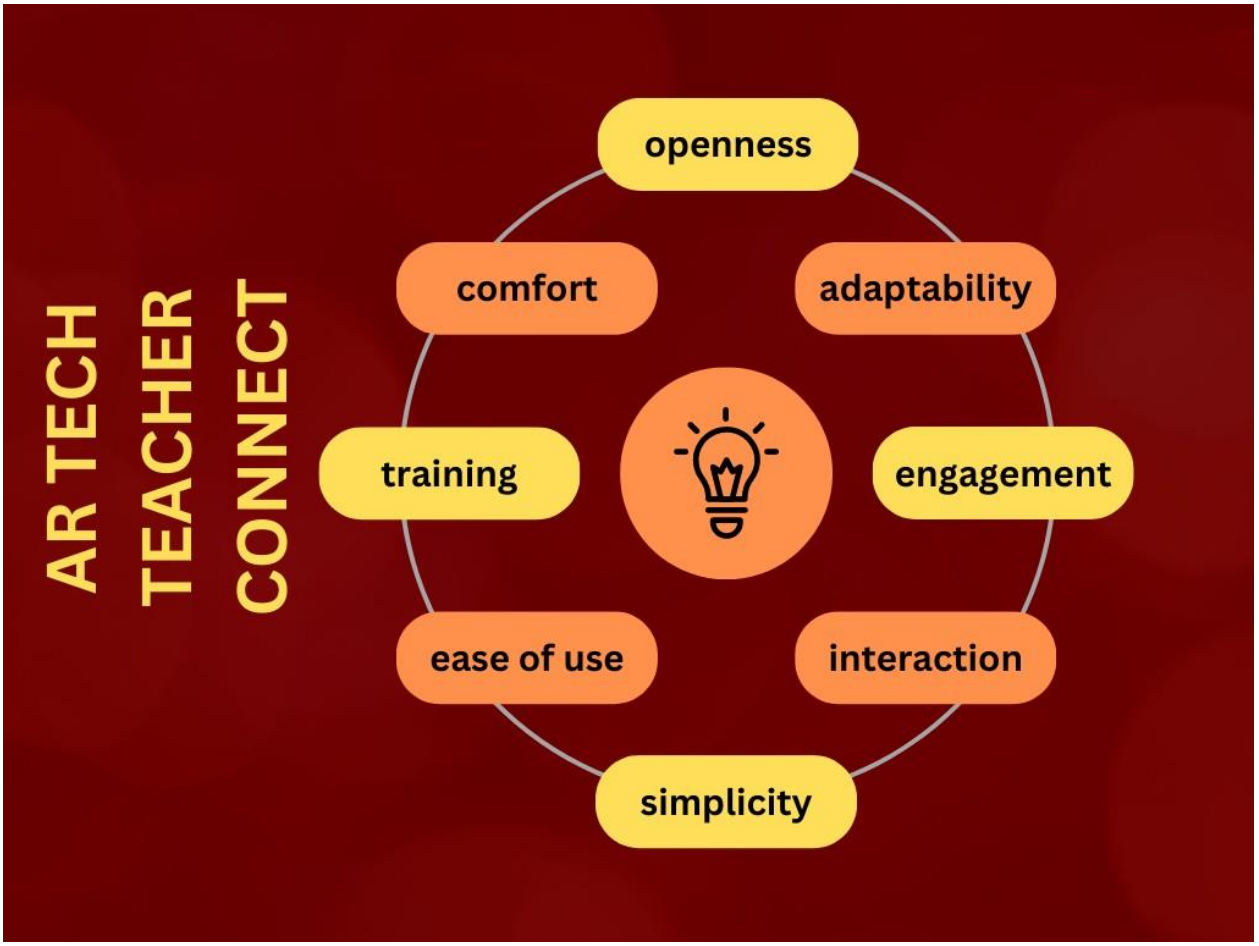

Figure 1.8 AR teacher connect diagram

- Ability of the teacher to learn the AR tech and adapt to it
- The openness of the school when it comes to the use of technology in the classrooms
- The openness of parents for the use of technology in classrooms
- The improvement in engagement or learning of the student
- Teaching aid availability
- Acceptance of students to the new teaching aid
- Ease of implementation in classrooms

Business Solution: Considering the business problem at hand, the market requires the following product to be created for classrooms/households with special children:

- Tangible, hands on product
- Low-tech intervention
- Adding a tech layer over a physical object
- Easy to learn
- Easy to open, lay out and pack up
- Easy monitoring
- Connectivism and Humanistic pedagogical approach

Considering the above, the following questions have been brainstormed post which the questionnaire was made.

Teachers:

Subjective: What is a normal day in your life like? What are some activities that you do every day, every week, every month with your students in the classroom?

- What kind of help/aid would you require in the classroom?
- What are your pain points and would a digital aid be or any help?
- How comfortable are you with technology and would you frequently use it at school if given an opportunity?
- Would you encourage video and online learning in classrooms?
- Are you open to alternate lesson plan suggestions?

- How long do you spend time planning a lesson for a topic?
- What resources do you use to teach in class at the moment?
- What kind of digital aids do you currently use?
- How do you track the child's progress at the moment and how efficient is that system?
- Do you enjoy teaching or does it sometimes become a burden due to constant assessment tracking and need for new ideas?
- What results in fatigue for the teacher? Is there a way to overcome this using our digital app?
- What do the kids relate to most in the classroom and what kind of teaching do they enjoy the most - moving around, listening, enacting, seeing visuals, etc.

Final questionnaire sent out:

Question	**Variables**	**Measurement**
1	**Is AR currently used in your classroom?**	**Yes** **No**
2	**Do you have any idea about AR technology used in Education**	**Yes, a lot!** **Maybe a little** **No idea!**
3	**Are you tech-savvy and able to learn simple technology when given basic training?**	**Yes** **I can try** **No**
4	**Do you encourage technology in the classroom if it proves constructive to learning?**	**Yes** **No**
5	**Are you open to alternate lesson plan suggestions?**	**Yes** **No**

6	**If the child poses complex or challenging questions, what do you use to answer them and how effective are those tools?**	**Verbal tools** **Activity related tools** **Verbal tools are more effective** **Activity related tools are more effective**
7	**Do you encourage questions in class?**	**Yes, during the session** **Yes, at the end of the session** **Yes, only if there is time left**
8	**Are your learners more kinesthetic, auditory or visual learners?**	**Auditory** **Kinesthetic** **Visual** **A mix**
9	**Are the students receptive to animated characters?**	**Very receptive** **Not interested** **Distributed Interest**
10	**Will your students be able to handle flash cards?**	**Yes** **No**
11	**Is it possible to continue the class without a full-fledged facilitation and mediation? Can the activity run on its own once the teacher gives instructions?**	**Yes** **No**

12	**How much teacher aid is needed?**	**Constant** **Half way** **None, once the instructions are given**
13	**Does your class have a mixed age group?**	**Yes** **No**
14	**Do you follow the multiple intelligence theory while planning lessons?**	**Yes** **No**
15	**Do you perform assessments post end of sessions?**	**Yes** **No**

Table 1.3 Questionnaire

3.3 Research Purpose and Questions

In the field of social science, the most common approach to classify research is according to purpose, process, logic and outcome of the research (refer Figure 3.1).

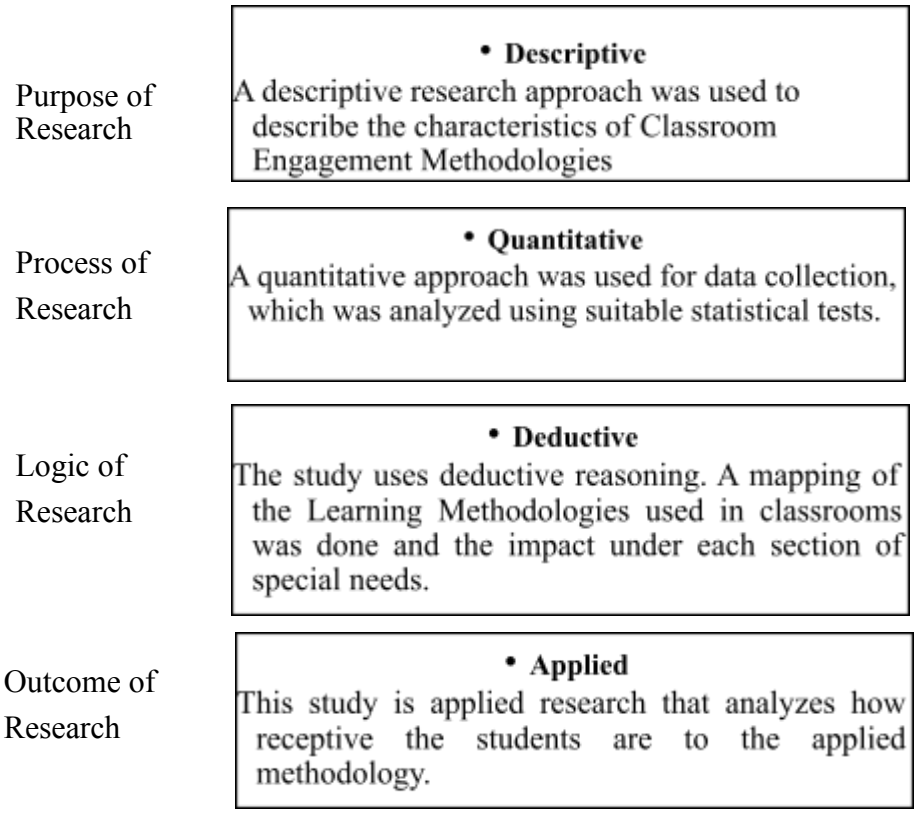

Figure 1.9 Research Flow

Source: Author's compilation

Given below is the larger framework and methodology of the study:

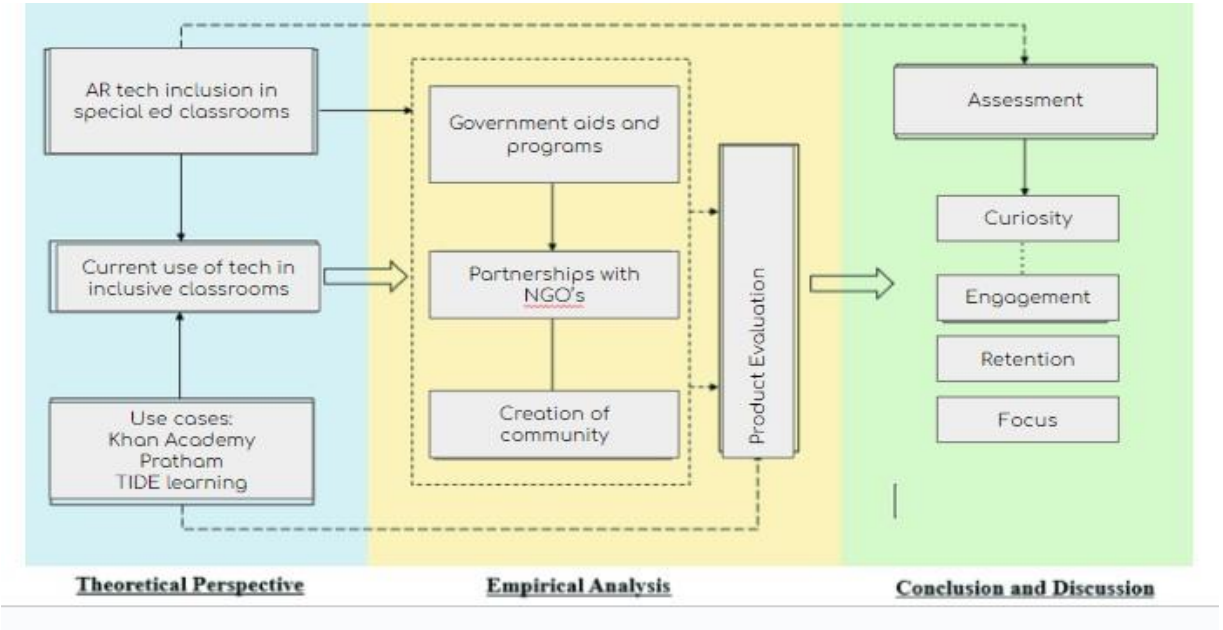

Fig 1.5 Research Framework

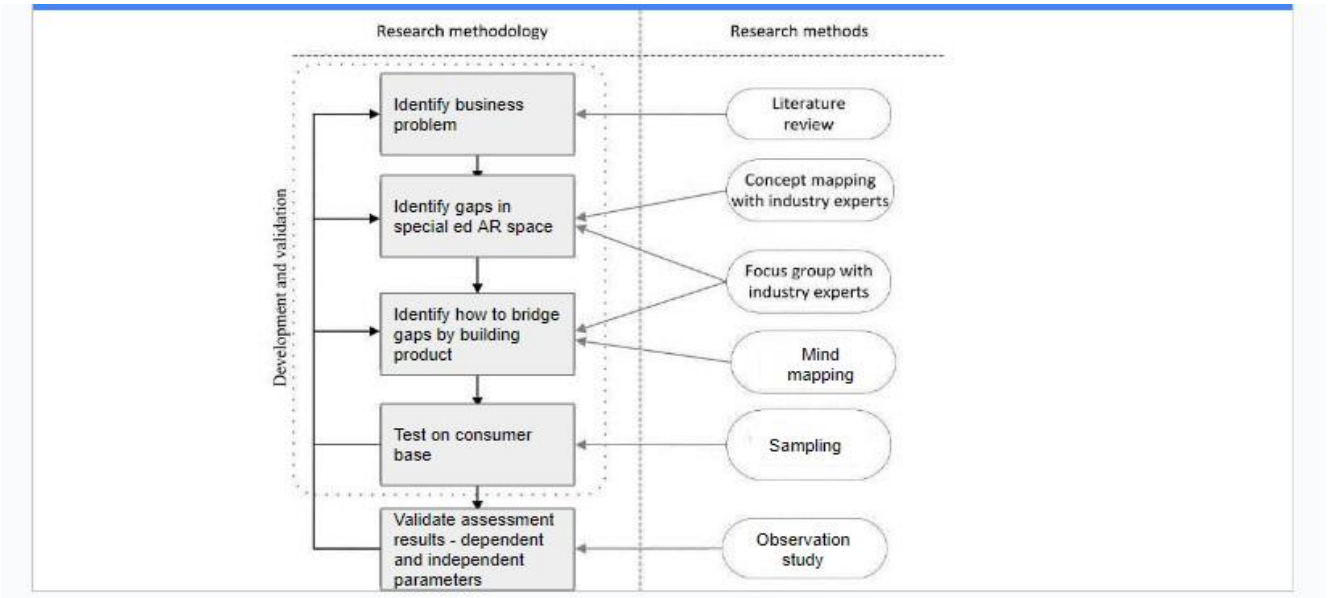

Fig 1.6 Research Methodology

Proposed research questions post questionnaire responses:

- Would we require training programs to clue in teachers on how to use the AR interface?
- Could we imbibe some sort of speech recognition so as to understand if the answer the child has given is right or wrong, and reward the child if so?
  -
- Which type of AR do we use?

Marker-based Augmented Reality– It triggers an augmented experience for users. Generally, it comes in use for retail and marketing purposes.

Marker-less Augmented Reality– It is a more advanced AR type. It enables users to place the virtual object wherever they want.

Location-based Augmented Reality– Next, this AR-type combines the virtual content to the generated experience for a particular area.

Superimposition Augmented Reality– It recognizes the given object in the real space and enhances it to provide an alternate appearance.

- Outlining Augmented Reality– It can identify lines and boundaries in areas that the human eye can't find.
  -
- Is there a possibility of incorporating VR alongside the AR experience?
- Is there a way of self-learning that can be induced using AR for the child with minimal intervention of the teacher?
- How much teacher intervention or aid is needed when AR learning is used?
- Can we build a storyline where there is a learning curve in the process?
- Can we have maps or large physical imagery mat over which the child can crawl on the AR can be initiated by the teacher?
- Would the use of character cards aid the likeness of the game for the children?

Business related questions - product front:

- What is the range of AR opportunities in the industry, and in what sequence should they be pursued?
- How will AR reinforce a company's product differentiation?
- Where will AR have the greatest impact on cost reduction?
- Should the company make AR design and deployment a core strength, or will outsourcing or partnering be sufficient?
- How will AR change communications with stakeholders?

3.4 Research Design

A descriptive study based on the survey technique was undertaken to evaluate the conceptual framework. The study measures the relationship between the characteristics of the student, teacher, and management in class engagement scenarios and how receptive the students are to such methodologies. The new prototype involving AR technology will also be tested in classrooms and an analysis was done to see if there is greater student engagement and learning.

3.5 Population and Sample

Sample Frame

There are more than 5.80 lakh children in the primary age group with disabilities like autism, dyslexia, cerebral palsy, and ADHD, out of which Tamil Nadu accounts for 62,538 children.

According to the study (2014). The Times of India. [online] 12 Aug. Available at: https://timesofindia.indiatimes.com/city/chennai/1-in-5-chennai-schoolkids-have-learning-disabilities-study/articleshow/40081936.cms [Accessed 14 Apr. 2023]., 1 out of 5 school kids in Chennai are disabled. Around 16% to 20% of children in city schools have learning disabilities.

Tamil Nadu has 2401 teachers working in the disabled sector, teaching kids of 21 different kinds of disabilities. They are across 5 boards - ICSE, IGCSE, Stateboard, CBSE, IB.

