

An Initiative of Augmenting Pedagogy in Inclusive classroom for Science at Secondary Stage

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...Inclusive education refers to a philosophical position as well as an arrangement of institutional facilities and processes. This is to ensure access to and conditions of success in education for everybody, including those in the margins, either with learning difficulties because of physical or mental disabilities or because of their social position...(NCFTE-2009)

ABSTRACT

Pedagogy of science through Augmented reality based integration of Information and Communication Technology in inclusive classroom contributing significant efforts to shape and enhance teaching-learning processes and material involved. It visualizes the real and virtual world together for science-based activities interactively in the educational platform that is becoming increasingly accessible among teachers, teacher educators, learners and parents. This paper elaborates and discusses the different dimension of Augmented reality, important parameter related to pedagogical processes of science in inclusive classroom. Augmented reality (AR) application software which is designed for Biology, Chemistry, and Physics at secondary stage. Further, this paper aims to propose several related practical oriented steps and procedures to be followed that could be applied in science to transform the learning effectively. Further areas of research and development put forth related to the Augmented Reality App.

Keywords: *Augmented Reality, Science Education, Inclusive Classroom, Artificial Intelligent*

1. Introduction

A typical classroom of Indian schools at present have children from diverse cultures, socio economic background and with human diversities or disabilities. Henceforth it becomes imperative for the teacher to understand the classroom both as an academic and social context, as it provides a setting for interaction dialogue and the opportunity to appreciate the diversity which contribute towards equal opportunities and development of an ecosystem for inclusive education. Inclusive education caters to all children from the disadvantaged social groups, linguistic minority gender gifted and talented but this document is from the perspective of disabilities. (*Rehabilitation Council of India: pedadody of Inclusive classroom*)

Inclusive means that as teachers, we have the responsibility to seek out all available support (from school authorities, the community, families, children, educational institutions, health services, community leaders, and so on) for finding and teaching ALL children.” - (UNESCO tool Kit)

Therefore science classrooms should be attached with well-equipped laboratories and digitally active. Students should be encouraged to make simple scientific instruments themselves since it will give them a practical bias to learn science at the secondary school stage. Thus, science learning requires a new technique that enables students to understand dynamic science concepts a lot of simply compared with the conventional teaching-learning process and methods. Technology simplifies the process of learning with psychological features and enhances productivity. Therefore, the assistance of ICTs in the main domains, particularly in science education is widely welcome. Moreover, technology is required and extremely helpful in science, (Physics, Chemistry, Biology and related discipline, etc.) to modify in-depth and complex scientific terms and processes. ICT integrated learning technique cultivates motivation, enhances collaboration, gives the ability to construct their information and knowledge stimulates higher-order and innovative thinking skills in the learning method that supports the sustainable development in schooling education. Therefore,

Augmented Reality (AR) with the addition of multimedia elements and theoretical steering has been planned to reinforce learners' science motivation to facilitate a learning experience beyond belief and expectation. Augmented reality (AR) as a technological enabler is on the far side changing into highly regarded in education. It combines virtual information with the real environment in real-time performance and enhances the user's perception such as vision, hearing, and touch with the combination of real educational material. Due to the development of mobile devices, the growth of Augmented Reality application software is acceptable in education and related discipline. Positive steps taken by the Central Institute of Educational Technology (CIET), a constituent unit of NCERT autonomous organization of Government of India is developing e-resource material for school and teacher education based on textbooks. Its major aim is to promote the utilization of educational technologies viz. Audio, Video, multimedia packages, Satellite communications and cyber media either separately or in combinations. The institute undertakes activities to widen educational opportunities promote equity and improve the quality of educational processes at the school level. Henceforth, CIET takes valuable technological initiatives to integrate the ICT in textbooks of Science at Secondary level published by NCERT to help learners enjoyed the activities and to understand, improve, gain and implement the real experience of information as given in the textbooks of Science in the means of what exactly try to explain. CIET design and developed ePathshala Augmented Reality (AR) application software that can be openly accessible and available online free of cost to download on mobile and Personnel Computers etc. With the help ePathshala AR app, the user sees the "real" world appears as an image on the screen so the user sees both the real world and the virtual objects all composed of pixels on a screen.

2. Features of ePathshala Augmented Reality

In developing the ePathshalaAR app, there are many features that have been applied by the department and programme coordinator during the research work. The features have been classified according to the multimedia elements which include; text, audio, video, graphic, animation, interactive and simulation. The important seven multimedia (MM) elements, which are able to provide useful and multi-sensory learning, experience. Additionally, a 3D model also delivers an in depth and an interactive learning experience.

- 2.1 Text:** It helps in presenting data on-screen and transfer concepts associated with pictures. Text within the increased reality app expresses relevant data to access and move to a different part of the content on simply click through mouse or bit on the sphere given on the screen.
- 2.2 Graphic:** There are four important applications of graphics that embody primary data, analogies or methods, organisers and cues, within the increased reality application package helps to the utilization of graphics establish attraction, communication and memory retention based mostly direct attention to the students.
- 2.3 Audio:** In this app, Audio provides alternative support to the particular images as given in the textbooks and helps to navigation the entire fields of information. The combination of visual presentation with audio explanation delivers information in an easily understood format.
- 2.4 Video:** Video shows a motion that occurs in the real world of Images, Laboratory Experiments, Reactions and Activities adopted interactively.
- 2.5 Animation:** Animation is update with different views to add visual impact to the multimedia presentation. Animations include interactive effects which allow users to engage with the animation action using their mouse or touch on screen or moving Smartphone in different angles. Special 3D Models features of this software displays an object in a form that appears to be physically present with a designated structure. The objects are represented in various dimensions that include width, depth, and height. The advantage of 3D models over videos and images is that the user is able to get a three-dimensional impression of the object. 3D model can be displayed as static object as well as animated object.
- 2.6 Simulation:** The Simulation can be used to complete all the activities and experiment in an interactive method. In the simulation each field related to experiment is given, learner can perform the experiments after clicking, dragging component given on the screen of smartphone, touch screen etc., with the help of alternatives such as instruction given through audio, direction hints and access and use hints simultaneously physical changes also visible on the screen in the process of individual apparatus arrangement.
- 2.7 Interactive:** when interconnection of audio, video, text, animation and graphics in meaningful way provides the hands-on practice to become engage and interact with retain more informative content that are being used in learning process. It generate strengthen problem solving and critical thinking skills among teaching and learning process.

3. Access and Use of ePathshala AR app

ePathshala AR app initiated for Secondary School Stage of NCERT textbooks for Physics, Chemistry and Biology. To access and practice on figures and activities given in the Textbook, learner can be rotate their mobile in horizontal, vertical, left, right, up and down direction following interactive steps given accordingly to the task performed. The technical and download process are shown in the given table 1.

Figure-1: ePathshala AR app technical features and download process

ePathshala AR app	
Technical Features	<ul style="list-style-type: none"> • Size of ePathshala AR app. software is 22.87 MB • Installation required internet facility in Android/smart phone • Camera to recognise figures, activities etc., from textbook or screen.
Download process	<ul style="list-style-type: none"> • Open Play Store on Mobile, computer, tablet pc etc • Type ePathshala AR app and click on search tab. • Next option will be open and then click again on ePathshala AR app. • After installation process, allow access the storage capacity etc., and then give permission; just it is required to check the space and availability of features are available for the working environment of app in Smart Phone without any interruption.

Examples to perform experiment and activities through AR app are given below:

3.3.1 Biology: Augmented view of Animal cells given in figure 1. All the steps followed by a left to right and top to bottom. During the access and use of a particular section, the process may be increased or decreased.