Out of which close to 700 are in Chennai in the interior district covering the areas of R A Puram, Kotturpuram, Thekidi, Saarangpuram, Mylapore, Mandavelli, Sholinganallur, Navalur, Adayar. The types of disabilities include the following:

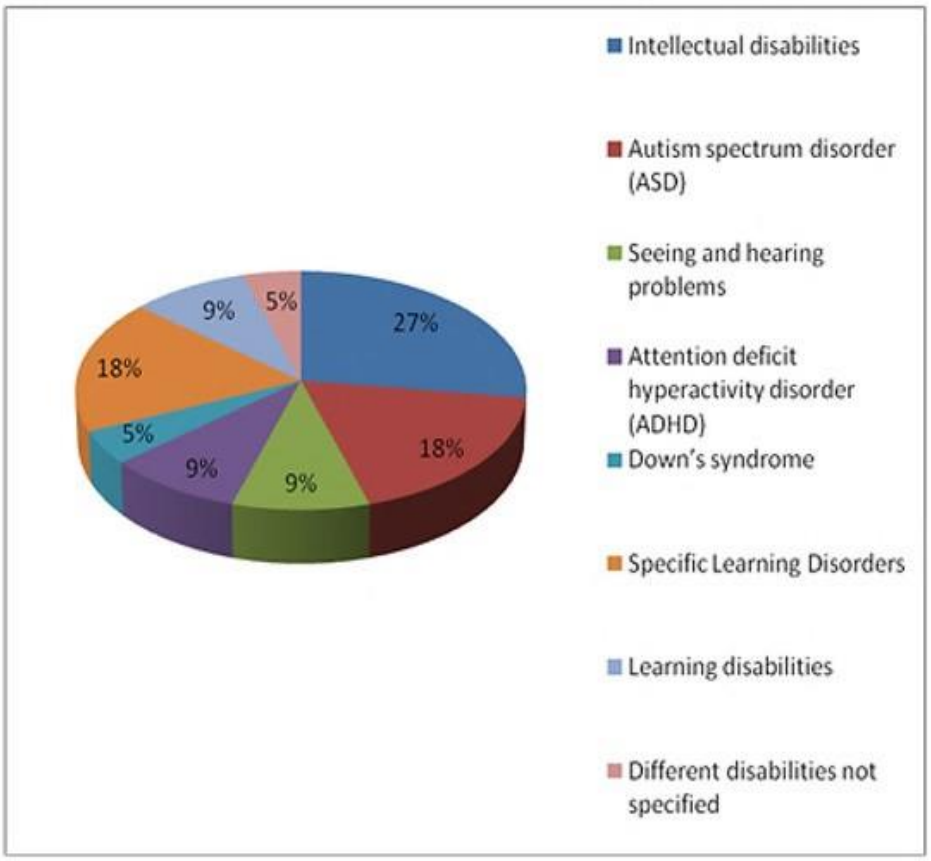

Fig 1.25 Disability mapping

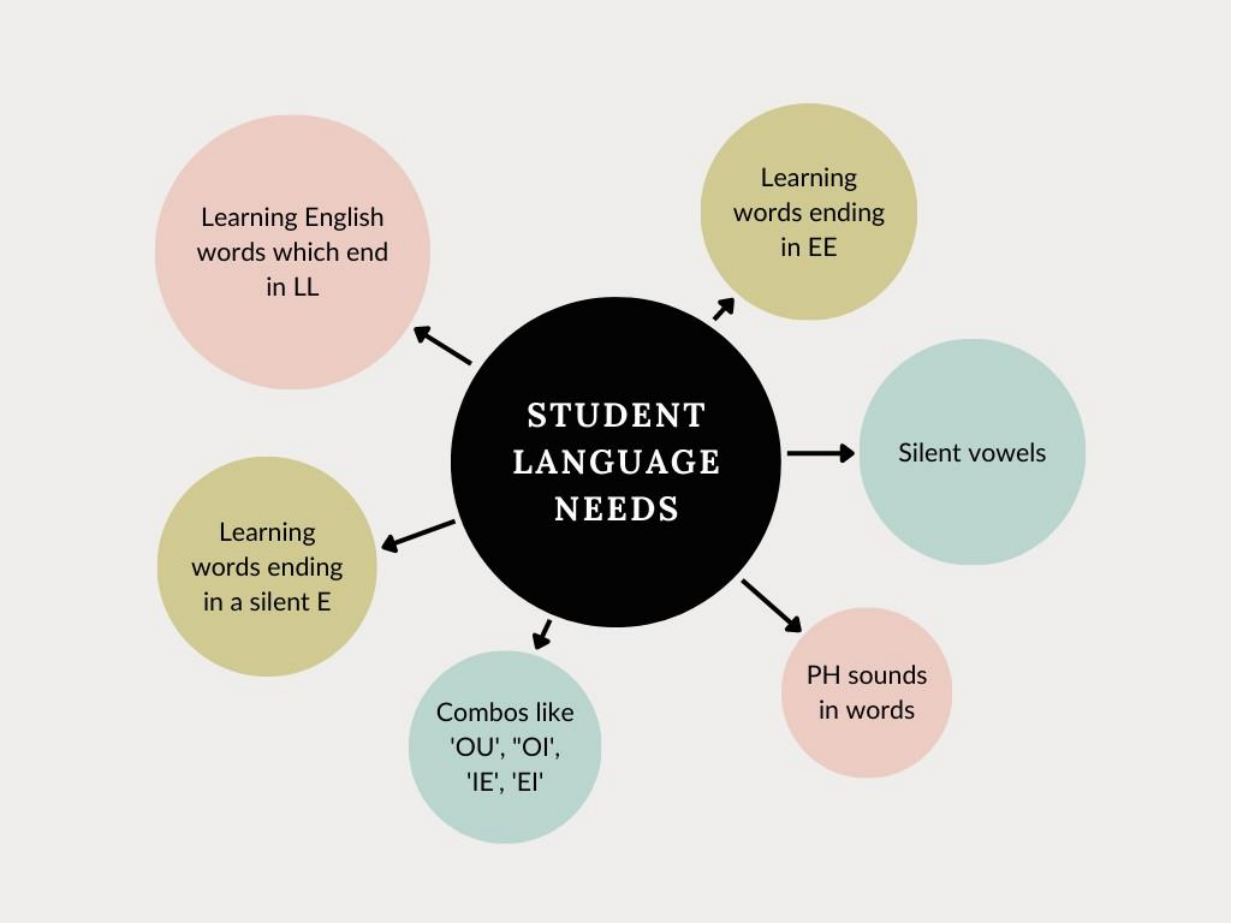

Fig 1.18 Language Needs

A mixed methodology was used via anonymized surveys and semi-structured interviews of teachers and school management. This was to allow for a combination of numerical measurement and in-depth exploration for creative on of the prototype. Equality in the gender of the kids on whom the tests have to be done using the prototypes has to be equal. The questions in the survey were answered through in-classroom observation. Participants in the interviews were selected by approaching upper and middle Management of schools.

According to ‘Extended reality technologies in small and medium-sized European industrial companies: level of awareness, diffusion and enablers of adoption’ (Henri Jalo, Henri Pirkkalainen, Osku Torro, Elena Pessot, Andrea Zangiacomi & Aleksei Tepljakov, 2022), the

examining issues of diffusion of AR technology, need for continuous training, 3D modeling, teachers' and students' involvement in AR applications development, and factors that can affect AR application development in school settings. A semi structured interview guided by a questionnaire and the technique of observation were used to interview secondary education teachers in North-Western Greece. The questionnaire included five sections, including questions about teachers' profiles, the diffusion of AR technology, the need for continuous training, 3D modeling, and students' involvement in AR applications development. Teachers were given four sections to respond to, and were then informed about AR technology. They were then given unlimited time to express their views.

The same was applied for the current research, a non-probability sample of 20 teachers was selected based on purposeful random sampling. The data was processed using content analysis and presented in diagrams and tables. A random sample of 20 teachers, 13 women and 7 men, working in primary education with different specialties and diverse teaching experience was studied. 70% of participants had been certified on ICT skills, 90% use some social media networks, 20% create their own material, and 60% sometimes create material.

In Accordance with the sampling size of 'Extended reality technologies in small and medium-sized European industrial companies: level of awareness, diffusion and enablers of adoption' (Henri Jalo, Henri Pirkkalainen, Osku Torro, Elena Pessot, Andrea Zangiacomi & Aleksei Tepljakov, 2022), and Marketing Research (naresh malhotra, 2007), Exploiting Augmented Reality Technology in Special Education: A Systematic Review (Cleo et al., 2020) 100 teachers were surveyed to understand the extent of use of technology in their classrooms. 20 teachers were interviewed and in classroom sessions were done with them to test the prototype. This was done across 5 boards- ICSE, CBSE, IGCSE,Stateboard, IB board.

Multi sampling was used here as we saw two target sets for the product. The parents of the students chosen to test the product on, were interviewed. 5 schools, with 20 special students in

each school. Which makes a total of 92 couples and 8 single Moms.

3.6 Participant Selection

The teacher's were spread across 5 schools of different boards in Chennai. According to Inclusive Education for persons with disabilities in primary and secondary education' (Lenin Iyer, 2020) done in Chennai, and 'Prevalence of disability in Tamil Nadu, India' (Banurekha Velayutham , Boopathi Kangusamy, Sanjay Mehendale, 2017), there are more than 5.80 lakh children in the primary age group with disabilities like autism, autism, cerebral palsy and hearing impairment, out of which Tamil Nadu accounts for - 62,538 children. According to the study 1 out of 5 school kids in Chennai are disabled. Around 16% to 20% of children in city schools have learning disabilities. The findings are based on a sample study of 200 students by Chennai-based clinical neuropsychologist Dr B S Virudhagirinathan, who has researched this field for several years, with Help Child Centre for Learning Difficulty. The study is a state wise research across Tamil Nadu of about 4000 children using a systematic random sampling method. These included children studying from class 1-6. During the study it was shown that the learning disabilities showed up the most from class 4 onwards. The sample study was conducted between equal numbers of boys and girls. Out of 200, 50 were from CBSE schools, 50 from stateboard and an equal number from Anglo Indian and Matriculation Schools. The children were from English medium schools who took Tamil as their second language. The research showed that 16% to 20% of the students had learning disabilities. The quarterly progress report on inclusive education by the state department showed 0.015% between the ages 6-14 had learning disabilities. The global prevalence rate of disability stood at 12% and was on the increase. The study was done across boards, with no gender biasing. An equal set of boys and girls were chosen. In accordance with the study of (Dr B S Virudhagirinathan, 2022), the following schools across the four boards were selected.

Figure 1.10 School board list

Also in accordance with the study by **(** Dr B S Virudhagirinathan, 2022), the following disabilities were chosen to look into as they were the prime disabilities found in students in Chennai, Tamil Nadu : ADHD, Autism, Intellectual Disability, dyslexia.

The sample that needed to be studied was drawn from an infinite population. The population was heterogeneous and widely distributed. Since this was a very hands-on prototype that eventually had to be tested, schools were physically visited and the classroom engagement scenarios were observed, allowing us to form insights from the same. The questionnaire was sent to the teacher's post-classroom observation to receive apt feedback.

3.8 Data Collection Procedures

The data collection procedures have been divided into 3 types: **derived, observational,** experimental.

Derived: A questionnaire was sent to the sampling set and the result of the questionnaire was administered to decide the direction to be taken for the prototype.

Observational: Classroom observation was done where the affinity of the learners towards the product was looked into.

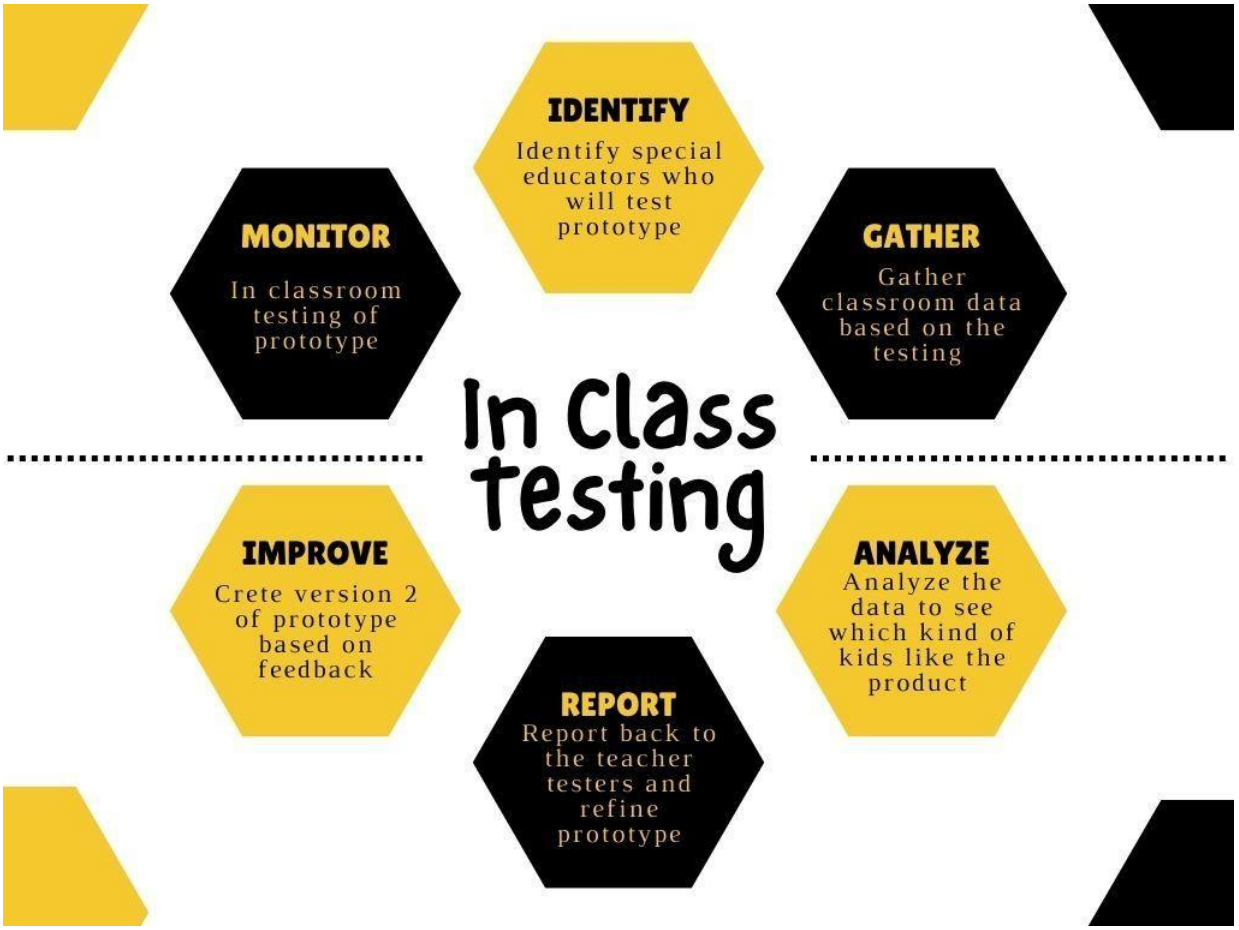

Figure 1.11 In class testing

Parameters for in class testing:

- Listening
- Concentration
- Learning Improvement
- Retainment
- Excitement

- Responsiveness
- Curiosity

The dependent and independent variables will hence be:

Study: Testing to check if the use of AR in Special Ed classrooms can aid student learning and engagement.

Independent variable here would be implementing the AR game teachers would use to teach a lesson in the classroom.

Dependent variable here would be the assessment results of the students post the usage of the AR game. Does usage of the game show improvement in learning and retention or not?

Experimental: The prototype went through a few versions based on the colors and characters that the children were drawn to and the results were determined.

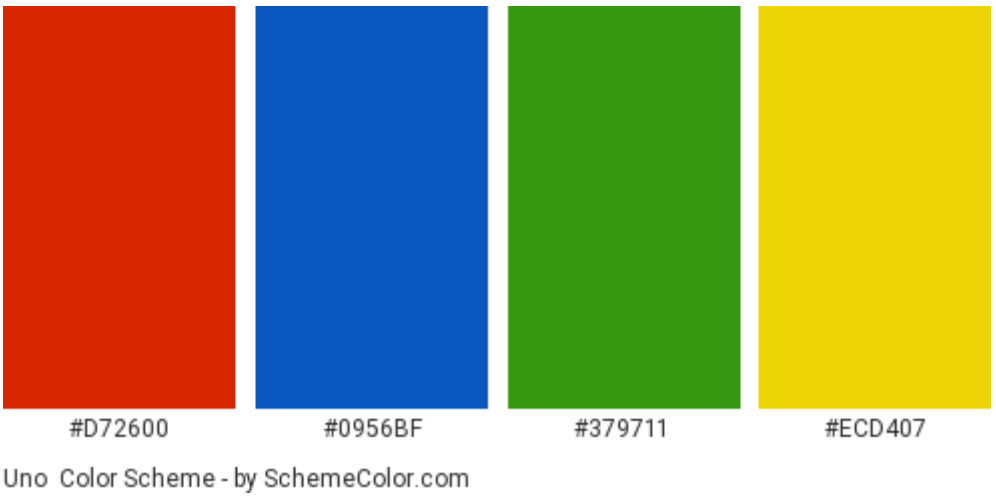

Figure 1.12 Color Scheme

Figure 1.13 Color Based Character Design

3.9 Data Analysis

Quantitative Analysis:

(1) Analysis was done to find the type of child who had the best affinity towards the product - those who found it engaging as well as learnt the concept taught well.

(2) Color scheme analysis to understand which colors the children were most receptive to.

(3) Analysis to understand the board in which the product could be administered .

(4) Dependent and Independent variables involved while testing

Below is the statistical analysis for the above 4 questions.
In Fig 1.14 we can see that the affinity of the autistic students is more towards the product, followed by dyslexic children.

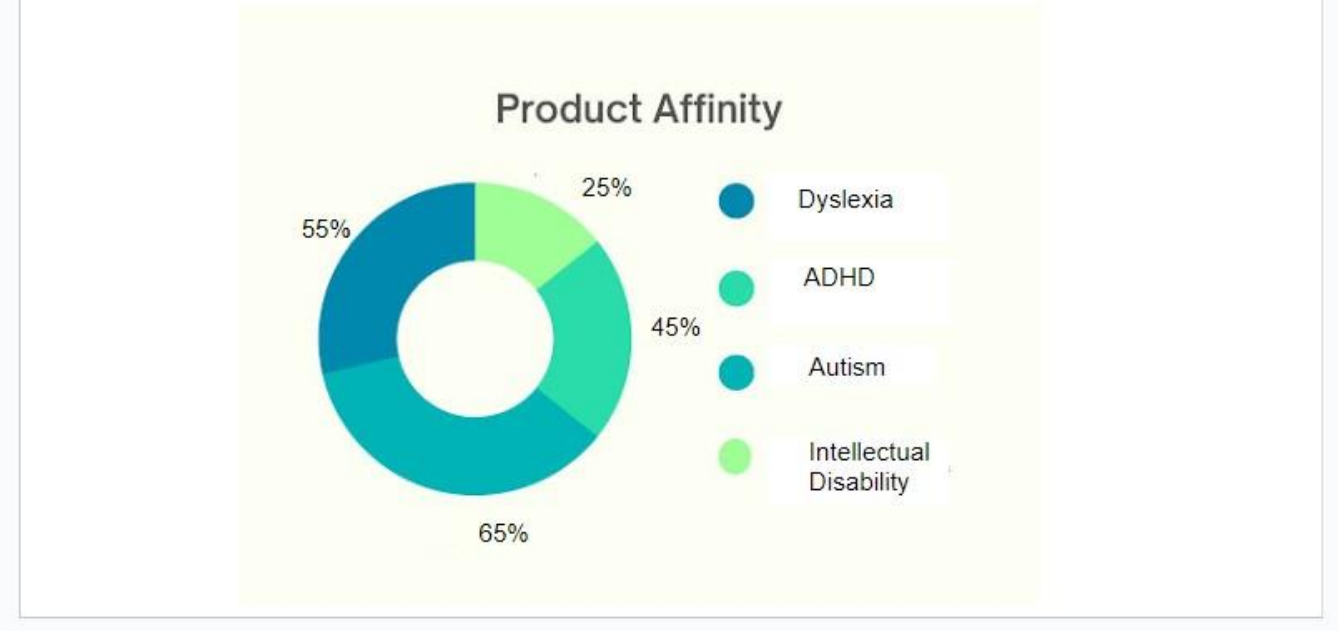

Figure 1.14 Product Affinity Chart

Green, blue, grey, pink and violet promote calm and a feeling of well-being. Blue reduces appetite and lowers body temperature. Blue is also the preferred colour for those with a visual impairment. Green helps to relax the nervous system and lessens feelings of stress.

Awareness Ribbons Chart: Color, Meaning, Causes (Garner, 2020)

Living, D. (2019). *Colours vs. Special Needs Individuals: What You Need to Know*. [online] Disabled Living. Available at: https://www.disabledliving.co.uk/blog/colours-vs-people-with-special-needs [Accessed 16 Apr. 2023].

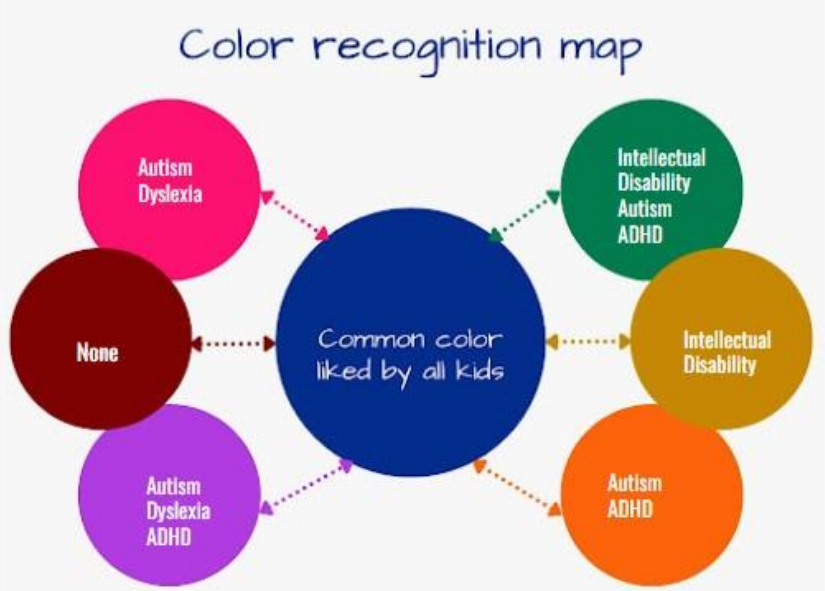

Figure 1.15 Color Code Scheme

Accroring to Fig 1.15, the colors which children gravitate towards are blue, green, grey, pink and violet. We have used the chromatography theory here to set on colors for the flashcards.

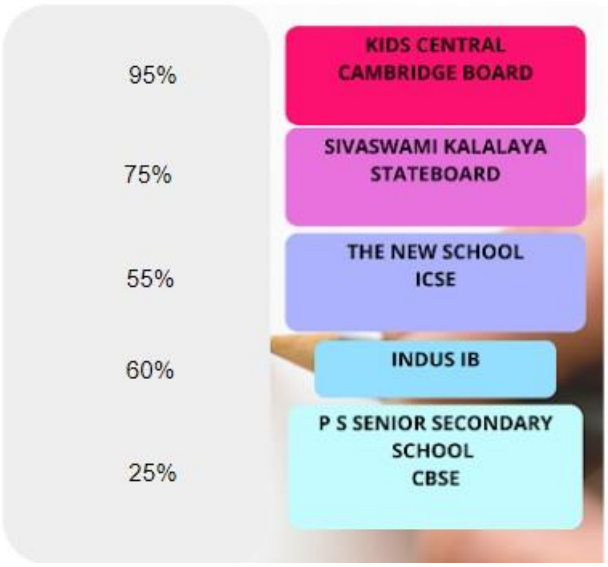

Figure 1.16 School board affinity feedback

According to Fig 1.16 we see that the Cambridge board has the greatest acceptance to such technology as well as the funds to buy such tech products.

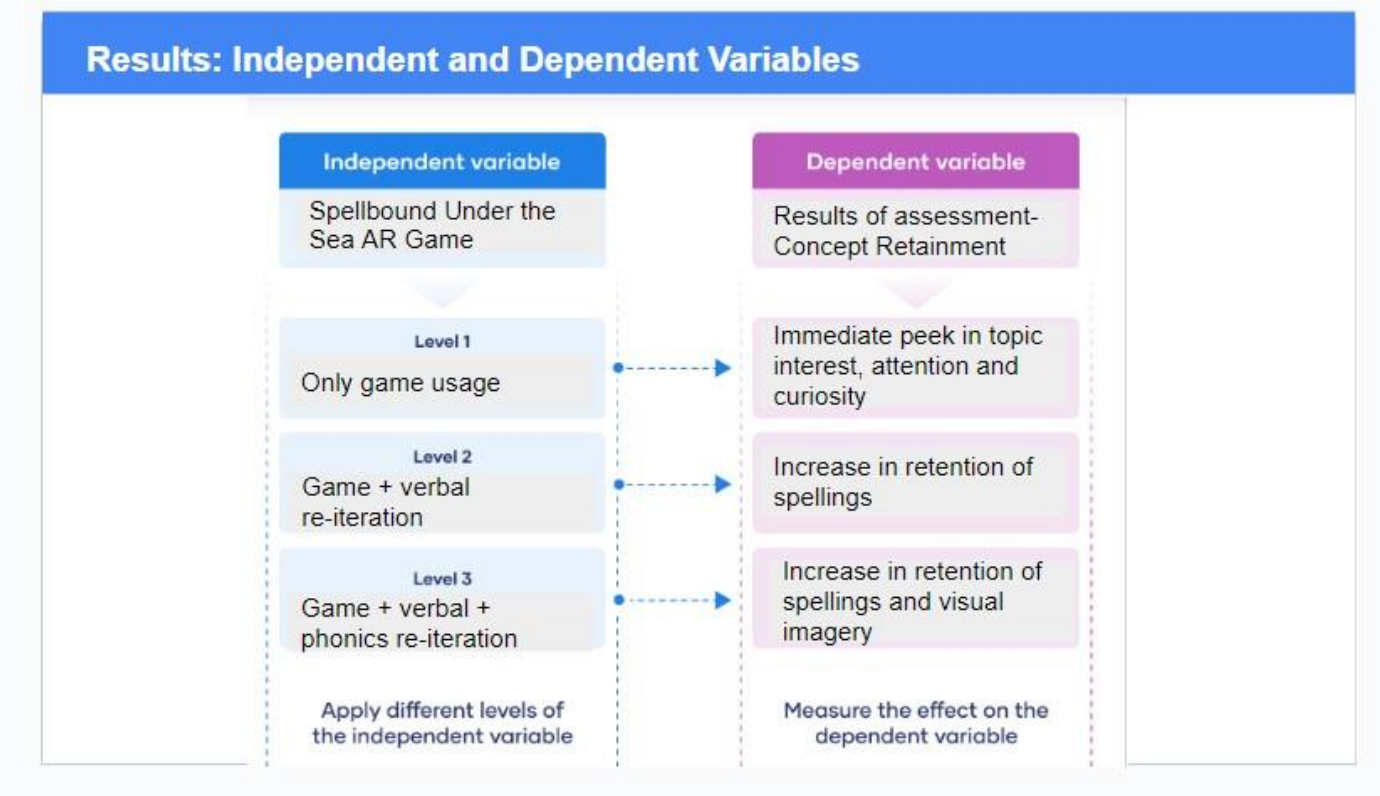

Fig 1.17 Independent and Dependent variables

Qualitative Analysis:

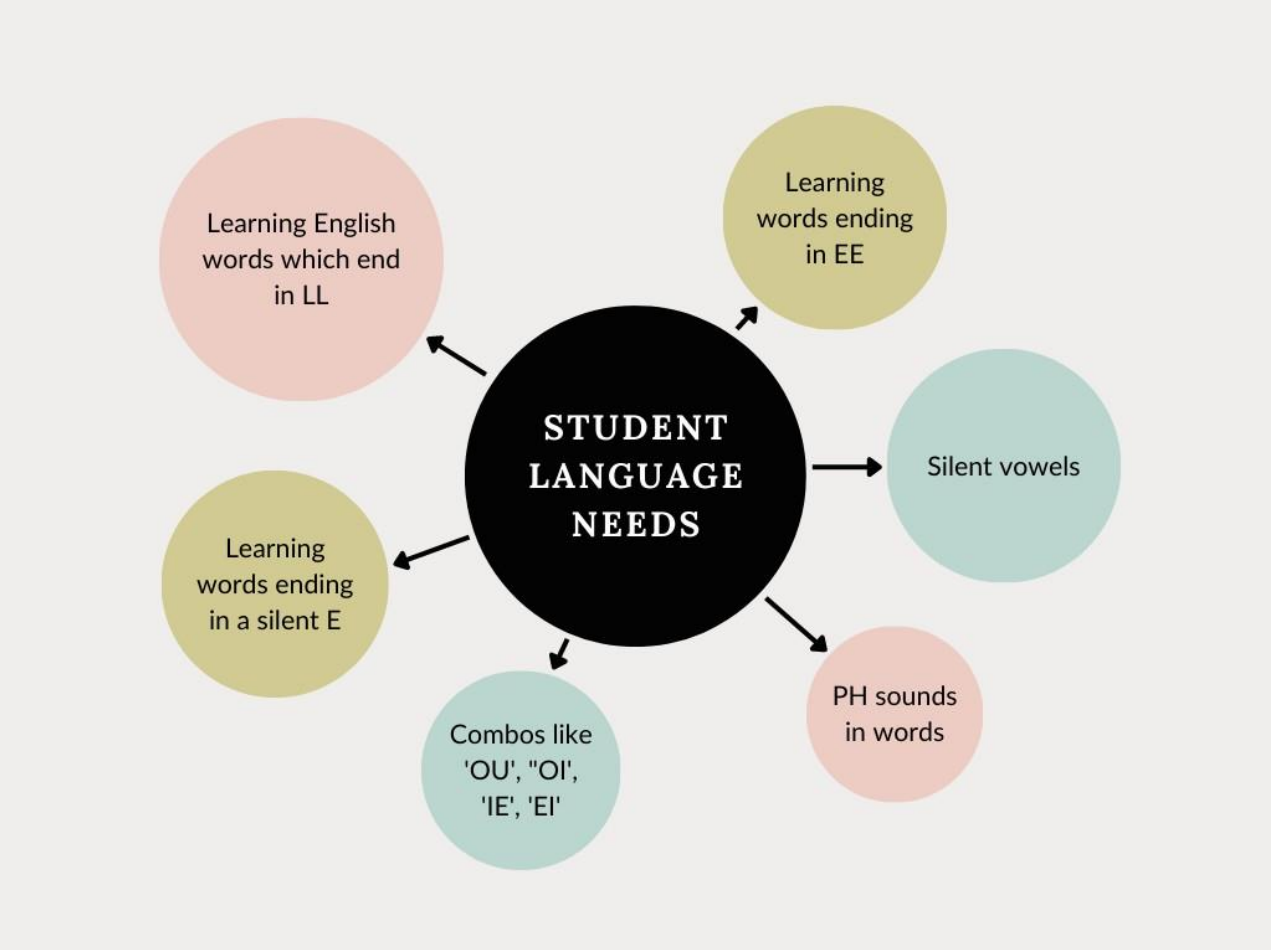

Figure 1.17 Student language needs

Language is a complex tool that helps us name things and bring communication to a new dimension. It is vitally important to provide a good communicative environment during early ages. Recent neuro-cognitive and psychological studies show that the first two years of life interaction experiences are crucial to early child-parent bonding. Studies also show that visual stimuli are widely available and it is inevitable in a learning environment, and that visual aids can be used as augmentative and alternative ways for words.

3.9.1 Storytelling through AR:

In accordance with ‘Storytelling in early childhood education: Time to go digital’ (Maila D H Raheim, 2021), the need for dynamic imagery in story formation and storytelling would aid the learning of language for such children. Storytelling would have a more visual appeal as opposed to static imagery or just words. This would also improve the ability of the child to connect the dots and understand story flow and chapter enhancement.

3.9.2 Gamification: The Importance of Flashcards

According to ‘The Utilization of Flashcards in Children Information Literacy Development’(Islahun Permata et al., 2021), flashcards appeal to visual learners and can be used to stimulate kinaesthetic learners too. They are a great way to introduce learners to new vocabulary. There are endless ways to use them in the classroom to practice and revise vocabulary.

According to the study, the utilization of flashcards in children information literacy development is as follows:

A flashcard is a tool for teaching students information literacy, which also include tasks like story-telling, writing, and analysis. Flashcard games that students find entertaining and that can boost vocabulary, linguistic proficiency, and storytelling prowess are eagerly started by them..

Here, we answer the question whether flashcards have an effect on the communication skills of 2-6-year-old children in primary school education. The hypothesis tested is whether the independence and the autonomy that could be given by the use of flashcards could push and launch spontaneous use of the new vocabulary.

We applied a teaching method that incorporates flashcards to enhance comprehension and thus memorization and give clues by flashcard manipulability. Thirty children in junior kindergarten

(ages 4 - 12) enrolled in primary schools in Chennai, were split randomly into experimental and control groups to participate in this acquisition study. They were taught using flashcards and the correct use of vocabulary was recorded.

The preliminary results indicate that the children reacted positively towards the introduction of flashcards during activities. Further observations suggest that the novelty element (the use of flashcards) could explain children's reactions, and that the experimental group performed significantly better than the control group.

Conclusion: The information age requires new learning methods that take advantage of digital tools and provide autonomy to practice outside of the classroom. This is a space where the use of flashcards for memory, re-calling and association of concepts and ideas, plays a key role.

3.9.3 Case study of UNO

According to 'Game refinement theory and its application to score limit games', (Nathan Nossel, 2014), game refinement theory has started to provide some interesting tools to measure sophistication of board games, sport games, and video games. In this paper, the game refinement theory was applied. This theory was applied to the UNO R card game, from which it identified valuable aspects regarding multiplayer and incomplete information games. Specifically, the analysis of the game refinement value zone of UNO was done and revealed the recommended number of players to play. Furthermore, measure of enjoyment between the players was compared. Experiments were conducted by developing various computer player types and simulating about 1.4 million UNO games. Results showed that critical states of the game and number of cards played are the important factors and confirm that UNO is best to play with 4, 5, or 6 players. Furthermore, another result shows that the second last and the last player get the most enjoyment out of the game.

We also see that the UNO cards are designed in a simple manner, with large words or numbers that are center aligned on the card as well as a simple color coding of cards that can be relatable to almost any age group.

The deck consists of 108 cards: four each of ‘Wild’ and ‘Wild Draw Four’ and 25 each of four colors (red, yellow, green, blue). Each color consists of one zero, two each of 1 through 9, and two each of “Skip”, “Draw Two”, and “Reverse”. These last three types are known as “action cards”.

3.9.4 Color scheme:

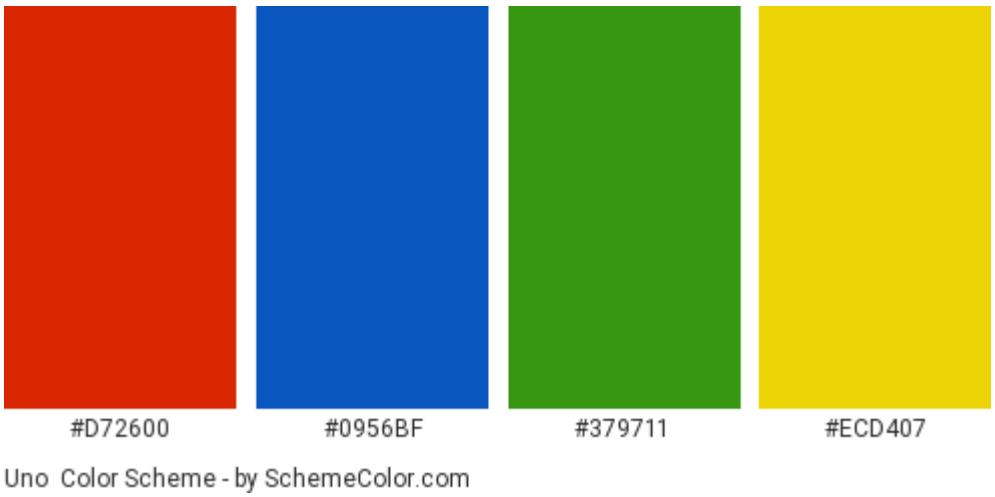

Figure 1.18 UNO Color Scheme

Figure 1.19 UNO Card Deck

The UNO card game has proved to be very simple to learn and the cards have been very easy to comprehend and understand. The popularity of the game was due to the simple, direct design and the simplicity of the rules of the game, which could be understood easily from a 5-year-old to a 70-year-old. This is the level of simplicity to be looked at when designing flashcard games for children in the learning arena too.

3.9.5 Case study of Brain Quest

In order for children to develop stronger mental performance abilities in real-world contexts, training methods should provide practice in tasks that include an effective component requiring social connections while using flashcards. Additionally, they ought to inspire over an extended period of time. In today's cognitive training games, the crucial connection between cognition and emotion, which is exemplified by "hot executive function," or the self-management skills we use when our emotions are high, and is linked to basic academic and life outcomes, is frequently overlooked. The motivation, relationships, and engagement of a group of ten-year-old students who spent five weeks playing the BrainQuest app-based cognitive training game in physical education classes are revealed by the solid qualitative data presented here. Concepts for

game design that aim to go beyond merely gamifying cognitive tests are presented alongside a debate.

As quoted from : (Workman Publishing. (2021). Workman Publishing. [online] Available at: https://www.workman.com/work-with-us/educators/pta-fundraising-program [Accessed 14 Apr. 2023])

Colorful and well-illustrated, grade and standards-aligned and filled with tons of interesting and diverse activities touching on a range of subjects and topics, Brain Quest's series of learning supplements can be a highly effective way for families to help students hone their skills in a more fun and flexible manner.

Intended to help students in Pre-K to Grade 7, roughly ages 0-13, with dedicated practice covering everything from basic words and colors to American history and geometry.

America's #1 educational bestseller, with more than 50 million copies in print.
Curriculum-based but infused with a spirit of fun, it's loved by kids, trusted by parents, and used and recommended by teachers because it works—and entertains.

3.9.6 The use of animated characters in education

When kids see animated content, it helps them develop social and critical thinking skills. This can be used to teach them valuable social lessons and develop a sense of empathy.

Learning science via animated movies: Its effect on students' thinking and motivation: According to some researchers, animations may lead to misunderstandings or prevent students from learning in a meaningful way. According to the study by (Alice Peters, 2017), the study looked at how animated movies affected students' learning outcomes and motivation to learn in order to test these assertions. Two pre- and post-questionnaires were given using the quantitative method: Skills in science thinking and the drive to learn science. The scores on the students' report cards were used to evaluate their overall science achievement. From 11 elementary schools, the research population (N = 1335) was divided into experimental (N = 926) and control (N = 409) groups. The use of animated films, according to the findings, improved

students' capacity for explanation and their comprehension of scientific concepts. In addition, the findings indicated that students who studied science through animated films developed greater motivation to learn science: compared to the control students' self-efficacy, interest and enjoyment, connection to daily life, and significance for the future. Students who used animated movies to study applied all three learning styles, adhering to the definition of multimedia: kinesthetic, auditory, and visual senses. The positive outcomes may be attributed to the use of multimedia and the fact that the students were actively pursuing new ideas that were relevant to their everyday lives.

3.9.7 Science Education in Primary Schools: Is an Animation Worth a Thousand Pictures?

According to 'The Effectiveness of the Use of Cartoons in Teaching English to the Children of Grade 5: An Experimental Study', (Naureen Nazar, Ammara Farukh, 2019), Science education focuses on processes and abstract ideas that frequently cannot be observed or touched. Teachers and educators now have the ability to present intricate animations that attractively illustrate scientific phenomena thanks to the development of web-based applications like Java, Flash, and others. The incorporation of web-based animated films into the science curriculum of primary schools was the subject of the investigation. The objective was to investigate teachers' perspectives on the significance of animations in enhancing the thinking abilities of young students and their approaches to incorporating animated films into their lessons. Additionally, the goal was to investigate the impact of animated films on student learning outcomes. Qualitative and quantitative tools were used to have informal conversations with 15 science teachers, and we gave pre- and post-questionnaires to 641 and 694 fourth- and fifth-grade students, respectively, who were put into control and experimental groups. Students in the experimental group studied science at least once a week through animated films and additional activities. The students in the control group only used textbooks and still images to learn about science. According to the findings, animated movies can help students develop a variety of thinking skills and encourage the use of a variety of teaching and learning strategies.

Additionally, the findings indicated that animations can foster scientific thinking, scientific language acquisition, and scientific curiosity. The fact that the students explored animated movies using a variety of learning styles and teaching methods made use of both visual-pictorial and auditory-verbal abilities explain these encouraging outcomes.

3.9.8 Multimedia application with animated cartoons for teaching science in elementary education

The above study also presented the results of a study on how animated cartoons were used in a multimedia application to see how well they helped science education. The researchers created a multimedia application in the style of cartoons, whereas animated cartoons were created from scratch using appropriate software.179 students between the ages of 10 and 11 participated in the study, which was carried out in a variety of elementary schools in Athens, Greece. The findings of the study demonstrate that the use of animated cartoons significantly improved young students' knowledge and comprehension of particular science concepts, which typically are difficult to comprehend and frequently lead to misconceptions.

3.9.9 The use of storytelling to develop the primary school students' critical reading skill: the primary education pre-service teachers' opinions

The aim of the above study was also to determine the primary education pre-service teachers' opinions about the use of storytelling to develop the primary school students' critical reading skills. The study was designed with a qualitative research approach and a criterion sampling method was used to select 53 participants. The collected data was analyzed through descriptive analysis. As a result of the study, it was obtained that the pre-service teachers had positive opinions about the use of storytelling to develop the critical reading skill and their opinions about the contribution of the method were compatible with the skills explained in literature within the context of critical reading. Consequently, the pre-service teachers suggested carrying out the studies on the applications of the method during their education, also they emphasized that these studies should be conducted with the primary education teachers.

This study presented the results of a study on how animated cartoons were used in a multimedia application to see how well they helped science education. The researchers have created a multimedia application in the style of cartoons, whereas animated cartoons were created from scratch using appropriate software.179 students between the ages of 10 and 11 participated in the study, which was carried out in a variety of elementary schools in Athens, Greece. The findings of the study demonstrate that the use of animated cartoons significantly improves young students' knowledge and comprehension of particular science concepts, which typically are difficult to comprehend and frequently lead to misconceptions.

3.9.10 Importance of storytelling:

Reading and telling stories to babies and children helps them develop their imagination, language, and emotional and social skills. You can occasionally read. Additionally, you can occasionally engage in cultural storytelling, sing songs, or read picture books. The oldest form of education is storytelling, which shapes, controls, and defines us. Stories teach us about life, ourselves, and others, as well as create magic and wonder. Additionally, they encourage respect for other cultures. The game "Tell a Story" motivates English language learners to speak and write English, encourages purposeful speaking, enhances listening skills, and engages boys. Storytelling can be used in schools to quickly raise basic literacy levels and improve skills, knowledge, and self-assurance in a variety of other areas. Story time helps children develop academically as well.

When children are asked to recall stories they have already read or when they are encouraged to write new stories, they can improve their memory. Children learn about cultural and lifestyle differences through storytelling. While reading stories to children, parents need to be careful about certain things, like changing the sound's pitch and using good body language.

Digital storytelling blends the ancient art of storytelling with contemporary tools to weave stories together with the author's narrative voice. It is used in many innovative ways at all levels

of education. A case study of a storytelling - art - science club in Jakarta, Indonesia, was conducted to explore how and why digital storytelling is used in early childhood education. The results indicate that simple digital technology made storytelling more entertaining, captivating, engaging, communicative and theatrical.

Since the beginning of human language, storytelling has been an important teaching tool. It aids in their comprehension of society and life in general.

Through settings and functions, storytelling has become a dynamic, contemporary presence over time. A contemporary initiative in education is digital storytelling.

Technology assists children from low- to medium-income households in excelling on tests of vocabulary, literacy, and math. It also enables teachers to access innovative and improved instructional approaches that support children's learning and growth.

Digital storytelling encourages students to organize and express their knowledge and ideas in a unique and meaningful way, which enhances learning. Additionally, it encourages students to create narratives out of their experiences, perceptions, and imaginations, giving educators insight into how children learn.

Young children can enjoy reading stories without knowing how to read them because they are becoming more and more accustomed to digital technology. When they collaborate with other people and computers to create digital stories, they can also improve their communication skills.

Even though many educators and parents are against using technology in early childhood education, digital storytelling appears to be a good way to teach young children.

The American Academy of Pediatrics, the Canadian Paediatric Society, the Department of Health of the Australian Government, and the Ministry of Health of New Zealand are just a few of the organizations that support limiting children's and adolescents' time spent in front of screens.

The inequitable infrastructure and a lack of human resources readiness pose challenges to the implementation of ICT in education. More than 80,000 schools in Indonesia do not have Internet access.

In the use of technology, human resource issues may limit its potential impact and raise educational inequality, particularly in developing nations.

When used correctly, media and technology can benefit educators and students, but they can also be misused.

A storytelling, art, and science club in Jakarta, Indonesia, that incorporates digital technology into its educational program was the subject of this study. The club has come up with a novel and creative way to teach contextualized storytelling with digital support that other schools and teachers have been inspired to use.

This study provides a useful perspective on the technological advancements in early childhood education and focuses on the use of ICT in early childhood education in Jakarta, Indonesia.

For the purpose of the triangulation process, the qualitative research included semi-structured interviews, observations, and document analysis. As they became involved in the process of data collection, the researcher made use of their senses to look and listen in a methodical and meaningful manner.

Throughout the data collection and analysis, the researcher kept the participants' data safe, transcribed everything, and did a member's check to make sure she understood what the participants had to say.

Triangulation, member checks, and the use of appropriate methods, procedures, and data were some of the crucial steps the researcher took to ensure the validity of this study. The sample and context were suited to the research question, methodology, design, sampling, and data analysis.

In this research, four teachers participated in a storytelling-art-science club that performed a digital storytelling program called the magic show. The teachers' views and experiences were explored, and additional data was collected from the children.

According to (Shuyan Wang, 2010) in Enhancing Teaching and Learning with Digital Storytelling, Jakarta, Indonesia, ten kindergartens and seven elementary schools hosted a magic show in 2000.It combines moral education, digital technology, the arts, science, and storytelling. To protect their anonymity and honor their integrity, the names of the teachers who participated in this study have been concealed. The club's preschool teachers have been teaching for between 10 and 35 years. They are all supportive of the use of storytelling in early childhood education and have extensive teaching experience with digital storytelling. Data analysis is carried out with analytical memos. There are two stages of code: The initial codes assigned to the data are the first-cycle codes, while the second-cycle codes are organized into meaningful categories, themes, or constructs. The researcher (Shuyan Wang, 2010) in 'Enhancing Teaching and Learning with Digital Storytelling', began by individually coding each interview transcript in the first cycle, then re-coded it, compared the first interview to the second, and continued coding until themes emerged. The researcher made assertions and reorganized and reanalyzed the data during the second cycle.

The researcher made the claim that teachers use digital storytelling to make moral education entertaining, exciting, communicative, and theatrical based on the four themes. Teachers use digital technology to enhance storytelling's enjoyment, amusement, and enchantment. Children adore it when their teachers appear in costume and with props.

Teachers explained that the use of straightforward media in the show could encourage children to communicate with one another and enable teachers to inquire about the stories.

The magician GMA, who was performing in an Islamic kindergarten south of Jakarta, Indonesia, was observed by the researcher. Playing the characters in the story got the kids involved in the story, and the teacher asked them questions and told them to move their bodies, make facial expressions, or imitate them. The instructor presented the students with the challenge to play

with fire and balloons and projected a massive forest fire on the screen. The kids said that if the paper touched the candle's flame, it would burn.

The students filled a balloon with water when the teacher inquired about balloons. The screen turned blue when the instructor lit a candle, and the word "EXPERIMENT" was written in large, bold letters. When the water-filled balloon was placed on top of a lit candle, the teacher demonstrated to the students that it did not explode or burn. The balloon's water absorbs heat, rises, replaces warm water with colder water, and the cycle continues.

The instructor added recorded voices to the background and used graphics to better dramatize and explain the stories to the students. In a non-religious kindergarten in South Jakarta, Indonesia, STA was in charge of the storytelling performance. He made a balloon character that was shaped like Elsa using the character from the movie Frozen. The instructor showed a silent movie scene in which Elsa's mother was trying to wake her up while she was sleeping in her bed. The children claimed that they would shake her body, poke her ears, or sprinkle water on her face.

The teacher demonstrated to the students how to prevent a balloon from blowing up using a needle and an inflated balloon like the noodles on a plate of spaghetti. The rubber in the balloon is made up of many long molecules that are linked together. After letting some of the kids try to poke the balloon, the teacher told a story about Elsa, who has trouble getting to sleep. During the two shows that were observed, the researcher asked the teachers about the show's planning and execution and listed some of the digital tools used by the teachers.

Teachers agreed that digital storytelling necessitates additional preparation in advance, but this preparation is essential to the presentation's success. Because teachers can create voices online using a variety of sounds, digital storytelling is easier to present than the traditional method.

Today's youth are becoming increasingly technologically savvy and participating in computer-based activities. In this study, teachers explained that using digital storytelling in the arts, science, and moral education makes certain subjects' explanations or practices more compelling and increases children's involvement in learning. Digital storytelling is a fun and engaging method for encouraging children to participate in education. It is a reliable tool for combining learning experiences with educational messages to create learning environments that are more exciting and engaging.

Children can use a computer program to create digital stories with the help of their teachers; however, in this magic show storytelling program, the teachers also presented the digital stories and prepared the stories beforehand. This research was carried out in Indonesia, where the majority of kindergartens are private, faith-based, and operated by communal or religious organizations. However, this study was carried out in the United States and examined the engagement of children in digital storytelling programs in kindergartens.

Digital technology encourages children to share their thoughts, ideas, and experiences and makes storytelling for arts, science, and moral education programs more engaging. Before, during, and after the storytelling, the children had conversations, responded to the teacher's questions, and participated in the storytelling activity.

Using recorded sounds and visual aids, the teachers transform storytelling activities into a dramatic and entertaining magic show. This is especially helpful for children because it makes the stories more dramatic and more realistic.

In this study, teachers combined real-world reading and discussions with simple digital technologies like PowerPoint to contextualize stories. They also added music, lighting, and other elements. They used the PowerPoint application rather than complex computer systems or

equipment. As they modified the timing and effects of slide transitions, added action buttons, and included audio and video recordings, the teachers' presentation skills were advanced.

Although simple digital technology makes storytelling more entertaining, captivating, engaging, communicative, and theatrical, many educators still prefer to tell stories in the traditional manner. Many people are familiar with PowerPoint, which can be learned independently. To run successful digital storytelling activities, teachers must be technologically literate and possess knowledge, expertise, and experience in child development philosophy. To acquire the media and technology knowledge and skills necessary for a successful program, they require training, opportunities for professional development, and examples of successful practice.

More schools should consider using digital storytelling in the classroom due to its advantages, and government funds should be used to upgrade school equipment. Although this study has revealed some limitations, it has provided significant theoretical and empirical information. To comprehend how frames are shaped in more common circumstances, additional research is required.

This study did not interview any children and only looked at how teachers use digital technology for storytelling in early childhood arts and science programs. To find out how the children themselves perceive and experience it, additional research is required.

3.9.11 Five Reasons Why Storytelling Is Important for Kids and Can Help Them Learn

Better Stories are a favorite pastime of kids because they can transport them to other worlds, arouse their imaginations, and leave lasting impressions. Children can learn better through stories. Storytelling can help kids get a sense of new people, places, or things, teach them about different values and beliefs, and give them new ideas to think about.

Kids benefit from the historical process of telling stories because it helps them hear language and build good memories. Children benefit greatly from storytelling in a number of ways, including their sense of dignity, emotional coping skills, vocabulary, and comprehension.

Storytelling is a wonderful way to teach children about daily routines, the passage of time, and compassion for others while also introducing them to new concepts and vocabulary. It can also be helpful when attempting to explain traumatic events, such as the death of a loved one or a family member. Before going to bed, children enjoy listening to stories because they can forget about their worries from the day.

By sparking new ideas about fantastic worlds, other planets, various points in time, and fictitious characters, stories help children develop their imaginations. Children gain a better understanding of how other children feel when they read and listen to stories with emotions.

Characters that kids want to care about in good children's books can make them laugh or cry. Take a jar that is empty and some paper that has been torn up. On each little piece of paper, write a random word or name, and ask your child to tell a story using that word or phrase.

After requiring your child to draw a map of a town, engage them in storytelling. Effective methods for conveying knowledge are necessary for education. Storytelling is a useful and personal tool that teachers can use to improve their students' educational backgrounds.

A story inspires intuition, and many stories are told orally in a family. Kids should also learn that good stories are a good way to learn and that good reading and listening skills are important for everyone.

3.10 Research Design Limitations

The data analysis was done in two phases. Phase 1 being the quantitative questionnaire sent out and Phase 2 being the qualitative in classroom prototype trial.

The research that was carried out throughout the observational and experimental phases was restricted in its scope due to geographical factors. The prototype was evaluated in Chennai in accordance with the research of the disabled student percentage by Dr B S Virudhagirinathan, who has researched this field for several years, with Help Child Centre for Learning Difficulty.. Because of logistical restrictions, the testing samples were only taken from these places. 5 schools were looked at by different boards - CBSE, Cambridge, IB, State Board and ICSE, and an evaluation of the prototype was carried out by bringing it into the classrooms and determining whether or not the product was easy to use for both the teachers and the pupils. The students' learning and engagement levels were evaluated, and the results were considered for future revisions.

3.11 Conclusion:

Storytelling using AR with the help of flashcards was proposed. Each flash card would have a line of the story which would be built upon. A new word that the child must learn is highlighted. Dynamic AR imagery is used to convey the storyline and an added activity to reiterate the word and the spelling of the word is done in between story cards.

The use of flashcards, puzzles and the idea of gamification in the field of education can also aid learning and engagement. Incorporating AR over flashcards is a great way to improve learning engagement. There are numerous instances of games such as UNO, Go Fish, Brain Quest which use cards to enhance learning and imbibing information.

The above aided in deep diving into how language is interpreted by the special children and how to bring in effective dynamic imagery using AR into the space to make learning effective, simple and engaging. The quality and type of imagery needed for such children which would induce better learning was looked into. We could form a metric system for the kind of images that can be used for more engaging learning and allow this to be a set of guidelines for AR image creators for special education purposes.

CHAPTER IV:

RESULTS

4.1 Research Question One

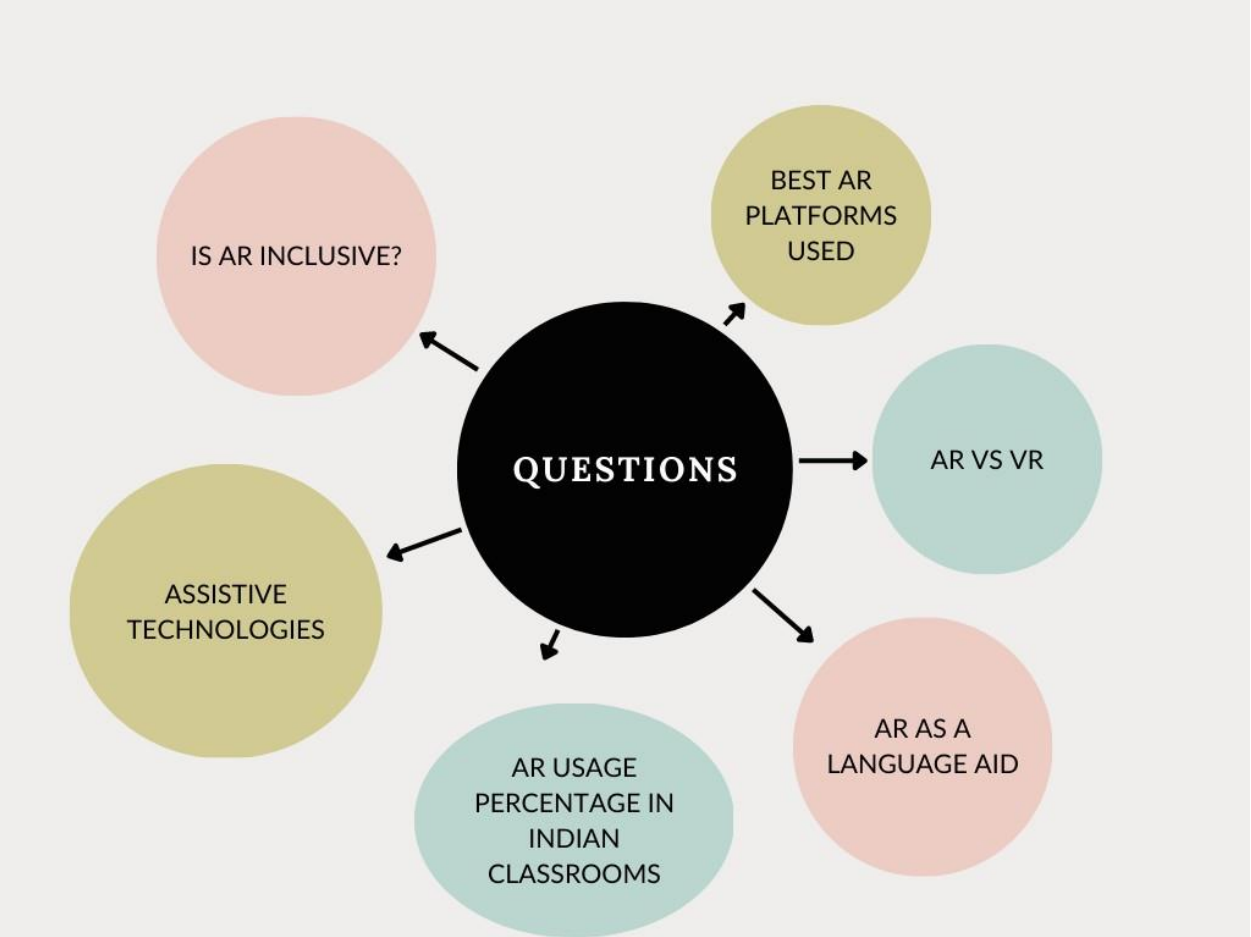

Figure 1.20 Question set 1

The primary research questions addressed by this review are:

To support the development of inclusive learning scenarios, what is the current state of augmented reality (AR) in education in terms of population, interventions, comparators, outcomes, and study designs, specifically in the specially abled sector?

Based on this primary research topic, a series of sub-questions were formulated:

- What are the benefits, limitations, efficacy, applications, obstacles, and reach of augmented reality in inclusive education?

- What sorts of augmented reality are the most promising for fostering inclusivity, and why?

- When examining the use of AR in inclusive education processes, what sorts of study designs have been considered for special students?

1. **What types of populations have been included in AR-supported learning scenarios?**

2. **What attention to diversity frameworks or models have been used to help the development of augmented reality (AR) applications that facilitate educational inclusion?**

3. **What technologies, inclusive of assistive technologies, have been created to promote the use of augmented reality for educational inclusion?**

4. **Which author's platforms and tools take into account the different needs of consumers while building AR-based learning experiences?**

5. **What is the impact of AR experiences on the outcomes described in this evaluation of the literature?**

After defining the research questions, preliminary analytical categories were constructed for each sub-question; these categories might be revisited during the review's execution. Next, the categories are displayed.

6. **What are the benefits, limitations, applications, obstacles, and scope of AR in inclusive education?**

• Education field: according to the International Standard Classification of education (UNESCO, 2013).

• Benefits of AR reported in inclusive education

• Limitations of AR reported in inclusive education

• What uses of AR have been reported in inclusive education?

• Problems reported with AR in inclusive education

• AR accomplishments reported in inclusive education

What sorts of augmented reality are the most likely to promote inclusivity, and why?

•AR types for inclusion: Justifications to be utilized for inclusion

7. **When examining the use of AR in inclusive education processes, what sorts of study designs have been considered?**

• Research technique

• Sample

• Procedure for data collecting

8. What types of populations have been included in AR-supported learning scenarios?

• Categories of groups with impairments

• Types of excluded groups in society

• Function within the varied population serviced

9. What attention to diversity frameworks or models have been used to help the development of augmented reality (AR) applications that facilitate educational inclusion?

• Developed frameworks for augmented reality and educational inclusion

• Augmented reality models for educational inclusion

• AR uses in inclusive education

10. What technologies, inclusive of assistive technologies, have been created to promote the use of augmented reality for educational inclusion?

• Technologies reported for educational inclusion

11. Which platforms and authoring tools take into account the varying demands of users when designing AR-based learning experiences?

• SDK‘s

• Programming languages

• Tools for authors

• Applications for 3D modeling

• Additional programmes

12. What are the repercussions of the AR experiences documented in this review?

• Implications of inclusive education

4.1 Research Question Two

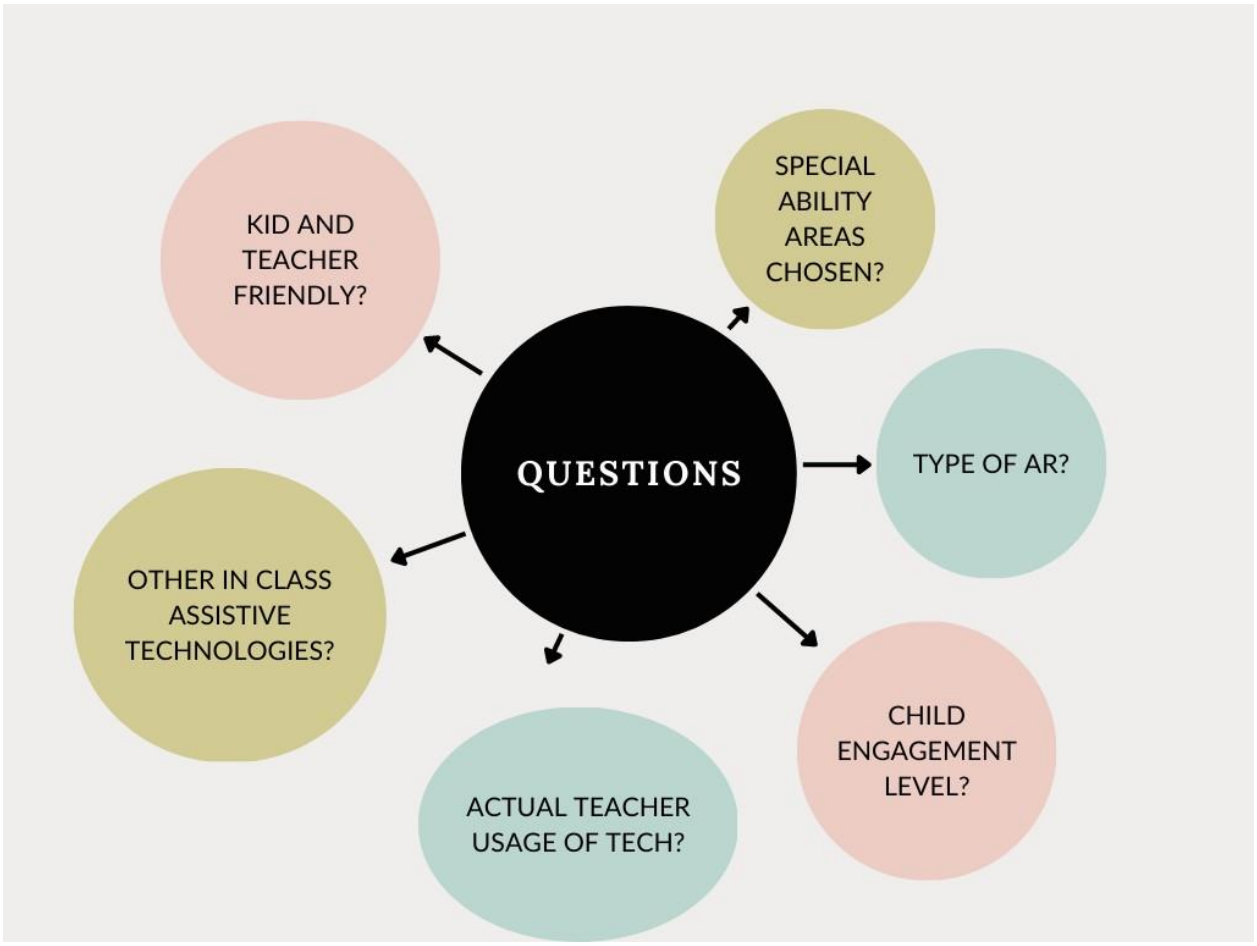

Figure 1.21 Question set 2

Proposed research questions post questionnaire responses:

1. Would we require training programs to clue in teachers on how to use the AR interface?

2. Could we imbibe some sort of speech recognition so as to understand if the answer the child has given is right or wrong, and reward the child if so?

3. Which type of AR do we use?

Marker-based Augmented Reality– It triggers an augmented experience for users. Generally, it comes in use for retail and marketing purposes.

Marker-less Augmented Reality– It is a more advanced AR type. It enables users to place the virtual object wherever they want.

Location-based Augmented Reality– Next, this AR-type combines the virtual content to the generated experience for a particular area.

Superimposition Augmented Reality– It recognizes the given object in the real space and enhances it to provide an alternate appearance.

Outlining Augmented Reality– It can identify lines and boundaries in areas that the human eye can't find.

4. Is there a possibility of incorporating VR alongside the AR experience?

5. Is there a way of self-learning that can be induced using AR for the child with minimal intervention of the teacher?

6. How much teacher intervention or aid is needed when AR learning is used?

7. Can we build a storyline where there is a learning curve in the process?

8. Can we have maps or large physical imagery mat over which the child can crawl on the AR can be initiated by the teacher?

9. Would the use of character cards aid the likeness of the game for the children?

4.1.1 Business related questions - product front:

- What is the range of AR opportunities in the industry, and in what sequence should they be pursued?
- How will AR reinforce a company's product differentiation?
- Where will AR have the greatest impact on cost reduction?
- Should the company make AR design and deployment a core strength, or will outsourcing or partnering be sufficient?
- How will AR change communications with stakeholders?

4.1.2 Proposed Dissertation Schedule and Milestones -Time Period Anticipated Activities

From 1st of Nov-15th Nov 2022
Understanding the real grasping of UNO and Brain quest for children with a test set of 10 children of age groups 4-6 years.

From 15th Nov - Dec 1st 2022
Going to Schools and understanding the use of flashcards in the early years and primary setup.

Dec 2nd - Dec 30th 2022
Creation of character cards and the larger sea template map for the underwater world.

Jan 1 2023 - Jan 30th 2023
Testing of the prototype for the test set of 20 children of ages 4-6 years who have learning disabilities as well as a set of 15 kids who don't have learning disabilities.

Feb 1st – Feb 28th 2023
Testing of the prototype in the school system for early years and primary levels to see where this product fits best.

4.2 Summary of Findings

The results of the analysis of the methodologies employed provide an overview of the approach to research in this field. They demonstrate that quantitative methodology predominates among the research designs (72,22%). Those with a qualitative approach (16.67%) or a blended approach (11.10) are less prevalent.

The use of Augmented Reality is being implemented across all levels of education; however, the primary focus is on primary education (44.44%), followed by secondary education (33.33%). There are very few studies (11.11%) that focus on early childhood education or postsecondary education.

The review has focused on the use of these technologies in the field of special education, and the findings indicate that virtual reality experiences are conducted primarily with students with autism, dyslexia, intellectual disabilities and ADHD. There are a total of 16.67% of studies that do not specify the type of educational need they are addressing.

During their intervention, researchers have utilized a variety of augmented reality (AR) techniques based on the type of technology used. The majority of investigations utilized mobile devices (50%) or computers (22.22%). Projectors (11.11%), the iPad (11.11%), and the iPod Touch (5.56%) were utilized to a lesser extent for AR activities. In all investigations, a webcam, either integrated or external, was used to enable student interaction with the objects.

Next, we considered the impact of Augmented Reality in the context of special education, i.e., the benefits and limitations of its use with students with special needs.
Among the advantages of using AR with these students, we can emphasize the following:

Academic performance (23.53 %), motivation (20.59 %), communication and social interaction (17.65 %), and autonomy (14.71 %) are the primary benefits of using augmented reality with students with special needs.

Low levels of teacher training (37.32%), scarcity of available AR technology (32.23%), lack of support from educational institutions (21.34%), and technical and accessibility issues (9.11%) in the use of AR tools are among the limitations of the use of augmented reality in the field of education, particularly in the field of special education.

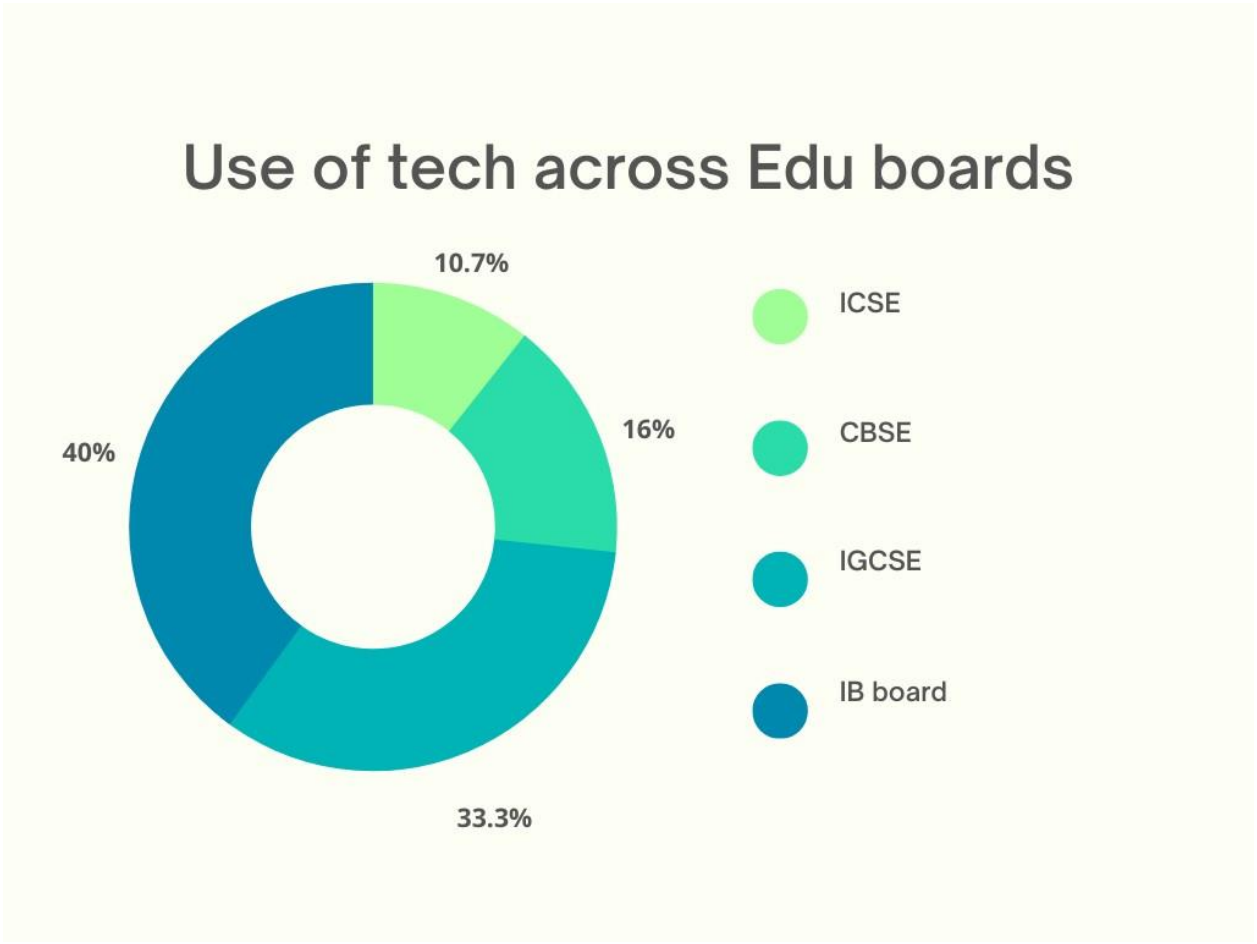

Figure 1.22 Use of tech across boards

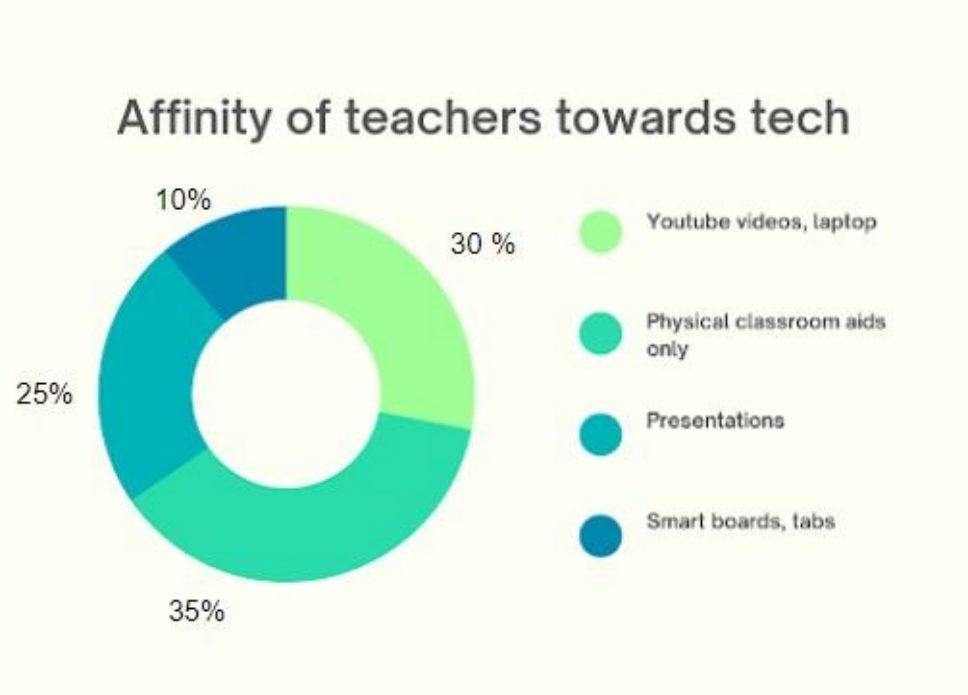

Figure 1.23 Affinity of teachers towards tech

Major Learnings from the Responses:

1. **The use of technology is not very high in majority of Schools**
2. **International Schools use SMART boards but have not progressed to AR and VR technology yet**
3. **Major schools need training programs for the teachers to understand technology**
4. **The use of Technology in classrooms has had a mixed response, some teachers looking at it as an aid and some as a distraction.**
5. **The use of flashcards and gamification has been taken in well by the teachers**
6. **Disabled students need constant mediation so self-sufficient instructional learning is not possible**

7. **Many classrooms for the disabled are mixed classrooms**
8. **Multiple Intelligence theory is used only by specialists in the special ed sector**
9. **Assessments are conducted on a weekly basis for students to assess progress on average.**
10. **Animation might appeal to a particular type of disability and might not be effective for all.**

4.2 Conclusion

AR in inclusive education: benefits, drawbacks, uses, problems, and scope.

Motivation (24%) and engagement (18%) are the key benefits mentioned in the trials. The review's top two benefits match prior AR education studies (Bacca et al., 2014; Diegmann et al., 2015; Chen et al., 2017; Fombona et al., 2017).

The AR engages students with impairments or special educational needs (SEN) (12%). This is intriguing since inclusive education relies on it. Hence, various research reveal the benefits of AR in dealing with kids with SEN, including those with auditory restriction (Carvalho, Manzini, 2017), visual limitation (Lin et al., 2016), autism (Tentori et al., 2015), attention deficit hyperactivity disorder (Lin et al., 2016b), and dyslexia (Persefoni et al., 2016).

The 8% cost of using this technology in the classroom is the fourth benefit. Although certain vision devices are expensive, “AR provides instruments for rapid and low-cost presence” (Zainuddin et al., 2010; Ab Aziz et al., 2012; Chen and Wang, 2015; Hsiao and Rashvand, 2015) and can enhance classroom processes.

Assisting with short-term memory (6%) is the sixth most common benefit (Vullamparthi et al., 2013; Cihak et al., 2016; Martín-Sabarís, 2017).

Benefits in order: learning efficiency (6%) Sytwu and Wang (2020). Learning (4%) Benda et al. (2020); Bülbül (2020). Student-centered technology (4%) (Tobar-Muñoz et al., 2021; Tentori, 2015). Student focus (4%) (Vinumol et al., 2013; Escobedo and Tentori, 2021). Training fun (4%) (Sheehy et al., 2021). Student exploration and easy technological use (4%) (Lucrecia et al., 2013; Marín Díaz, 2020). The student's happiness (4%) and most realistic perception (2%) (Miundy et al., 2020).

These findings suggest AR promotes inclusive education.

The majority of studies (54%), which allows room for further research into AR's limits in inclusive education and other contexts, do not discuss AR's limitations. The sample size (22% subjects) is one of the biggest drawbacks. These studies suggest sample size issues in research. Our literature search found that most studies included fewer than 10 participants, which is small (Zainuddin et al., 2020; McMahon et al., 2020; Cascales-Martínez, 2020). Yet, there are additional challenges, such as the fact that there are few kids with special educational requirements in the same group or school, thus the research evaluation is usually distributed. So, similar populations should replicate this research (McMahon et al., 2021).

The necessity to connect to the internet (5%), which is necessary for some AR applications, is the next barrier (McMahon et al., 2020). If not, AR technologies may be hampered.

The assessment found further AR weaknesses in enabling inclusive education

(1) technical issues while using the app (4%), which the authors say are crucial when studying individuals with physical or mental limitations since frustration must be managed. So, AR experiences and internet requirements must be meticulously planned (Sytwu and Wang, 2020).

(2) no study on mobile AR (MAR) in SEN education (4%). Mobile devices in education are not new, but more research is needed on using them with diverse populations in inclusive education (Sheehy et al., 2020).

(3) Qualified staff is needed (4%), especially teachers (Colpani and Homem, 2016) and helpers (Marín Díaz, 2016). Augmented content development may be more complicated.

(4) Inclusion and special needs research cannot be replicated (4%). (SEN). These studies address SEN issues, hence they cannot be replicated in other educational environments, with some exceptions (Chen and Wang, 2020).

(5) the study's 4% participant recruitment problem, which explains the sample size constraint above. Researchers have trouble discovering SEN students and getting their parents' consent to participate in studies (Lee et al., 2021).

4.2.1 Infrequent study constraints include:

(1) Luminosity issues (2%); AR technology, especially markers, need decent lighting.

(2) AR applications cannot add 3D images in application mode (2%), therefore users cannot update or add images.

(3) Long-term AR findings are needed to support inclusion (2%). To determine the time and student outcomes of long-term educational inclusion using AR, it should be examined.

Student digital competency training (2%). Planning and training are required for SEN students who don't know how to use technology (Cascales-Martínez, 2021). The competent personnel subcategory is similar to this one.

(5) The novelty effect may bias research outcomes by 2% (Cascales-Martínez, 2021). It may be due to students' technological obsession and lack of interest in schoolwork. Avoiding distractions requires time management and didactic methods.

(6) Using one tool to gather data (2%). In the case of children with diverse SEN, it is recommended to use multiple information gathering tools in the same study (Zainuddin et al., 2020).

(7) Additional research is needed to prove school acceptance (2%). To avoid marginalizing SEN students and other marginalized groups, AR research should always be expanded to find alternatives.

Handheld gadgets (68%), which promote educational inclusion through AR, are most popular. This demonstrates that AR applications on mobile devices, tablets and smartphones being the most extensively utilized, boost educational inclusion (Hsiao and Rashvand, 2015). PC and Webcam (12%) come second, especially when caring for children with autism spectrum disorders (ASD) or intellectual disabilities who need gadgets like desktop PCs. Third (6%), head-mounted devices or screens. They have been considered for autism, hearing, and vision impairment (Fernandez et al., 2021; Sandnes and Eika, 2021; Sahin et al., 2021). Deaf kids in regular schools wear glasses (4%) to communicate (Parton, 2020; Ioannou and Constantinou, 2020). Finally, large-screen projectors (2%) have been employed in certain circumstances to teach elementary school mathematics (Cascales-Martínez, 2020).

We observed that 58% of the studies evaluated focused on primary school pupils with various SEN, using UNESCO's 2020 international standard classification. AR ranks second in lower secondary education (12%). These two fields of application account for 70% of research, confirming the global trend towards inclusivity in primary education (Lindsay, 2020). Long-distance education (8%), based on Tesolin and Tsinakos (2018), ranks third. Finally, early childhood education, brief cycles of tertiary education, and undergraduate or comparable studies are not recorded in the literature examined, possibly due to the difficulty of recruiting a large enough sample.

The most important problem is long-term AR use in varied situations (10%). In this way, the solutions identified in trying to support inclusion make each study appropriate to a specific setting, but studies also show that solutions designed to aid children with SEN can benefit all students (Meyer et al., 2021). Thus, solutions established in various contexts should be pushed and utilized for a longer time to prove their efficacy. The authors of the papers referenced to the

review also recommend cutting AR vision technology expenses by 8%. Several AR devices are inexpensive, which is an advantage, while some, like spectacles, are more expensive. Because educational institutions frequently have a minimal budget for inclusion solutions, this is another difficulty. Finally, handheld device hardware and configuration potential must be increased (4%), to assure quality audio and video and an improved AR experience.

Creating individualized learning exercises (2%), allowing settings changes like sound control (2%), and (3). User connection limitations with the Kinect device (2%), a tool that is used in some cases as a motion sensor combined with AR to address some issues for children with disabilities, but when the number of participants exceeds 6, it cannot be used anymore; (4) creating strategies to avoid student distraction (2%); and (5) enabling students with visual impairments to use AR in their learning processes (2%). Although AR has been used with kids with vision impairments, it is unlikely to be used with blind pupils (Marín Díaz, 2020). Azuma et al. (2019) showed that AR may be used by blind pupils to perceive hearing, smell, and touch.

4.2.2 Promising inclusion-supporting AR types.

Because markers are durable and efficient, researchers used them 84% of the time when discussing inclusive education (Bacca et al., 2020). Markers are graphic symbols with patterns that are easily detected by AR software using any camera, triggering 3D objects (Wojciechowski and Cellary, 2019).

RA location (4%), which requires accelerometer and compass equipment and GPS Internet access, is the second category in the table. This type was utilized for intellectually disabled and Down syndrome students (Smith et al., 2020).

4.2.3 AR evaluation research designs.

The following table displays the research methodologies used: "qualitative-exploratory case study" (22%), "qualitative-descriptive" (24%), and "mixed methods" (16%). These were the most commonly used methods in the documents analyzed: “literature reviews or studies case”

(6%), “Single Subject Designs” (12%), “quasi-experimental design” (8%), “literature reviews or case studies” (6%), “pre-experimental design” (2%), “pure experimental design” (2%), “transversal research” (8%). Previous research supports single-subject designs (Horner et al., 2019; Gast, 2020).

4.2.4 Here is a brief overview of the key findings:

• From 2019 and 2022, an average of eight publications per year were published on the use of augmented reality for educational inclusion, with the highest number of articles appearing in 2020, with an average of eleven articles.

• Most research has been conducted in the subject of education sciences; engineering, manufacturing, and construction have received the least attention.

• Among the claimed benefits of inclusive education were motivation, interaction, and capturing the student's interest.

• The primary disadvantages are limited sample sizes (often only a single person is included) and the requirement for internet connectivity, as this service is inadequate or nonexistent for certain groups.

• The most often utilized devices are mobile or handheld devices, followed by desktop computers or personal computers.

• Long-term attention and utilization in other situations or contexts rank among the most often cited obstacles. The majority of studies have not examined extending the duration of testing and evaluation, nor have they considered expanding to scenarios other than those first employed.

• A large proportion of studies have been applied to primary education, but secondary school, early childhood, and short-term education should be examined in the future.

• The most prevalent sort of augmented reality (AR) is based on markers, followed by geolocation; research without markers has not yet been conducted.

• The majority of research employed modest sample sizes of ten or fewer people, while others comprised 11 or more subjects.

• Questionnaires and interviews were the primary means of information collecting.

• About the population serviced, the studies tended to focus on students with disabilities, ignoring other populations or groups that are also excluded from the education system, a topic that could be investigated in the future.

• Few frameworks for inclusive education were documented, despite the existence of a number of issues requiring resolution.

• Many technologies have been utilized and merged in order to implement them in inclusive education, the majority of which have been mobile devices, with the use of glasses and sensors being expanded.

• Vuforia is the most popular library for creating augmented reality (AR) applications, while Aurasma and Layar are the most popular authoring tools; it should be noted, however, that few studies address this fact.

• The largest effect is the improvement of communication skills among students with disabilities, particularly those with hearing impairments, where more research has been conducted and hence more studies have been conducted on this topic.

CHAPTER V:

DISCUSSION

5.1 Discussion of Results

The research and questionnaire responses have led to the understanding that the use of flashcards has a high impact on kids and the gamified approach to learning is a more engaging learning methodology. Such methodologies are very new to the majority of the classrooms in India. A few international Schools seem to be using SMART boards in the class but the advent of AR and VR in classroom setups have not begun full-fledged in India.

5.1.1 Discussion of Research Question One

Game created: The Great Underwaters!

Flash cards were created with characters on them. Each character has a particular quirk. The child can choose a card and he/she plays that character in the story.

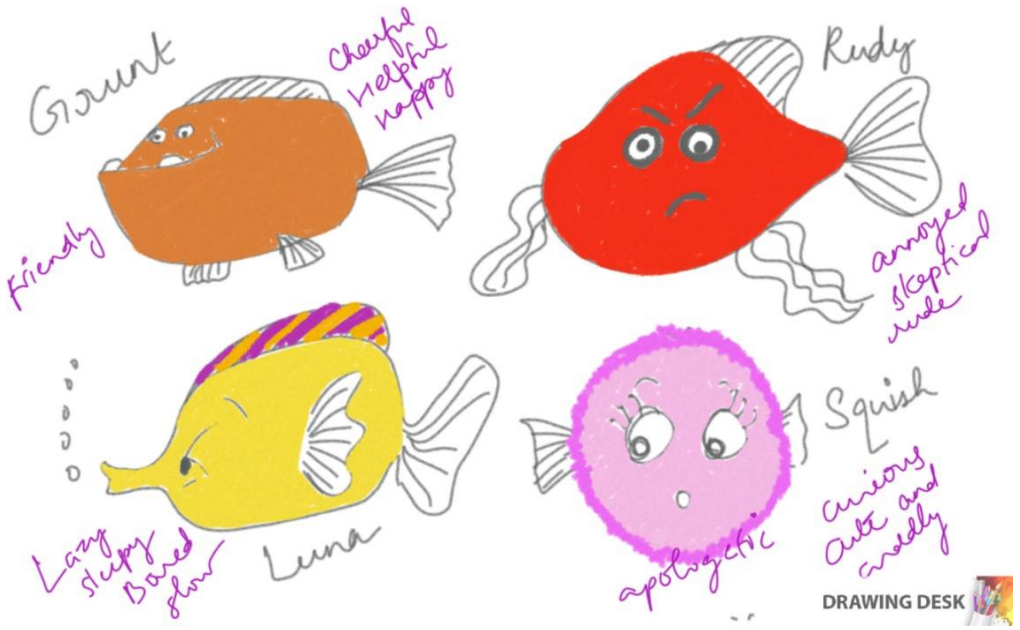

Figure 1.24 Character Prototypes

Each character comes alive when viewed through the AR app on the phone.

Voice overs for characters:

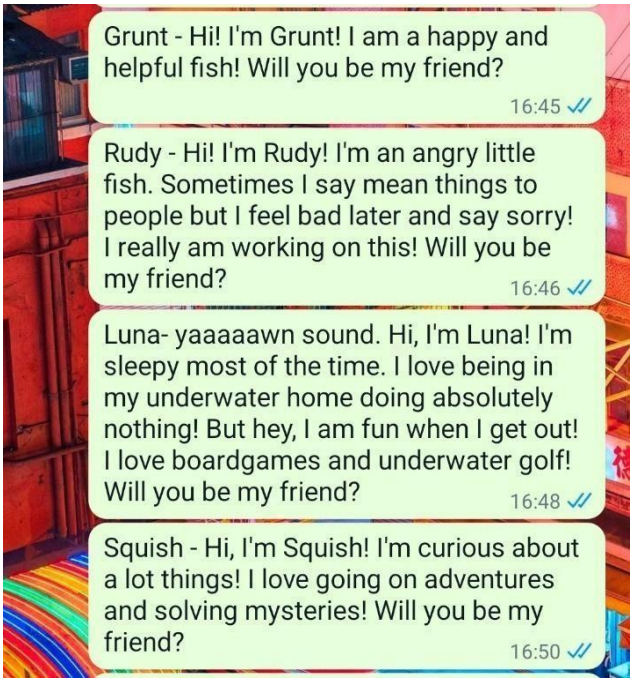

Figure 1.25 Character Personas

Once a character is chosen, a large underwater map is revealed to the child. The map consists of a story the child must maneuver through themselves.

Images of the underwater map. Each section of the map comes alive when the AR app on the phone is placed over the images. As the child maneuvers over the map, the story is told and the child is asked to engage with it by being asked to find items and asked questions based on the learning outcomes.

Underwater world inspirations:

Figure 1.26 Underwater Inspirations (source: google image compilation)

Character Inspirations:

Figure 1.27 Character Inspirations Set 1(source: google image compilation and bharath art studio)

Figure 1.28 Character Inspirations Set 2 (source: personal art drawn by divya)

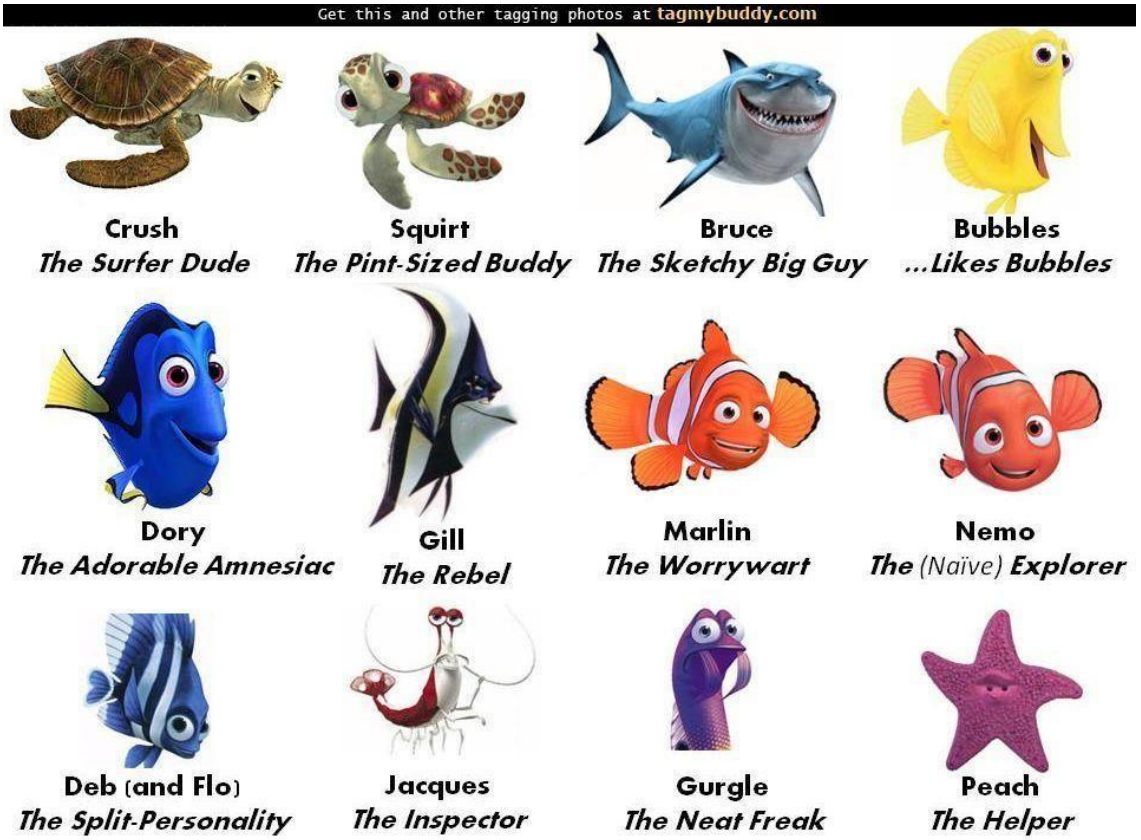

Figure 1.29 Animated Character Set 1(source: google image compilation)

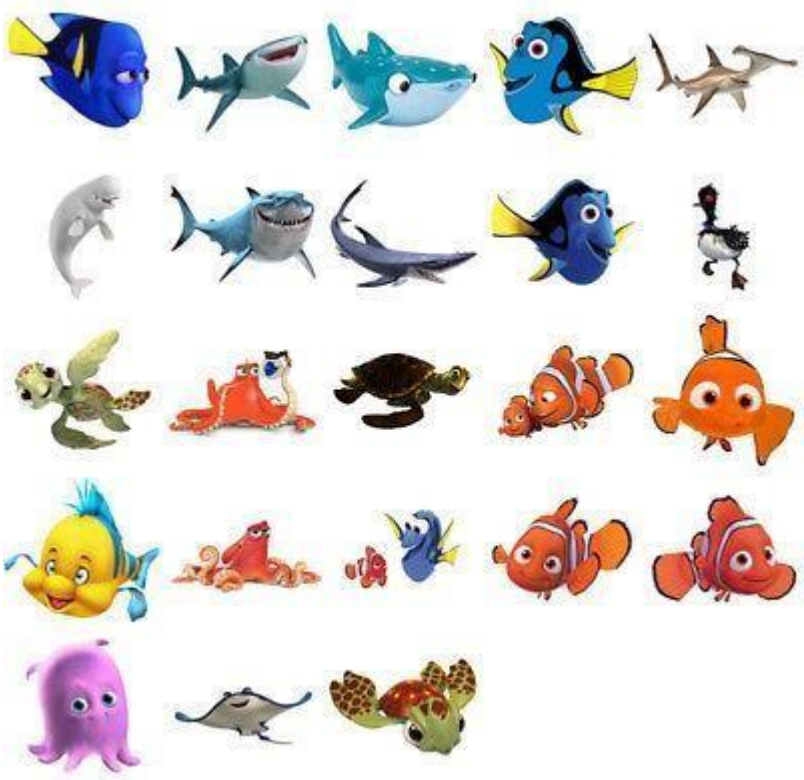

Figure 1.30 Animated Character Set 2 (source: google image compilation)

Final Characters and World design:

Figure 1.30 Final Characters set

Figure 1.31 Final Characters Flashcard set

Not all children will be able to pronounce a combination of letters easily. Basic phonics should be used. Using different sounds together and comprehending the word could be tough for the child (Raising Children Network. (n.d.). 'What's that sound?' Activity for children with disability or autism. [online] Available at:

https://raisingchildren.net.au/guides/activity-guides/sensory-play/whats-that-sound-activity-children-disability-autism)

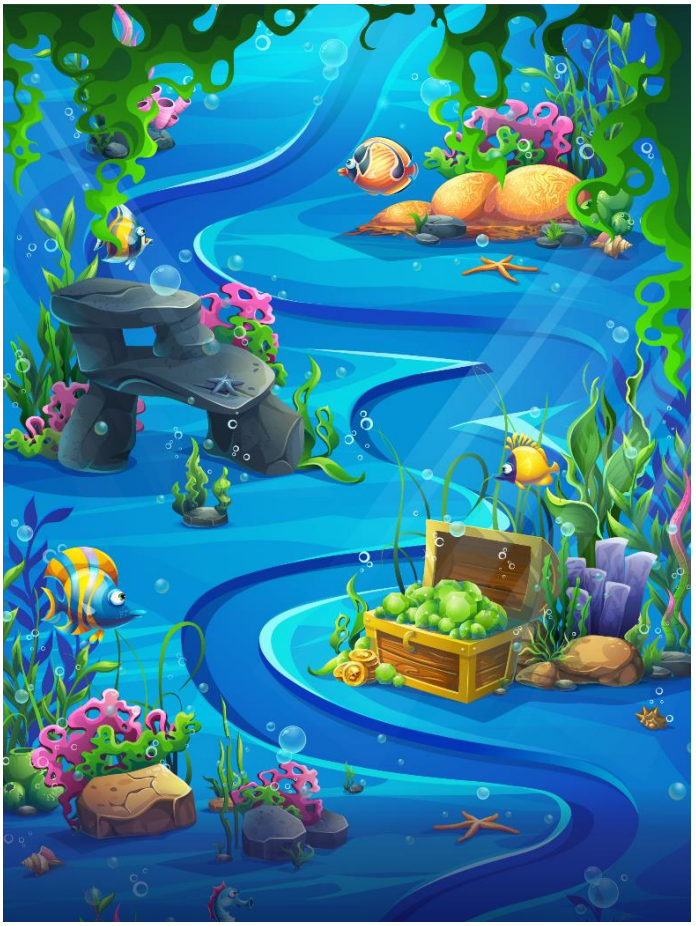

Figure 1.32 World Design

5.1.3 Discussion of Research Question Two

Basic Storyline and Learning Outcome:

The storyline comprises of the journey of four sea creatures, Squish, Grunt, Luna, Rudy and Jinx who move across the underwater world learning how to spell the words which have a silent E at the end: HOME, GAME, SOME, TAME, SHAME, BLAME and words with double letter sounds at the end.: SPELL, GUESS, TELL, DWELL, SHELL, PRESS, DRESS, QUILL, DRILL, SPILL, PILL.

Learnings on Testing Prototype:

1. **Autistic students were the most receptive to the AR, followed by Dyslexic ones**

2. **It proved to enhance their social skills, social relationships and their engagement.**

3. **The motion of characters in the animation was imitated by the disabled students voluntarily**

4. **The need for teacher aid dropped by 20% as the students were engaging for a certain period of time without teacher mediation**

5. **The students gravitated to characters of the color red the most**

6. **Students were not able to comprehend the map or the direction in which the map was to be placed. Start to finish had to be done in guidance of the teacher.**

7. **The students were able to hold onto the phone effectively to see the AR on the screen.**

8. **Students were shown emotion (laughing, giggling, pointing and making sounds) while the AR was on play.**

9. **Students preferred to sit on the map due to the scale of it, instead of around. They preferred the immersed experience.**

10. **Students seemed to want to choose the same characters on multiple tries of the same game.**

11. **A maximum of 3 students per map could be managed by the teacher**

for best learning outcomes.

12. **On assessment post the use of the prototype, the kids were able to point to characters and parts of the map when questions were posed.**

CHAPTER VI:

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Summary

The prototype was most effective for Autistic students and secondly for dyslexic children. They seemed to be the most receptive and liked to engage with the product. It proved to enhance their social skills, social relationships and their engagement in the classroom and outside.

Autism spectrum disorder (ASD) is a developmental disability caused by differences in the brain. People with ASD often have problems with social communication and interaction, and restricted or repetitive behaviors or interests. People with ASD may also have different ways of learning, moving, or paying attention.

Main pain points of autism: Finding it hard to understand what others are thinking or feeling, getting very anxious about social situations, finding it hard to make friends, or preferring to be on your own.

The use of the characters proved to be helpful for such children. They were immediately able to connect to the moving characters and wanted to continue the journey with the characters. The animated movements of the characters were a plus as the kids seemed to want to move along with the characters and imitate the motions.

Dyslexia: As dyslexia is a disability heavily related to language and reading, the product proved to be a great aid to making language learning fun and also to increase retainment and memory of words and spellings.

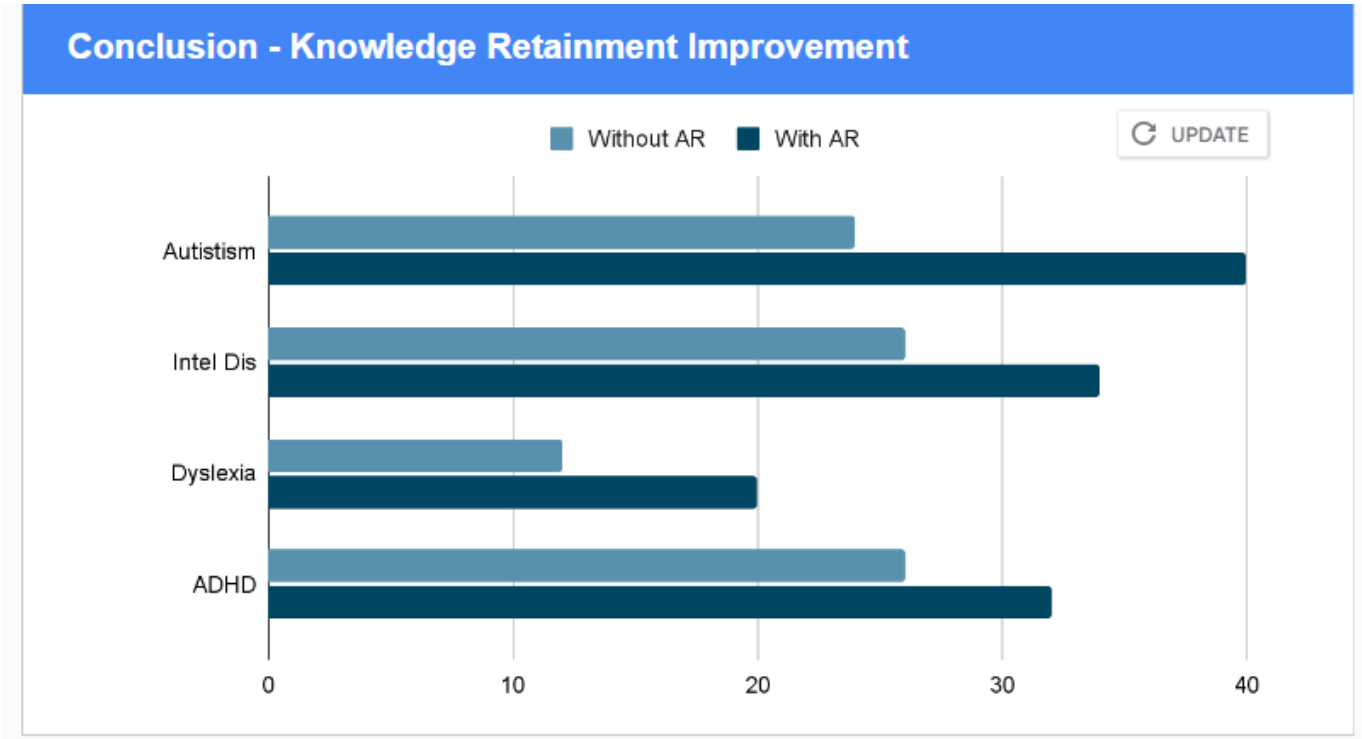

Table 1.22 Knowledge retainment improvement

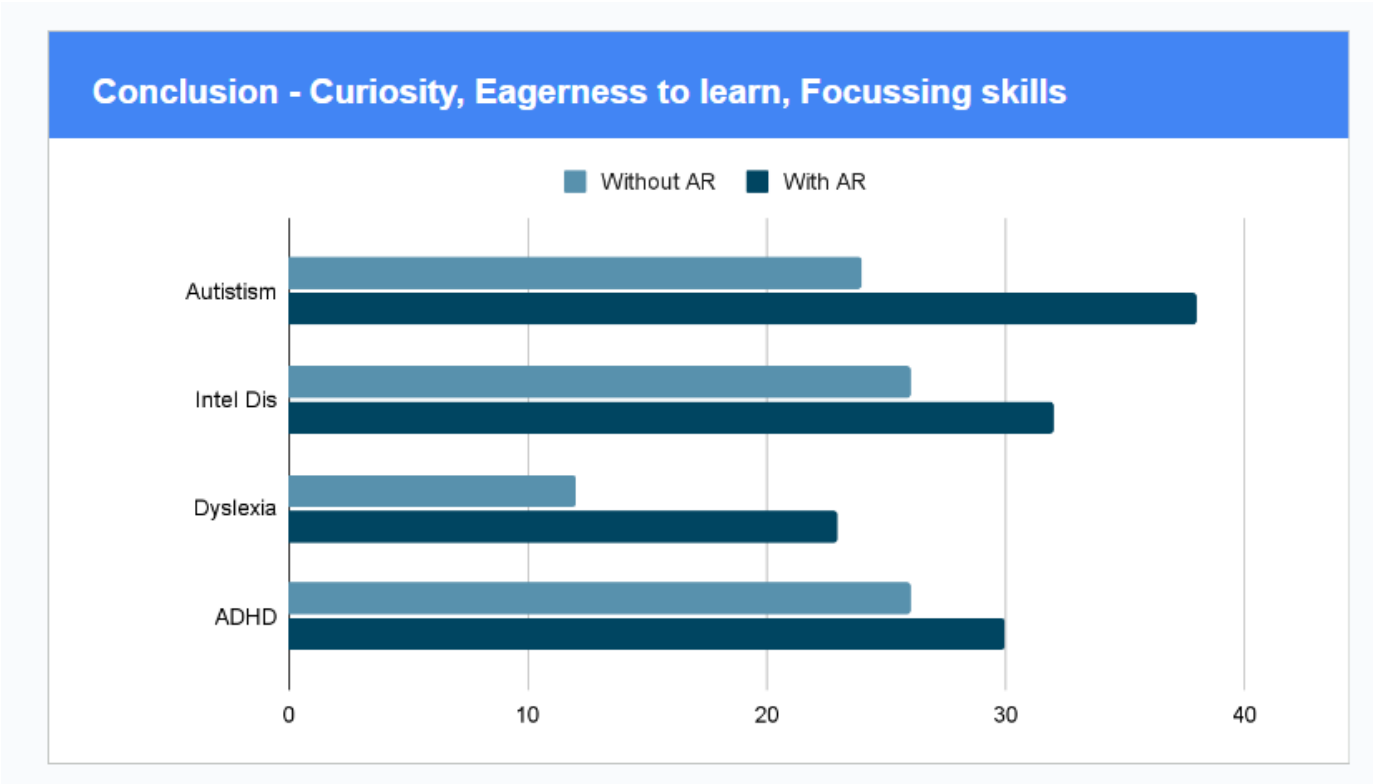

Table 1.23 Curiosity, Eagerness to learn, Focus skills improvement

6.2 Implications

These pupils' capacity to communicate can also be improved through the use of augmented reality apps by teaching them how to interpret facial expressions, maintain eye contact, ask questions, and understand non-verbal social cues.

This could lead to improved learning interactions, consistently draw the attention of students, expand their vocabulary abilities, and keep them more engaged and excited than in sessions that do not use AR.

Students who have Autism Spectrum Disorder or Asperger Syndrome benefitted from this in their educational experience since it will assist and enable communication, boost learning motivation, attention, and independence, and benefit from the use of mobile devices or headphones.

The Dyslexic set of students benefited the most from the product resulting in increased retention, memory, curiosity and interest in the topic at hand.

6.2 Financial Analysis

A costing analysis was done for each unit of the product to be sold:

Items in kit	Cost (Rs.)
4 Printables and stickers	200
Box and covers	60
Overheads	40

- Cost to manufacture kit(including overhead costs): Rs.300
- Each kit was priced at Rs.550

- If bought in bulk by a school it would be Rs.450 per kit
- If bought individually: 83.3% profit margin
- If bought in bulk: 50% profit margin
- Single units can be used for a family or per class.
- Bulk units can be used across classes of ages 5-9 years.

Figure 1. 33 Product sales for households

Figure 1. 34 Product sales for management

As we can see from the above graphs, a small price change to the product could result in an increase of our customer base.

Price change due to feedback received, allowing for greater customer base:

To accommodate more buyers:

- Cost to manufacture kit: Rs.300
- Each kit has a revised price of Rs.450
- If bought in bulk by a school it will be Rs.400 per kit
- If bought individually: 50% profit margin
- If bought in bulk: 33.3% profit margin

Business Timeline:

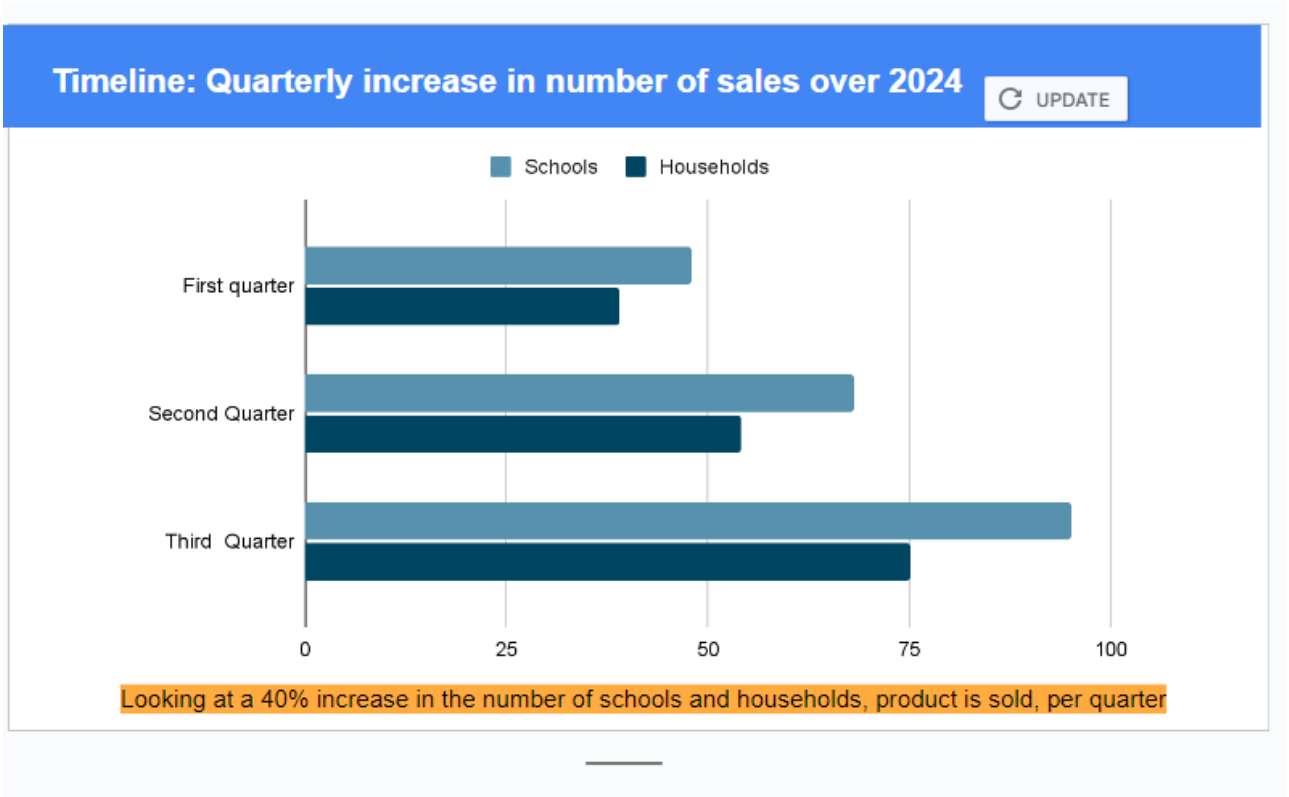

Fig 1.35 Timeline

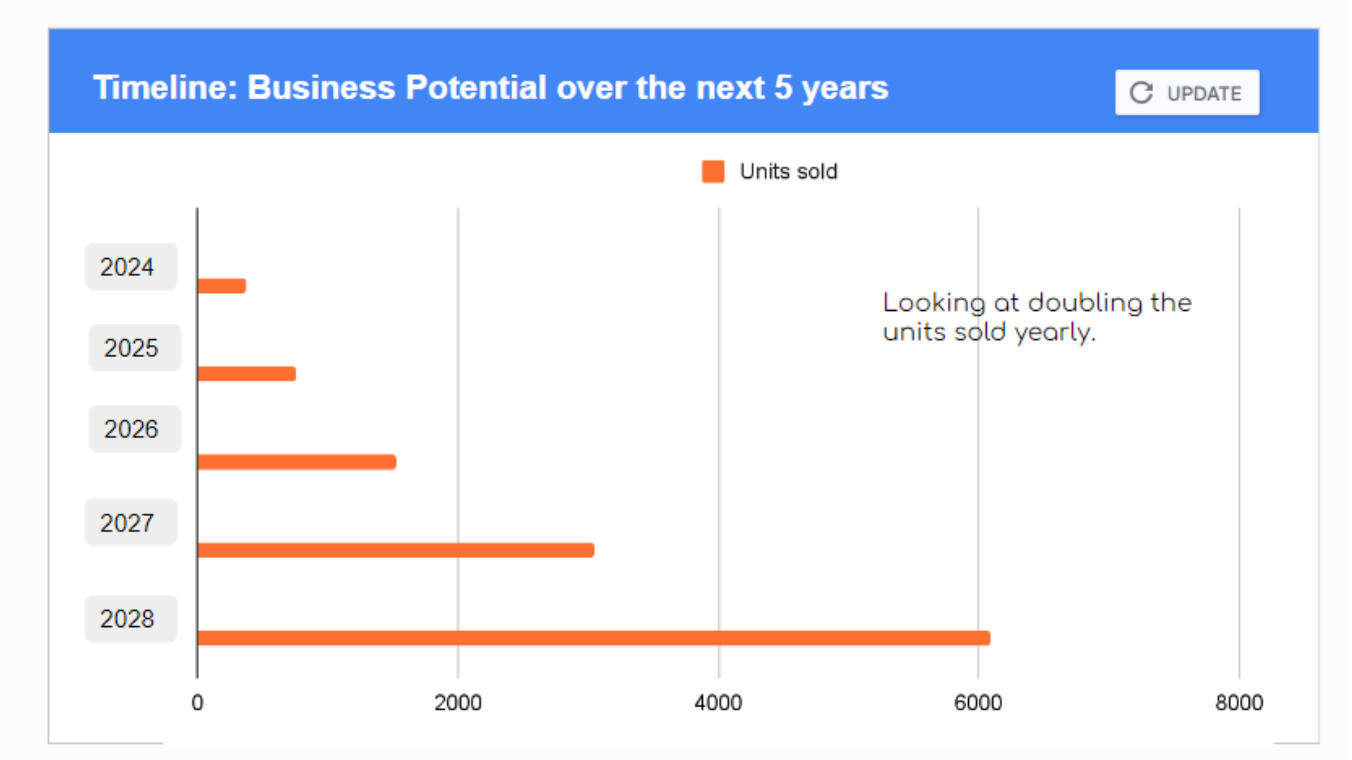

Fig 1.35 Timeline

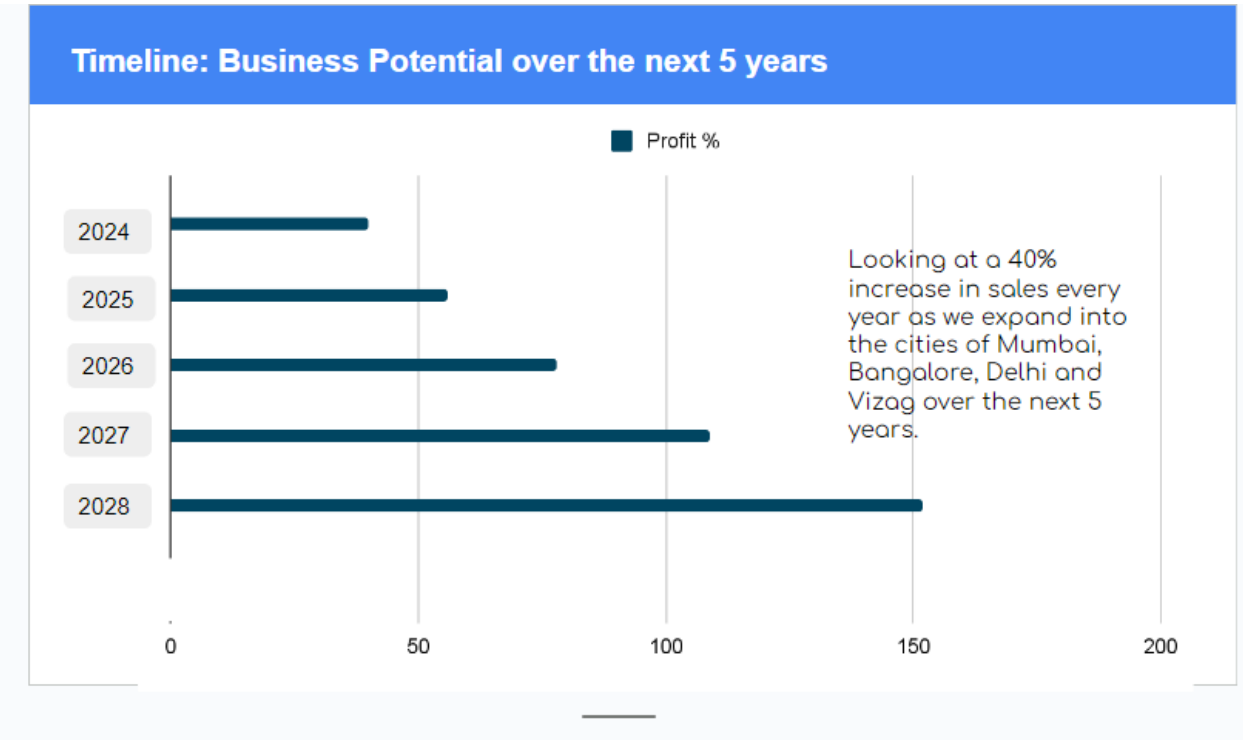

Fig 1.36 Timeline

6.3 Managerial Implications

The findings of this research provide marketers with valuable insights, who wish to experiment with AR technology and multi-sensory interfaces to influence consumer decisions, particularly in emerging markets such as India. Recent COVID19 pandemic has necessitated that in many regions of the world, physical retail stores have closed, which has significantly altered consumer behavior. (Scott et al., 2020) The majority of consumers - schools and households are progressively shifting to online channels of learning to keep learning and engagement continuous. To endure the current crisis, marketers must provide online alternatives such as easy to use mobile applications, with simple, hassle free tech that can be used by consumers. Smartphones are the primary devices used for app based learning and can be implemented in classrooms and households as well. A larger reason is that the majority of the households and teachers in Schools make use of mobile phones, hence no extra physical tech element is needed, that what they already have. We believe that a multisensory learning experience has the potential to provide marketers with a competitive advantage and point of differentiation. Our research provides marketers with novel insights regarding emerging ed tech and course creation markets (e.g., India), which have enormous potential for emerging technologies in diverse sectors such as education, special ed, inclusive education and after school education in households (TNN, 2020).

Marketers may be hesitant to invest in new technologies in VR due to limited consumer adoption and usage, heavy physical elements which might increase costs and the fact that special children gravitate more towards tangible classroom aids and AR elements than VR, as VR could potentially cause the children to get a sense of fear due to the sudden change in environment without facilitation.. Our findings provide marketing decision-makers with strategic insights pertaining to the creation, implementation, and propagation of multisensory features in the education sector and academia. In our

research, AR interfaces perform better than basic mobile applications and act as a great additional benefit in reiterating topics in the classroom and generating greater interest, curiosity and overall retention of the students.

Indicators of usability and responsiveness,Venkatesh and Bala (2008) identified antecedents to technology adoption and utilization intentions. Therefore, marketers should concentrate on developing technologies and features that progressively expand the classroom experience, smartphone interface to a multisensory (audiovisual) interface. Moreover, an intuitive and responsive user interface reduces the cognitive load of consumers' decision making, which should result in increased sales and a more satisfying purchasing experience. In case marketers confront the practical challenge of convincing users to download and continue to use their apps for learning, in such situations, a favorable word-of-mouth (WOM) recommendation from users and higher levels of satisfaction can certainly aid marketers in accelerating the adoption and usage of their applications.Also in classroom trials and training sessions could aid to the use of the product.

For instance, the IKEA place app based on augmented reality received extensive coverage and positive WOM in online media, resulting in hundreds of thousands of app downloads within a few months (Delage, 2018). Our findings indicate that an AR interface results in more favorable WOM recommendations, which should allow firms to overcome barriers (such as network externalities and trialability) to market penetration (MISHRA ET AL, 2019).

The adoption of virtual reality technology (Laurell et al., 2019) says that marketers should take advantage of the positive WOM potential of multisensory interfaces to

market their products. We ardently believe that multisensory environments mediated by technology offer numerous marketers untapped and innovative opportunities to significantly improve the learning experience in classrooms and households for special children.

Marketers seek to create emotionally powerful and long lasting relationships with consumers that benefit both parties. A multisensory interface with striking visuals produces increased emotional arousal than a touch-based interface. When designing products with visual interactions and due to the importance of emotional appeals, businesses should employ multisensory technology to offer a test-and-buy model similar to the tourism industry. In classroom testing can be done before buying the product to see the impact it has on learning over all. Similarly, in order to increase donations and support for a social cause, NGOs should engage with their target audience in a multi-sensory environment cause.

To mitigate the risks associated with their purchase decisions, consumers prefer immersive real-world experiences, which provides firms with vast opportunities to influence consumers at various touchpoints, including households and physical classrooms (Biswas, 2019). In general, mobile apps provide easy access to pertinent information that is essential for evaluating a utilitarian product (Wagner et al., 2018), which makes the phone a more functionally suitable device for the task at hand. Our findings indicate that a multisensory interface influences positively both utilitarian and hedonic consumer responses. Using AR, consumers experience greater engagement, sensory appeal, over all learning and retention, as they immerse themselves in the process of learning and engagement with the concept at hand (Bonetti et al., 2018). These characteristics have additional psychological benefits that increase sensory engagement and learning. Therefore, marketers should invest in such AR capabilities.

Firms should continue to offer, peruse and search capabilities on mobile applications and introduce multisensory capabilities so that users can evaluate and experience products as if they were in the real world.

The unprecedented prevalence of "Pokemon Go," an augmented reality (AR) game, is evidenced by the advent of mobile gaming has radically altered the gaming industry. Millions of online gamers routinely invest a substantial amount of money time spent playing AR activities. These gamers also invest a substantial quantity of money in peripheral hardware to improve the player's gaming experience. These consumers anticipate a similarly immersive and enjoyable online retail experience. We believe that marketers have an excellent opportunity to reap the benefits of the "first-mover advantage" if they can effectively respond to and satisfy consumers' desire for a visceral and multisensory experience.

6.3 Academic Implications

The purpose of this review was to synthesize the existing scientific literature on the use of AR in classrooms with specially abled children. These studies provide valuable information regarding what is known about the use of AR in special education.

Numerous studies in the scientific literature emphasize the relationship between augmented reality (AR) and the improvement of teaching and learning processes for all learners; however, there are fewer and fewer studies that detail the options for learners with special needs.

The results of the literature review have enabled us to assess the current state of research in the field of Augmented Reality (AR) applications for students with educational requirements at various educational stages. In this regard, and in response to the first research question (RQ1), "What is the general state of published research on the use of Augmented Reality applied to students with educational needs?"The preliminary data

indicate that this is a burgeoning field, as evidenced by the progressive and constant increase in the production of articles analyzed from 2016 to the present . As predicted, and based on the empirical studies analyzed, predominantly employing quantitative methods (71,43%), AR is having a growing impact on the education of these pupils. This enables the use of these technologies as educational aids for these individuals.

In contrast, with regard to the second research question (RQ2), "What experiences with Augmented Reality are being conducted with students with educational needs? ", the results of this study indicate that AR can be applied in classrooms at various educational stages, from early childhood education to higher education, with students with educational needs in a variety of subject areas, primarily science, mathematics, and literacy, our product focus being literacy and language skill improvement.
Our findings, which are supported by prior research in the LR, demonstrate that these technologies, through the development of various didactic strategies, benefit students with various types of educational needs, particularly those with dyslexia and students with autism spectrum disorder. Students' enthusiasm in utilizing AR technologies reflects this. Students with dyslexia and students with autism spectrum disorders may have been the most targeted group for AR research due to the characteristics of this technology (improved academic performance, higher motivation, improved communication and social interaction, and promotion of autonomy), as demonstrated in this study and consistent with previous research. These technologies are also effective with students who have been identified as having learning difficulties, preventing them from becoming readily distracted and increasing their interest in class with the aid of augmented reality.

In the majority of studies, mobile devices were found to be the preferred devices for working with augmented reality (AR) content in special education, primarily mobile

phones, computers, and Tablet/iPad. This is due to the fact that these technologies are more portable, accessible, and user-friendly for students, and they provide anytime access to information, which facilitates interaction with physical objects. This finding is consistent with all AR in education investigations.

In addressing the third research question (RQ3), What is the impact of the use of Augmented Reality in the field of special education, as indicated by the studies analyzed, we can see that the use of these tools permits the creation of new learning experiences by combining virtual and real-world elements.

Using the study as a guide, and based on the findings, we can conclude that the use of AR has a positive effect on students with special educational requirements. Thus, we can emphasize that the most beneficial aspects of using augmented reality in the classroom with these students are the academic performance gains. Moreover, these experiences heighten students' enthusiasm and interest in the teaching–learning process. This is because by witnessing objects in two and three dimensions, they appear more real than when they are observed on paper. It has been found, among other things, that its use improves students' social relationships, thereby facilitating their integration with peers. Notably, the demonstrated positive effects of augmented reality (AR) play on the improvement of physical activity in people with different needs prompt us to reconsider the applicability of this type of resource to different interactive projects at different educational stages.

Although Augmented Reality (AR) has been identified as an emerging technology in the field of special education, specific strategies are required for its application by educators. Consequently, the dearth of teacher training and the difficulty of gaining access to these technological resources are of the greatest concern. Moreover, although it is recognised as an emerging tool in the field of special education, it is still difficult to generalize whether they are intended for the entire population with SEN due to evidence of a

limitation in quality and teaching experiences with students with visual impairment; therefore, it is recommended that future research concentrate on this aspect.

In response to the final research question (RQ4), "What is the conceptual structure of the scientific literature that publishes on the use of Augmented Reality in special education? ", we specify that the conceptual structure of the sources consists of three clusters that correspond to the principal thematic areas of research that are being worked on during this time period (2016–2021). Thus, we can emphasize the three main topics: the use of augmented reality technology with students who have special educational needs, the role and training of teachers in the implementation of these technologies, and the impact of using these tools with these students.

The findings of this review indicate that the use of AR as a technological resource yields positive results in the education and daily lives of students with special educational needs . To increase their students' quality of life, it is recommended that teachers enhance their training on AR-based learning strategies.

Restrictions to the academic study are, the research articles analyzed in this review are selected based on the researchers' chosen criteria. Only publications in WoS or Scopus are evaluated. In addition, only "articles" have been selected as the document type for this review. Future researchers may desire to examine additional databases and documents in order to establish a more comprehensive picture of the advantages and disadvantages of using Augmented Reality technology with students with special needs.

The future research direction would include that the obtained findings can serve as a starting point for determining the future research directions that must be pursued in order to effectively implement Augmented Reality in the context of special education. Design, implementation, and evaluation of teacher training plans in emerging technologies to

employ Augmented Reality in the classroom with students with educational needs at all educational stages are among the future lines to be developed.

6.3 Limitations of Study

The proposed implications are constrained by the limitations of this study results that provide guidance for future research. The first limitation of the research is its generalizability. The sample represents the population of classrooms and households in India, a developing nation. Young consumers are major smartphone users and early technology adopters. However, elderly individuals may not have comparable (Mishra et al., 2018) ease and convenience in using new technologies such as mobile phones and AR devices. Similarly, progressing countries with superior technological infrastructure have a higher rate of adoption and utilization of new technologies (see examples in Grewal et al., 2020). To increase generalizability, future research may include a sample of elderly respondents or a sample from a developed nation.

Geographical limitations are evident here. The distribution of schools is varied across the geographical area of Chennai. The inner private district was considered as the prime market for the study, who proved to have enough enrolled students, well managed classrooms, strong financial funding and an openness to new methodologies.

The schools out of this regional boundary were rural schools with poor infrastructure and lack of basic amenities. They operated heavily on external funding. Hence this market was not taken into account due to lack of funds for such a product.

Multisensory experiences are highly context-dependent users. An AR experience of evaluating a classroom experience , for instance, may be vastly distinct from playing a virtual game due to the variations in user participation and the presence of additional visual and auditory sensory signals. Consequently, future research can investigate the

role of involvement in attitudes and behavioral intentions in multisensory environments. During the course of the experiments, we discovered that most students did not feel secure wearing the VR headset for an extended period of time. This practical concern of how wearing a VR device for an extended period of time (duration of usage) impacts users' perceptions of usability can be explored in further research.

We did not control for brands in this study (e.g., IKEA is a well-known brand). The influence of the brand (app or tourism company) and perceived productimage (e.g., destination image) should be investigated further. We did not account for the impact of participants' prior exposure to the product category and their role (user or purchaser), which can be investigated in future studies. Recent research indicates that the type of interface influences the time required to make a purchase (Chung et al., 2018), which can be investigated further in the context of a touch based interface versus a multisensory interface.

We observe some counterintuitive product and pricing findings. The pricing change resulted in an increase in the user base. A reduction in bulk production costs could result in a greater reduction in price, which could result in doubling the user base across households and classrooms. Combining various technologies, we believe that the novel multisensory experience enhances the user's enjoyment of the learning and engagement. Additional research may employ longitudinal studies to account for novelty effects and determine if consumer responses alter over time.

6.3 Recommendations for Future Research

Augmented reality (AR) technology has recently emerged as a viable method of effective therapy in a variety of subfields within the field of medicine, including diagnosis, the promotion of wellbeing, and treatment for mental health. When it comes to intervention programmes, augmented reality has been employed to address the treatment of a number

of neurodevelopmental illnesses like autism spectrum disorder (ASD). Specifically, in this field, AR has shown some advantages in comparison to more traditional interventions. This is because it enables individuals with ASD to be treated in more ecological and realistic environments, which can be manipulated and adapted to the specific and heterogeneous characteristics that children and adolescents with ASD exhibit. Hence, this form of treatment would allow for higher ecological validity in controlled conditions, and the abilities learned would be generalizable to other domains as well as the contexts of everyday life.

Although it is true that more studies are required with better designs that have higher methodological quality and more significant results, we can state that this is an expanding field of research, where the majority of publications are pilot studies or protocols of study and are exhibitions of technological development processes. Despite the fact that more studies are required with better designs that have higher methodological quality and more significant results, we can state that this is an expanding field of research. Yet, the studies indicate that there is a need to broaden the scope of the research and to carry out more complex scientific designs with representative samples that evaluate augmented reality apps in regulated environments. As the number of children diagnosed with ASD continues to rise, there is a greater need for interventions that can accommodate their diverse requirements while simultaneously fostering their full potential. Professionals have a responsibility to make educated decisions about which interventions are supported by evidence, and then to tailor those programmes to the unique characteristics of each individual kid. Children who have autism spectrum disorder (ASD) tend to be visually stimulated and have a learning style that lends itself well to augmented reality technologies. This review contributes to our understanding of the efficacy of including AR features into therapies designed to improve various aspects of functioning in children and adolescents diagnosed with ASD.

The findings show some promise; however, there is a requirement for additional high-quality research that is based on methodological rigor.

As a summary:

- Create more such maps and spaces that the child can traverse and learn.
- Modify character set closer to liked colors.
- Continue using gamification as the core of the learning.
- Bring in variations in AR to make the engagement more exciting.
- Create disability specific games.
- Product also has great potential in the Ed Tech corporate market for lesson plans created for special kids.

6.4 Conclusion

To sum up, the paper dealt with how to make learning engaging and easier for special children in the early childhood and primary age group using AR technology. This resulted in the findings that the product created heavily aided language retainment in autistic and dyslexic children of ages 4-9.

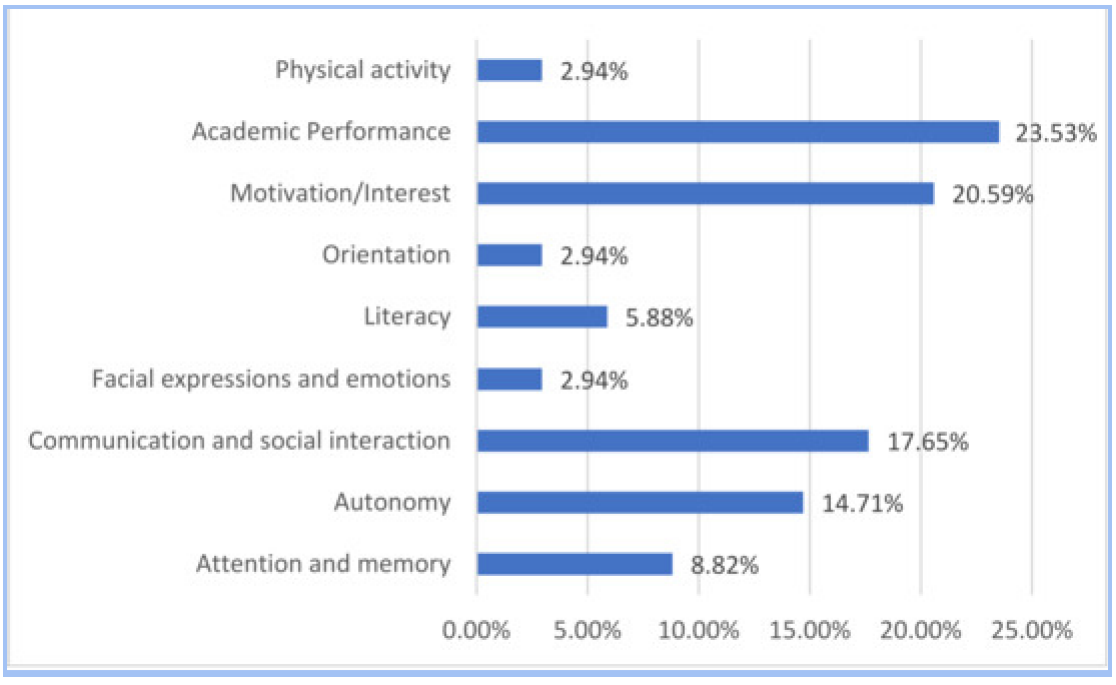

Fig 1.37 Improvement in learning using AR

Surprising findings: Due to the range of the autistic spectrum, it was suggested by teachers interviewed that although the product could be helpful for such children, there was a probability that some autistic children might show a level of disinterest to it due to the inherent nature of the disability. But it was surprising to see that more than 65% of the autistic children were very interested in using the product and it added to their learning, engagement, curiosity and knowledge retention. In fact they were wanting to use the product even after the session was complete, showing a higher level of interest than the other students.

Service to society: Many of the approximately 5.1 million children with disabilities in the Region are 'missing' from their families, classrooms, and communities. Meaning, their holistic presence in the society is weaker than that of everyone due to certain stigmas. Hence the need for greater inclusivity and formation of communities which aid in their holistic development as individuals who are a part of the society, with equal rights and opportunities is needed. According to data on their situation, we know that their rights are frequently violated, especially if they come from socially marginalized families. Children with disabilities are frequently viewed as a problem that must be "fixed," with the emphasis placed on their disability and a medical response, rather than their abilities and potential.

We support outreach services to families with young children to identify and respond to disabilities at an early age, allowing children to realize their full potential and helping families to remain intact. We intend to combat the discrimination that causes their exclusion from schools and communities, striving to make schools more inclusive and altering attitudes towards disability through communities, workshops and more engaging learning. We also collaborate with organizations of disabled people (DPOs) to assure the full inclusion of children with disabilities in family life, schools, and communities. Through AR learning and creating a community of disabled learners - including the parents and the teachers, we can create better opportunities for such children giving them a quality of education at par to that of any other child going to school.

Specifically, through the research, the paper has explored how digital trends, specifically AR, have come up in the education industry to increase student experience and ease for teachers. While embracing technological developments increases companies' competitiveness, such advancements change operating models and businesses and internal teaching methodologies, making them reliable, effective, and more agile. The paper has established that digital technologies are the current drivers of the education industry and are very crucial for special education - specifically for language based learning for the children having the disabilities of Autism, Dyslexia, Intellectual Disability and ADHD . Some of them play a great relevance in the education industry and have been able to support the introduction of more engaging, inclusive systems which enhance learning and reduce the burden on the teacher. With such development, the industry is headed, for now, that methodology of engagement keeps on evolving each day. For such reasons it is necessary to research how new technologies may help flourish and support or thrive their digitalization, how effective these digital methodologies were in real-time and how much effort has to be taken to learn the operation of these methodologies by the teacher and use them effectively in class for improved holistic learning.

SURVEY COVER LETTER

Subject: You are invited to a research survey – Questionnaire for use of AR tech in classrooms for disabled students

You are invited to participate in a research study titled “Use of AR tech in classrooms for disabled students.”. This study is being conducted by Divya R and his/her research committee from the Department of Education at SSBM University via Upgrad. The purpose of this study is to understand the viable use of technology in classrooms with disabled students. In this study, you will be asked to complete an electronic survey. Your participation in this study is voluntary and you are free to withdraw your participation from this study at any time. The survey should take only 15 minutes to complete. This survey has been approved by the Institutional Review Board of SSBM University, through Upgrad. There are no risks associated with participating in this study. The survey collects no identifying information of any respondent. All of the responses in the survey will be recorded anonymously. While you will not experience any direct benefits from participation, information collected in this study may benefit the profession of Education. If you have any questions regarding the survey or this research project in general, please contact Divya R or his/her advisor Dr. Anuja Shukla at 9900063110. If you have any questions concerning your rights as a research participant, please contact the SSBM University. By completing and submitting this survey, you are indicating your consent to participate in the study. Your participation is appreciated. Divya R , Doctoral Candidate, SSBM University Advisor Dr. Anuja Shukla, Department of Education, thesis guide. Please click on the survey link below and provide us with your feedback no later than Month. This invitation does not imply any endorsement of the survey research and/or its findings by SSBM.. The survey contents and findings are the sole responsibility of the individual conducting the survey.

INFORMED CONSENT

Research project title: Using AR tech in classrooms for the specially abled.

Research investigator: Divya R, Guide: Dr. Anuja Shukla.

Research Participants name:Trishula Jhala

The interview will take 30 minutes. We don't anticipate that there are any risks associated with your participation, but you have the right to stop the interview or withdraw from the research at any time.

Thank you for agreeing to be interviewed as part of the above research project. Ethical procedures for academic research undertaken from SSBM institution via Upgrad, require that interviewees explicitly agree to being interviewed and how the information contained in their interview will be used. This consent form is necessary for us to ensure that you understand the purpose of your involvement and that you agree to the conditions of your participation.

Would you therefore read the accompanying information sheet and then sign this form to certify that you approve the following:

• the interview will be recorded and a transcript will be produced

• you will be sent the transcript and given the opportunity to correct any factual errors

• the transcript of the interview will be analyzed by Divya R as research investigator

• access to the interview transcript will be limited to Divya R and academic colleagues and researchers with whom he might collaborate as part of the research process

• any summary interview content, or direct quotations from the interview, that are made available through academic publication or other academic outlets will be anonymized so that

you cannot be identified, and care will be taken to ensure that other information in the interview that could identify yourself is not revealed

any variation of the conditions above will only occur with your further explicit approval Or a quotation agreement could be incorporated into the interview agreement Quotation Agreement I also understand that my words may be quoted directly. With regards to being quoted, please initial next to any of the statements that you agree with: I wish to review the notes, transcripts, or other data collected during the research pertaining to my participation. I agree to be quoted directly. I agree to be quoted directly if my name is not published and a made-up name (pseudonym) is used.

I agree that the researchers may publish documents that contain quotations by me. All or part of the content of your interview may be used; In academic papers, policy papers or news articles On our website and in other media that we may produce such as spoken presentations.

By signing this form I agree that:

1. I am voluntarily taking part in this project. I understand that I don't have to take part, and I can stop the interview at any time;

2. The transcribed interview or extracts from it may be used as described above;

3. I have read the Information sheet;

4. I don't expect to receive any benefit or payment for my participation;

5. I can request a copy of the transcript of my interview and may make edits I feel necessary to ensure the effectiveness of any agreement made about confidentiality;

6. I have been able to ask any questions I might have, and I understand that I am free to contact the researcher with any questions I may have in the future.

Interview Consent Form School of SSBM University via Upgrad_____

Printed Name _____

Participants Signature _____

Date:

Researchers Signature _____

Date:

Contact Information:

This research has been reviewed and approved by the SSBM University Board via Upgrad. If you have any further questions or concerns about this study, please contact: Divya R @9900063110 Full E-mail: divya.ovya@gmail.com

You can also contact Dr. Anuja Shukla, supervisor @ anuja@ssbm.ch

INTERVIEW GUIDE

The constructs being looked at when it comes to the use of AR technology in a classroom of disabled students:

- Ability of the teacher to learn the AR tech and adapt to it
- The openness of the school when it comes to the use of technology in the classrooms
- The openness of parents for the use of technology in classrooms
- The improvement in engagement or learning of the student
- Teaching aid availability
- Acceptance of students to the new teaching aid
- Ease of implementation in classrooms

Considering the above the following questions were brainstormed for teachers, after which a questionnaire was formulated.

Teachers:

Subjective: What is a normal day in your life like? What are some activities that you do every day, every week, every month with your students in the classroom?

- What kind of help/aid would you require in the classroom?
- What are your pain points and would a digital aid be or any help?
- How comfortable are you with technology and would you frequently use it at school if given an opportunity?
- Would you encourage video and online learning in classrooms?
- Are you open to alternate lesson plan suggestions?
- How long do you spend time planning a lesson for a topic?

- What resources do you use to teach in class at the moment?
- What kind of digital aids do you currently use?
- How do you track the child's progress at the moment and how efficient is that system?
- Do you enjoy teaching or does it sometimes become a burden due to constant assessment tracking and need for new ideas?
- What results in fatigue for the teacher? Is there a way to overcome this using our digital app?
- What do the kids relate to most in the classroom and what kind of teaching do they enjoy the most - moving around, listening, enacting, seeing visuals, etc.

Final structured questionnaire sent out:

Question	Variables	Measurement
1	Is AR currently used in your classroom?	Yes No
2	Do you have any idea about AR technology used in Education	Yes, a lot! Maybe a little No idea!
3	Are you tech-savvy and able to learn simple technology when given basic training?	Yes I can try No
4	Do you encourage technology in the classroom if it proves constructive to learning?	Yes No
5	Are you open to alternate lesson plan suggestions?	Yes No

6	**If the child poses complex or challenging questions, what do you use to answer them and how effective are those tools?**	**Verbal tools** **Activity related tools** **Verbal tools are more effective** **Activity related tools are more effective**
7	**Do you encourage questions in class?**	**Yes, during the session** **Yes, at the end of the session** **Yes, only if there is time left**
8	**Are your learners more kinesthetic, auditory or visual learners?**	**Auditory** **Kinesthetic** **Visual** **A mix**
9	**Are the students receptive to animated characters?**	**Very receptive** **Not interested** **Distributed Interest**
10	**Will your students be able to handle flash cards?**	**Yes** **No**
11	**Is it possible to continue the class without a full-fledged facilitation and mediation? Can the activity run on its own once the teacher gives instructions?**	**Yes** **No**

12	**How much teacher aid is needed?**	**Constant** **Half way** **None, once the instructions are given**
13	**Does your class have a mixed age group?**	**Yes** **No**
14	**Do you follow the multiple intelligence theory while planning lessons?**	**Yes** **No**
15	**Do you perform assessments post end of sessions?**	**Yes** **No**

Question for parents (Y/N)
Can your child be given a product for him/her to try out without parental facilitation?
Do you often use videos to aid learning?
Do you use sensory aids at home?
Are your children responsive to questions?
Does your child require movement oriented learning?

Can your child be given a product for him/her to try out without parental facilitation?
Do you often use videos to aid learning?
Do you use sensory aids at home?
Are your children responsive to questions?
Does your child require movement oriented learning?

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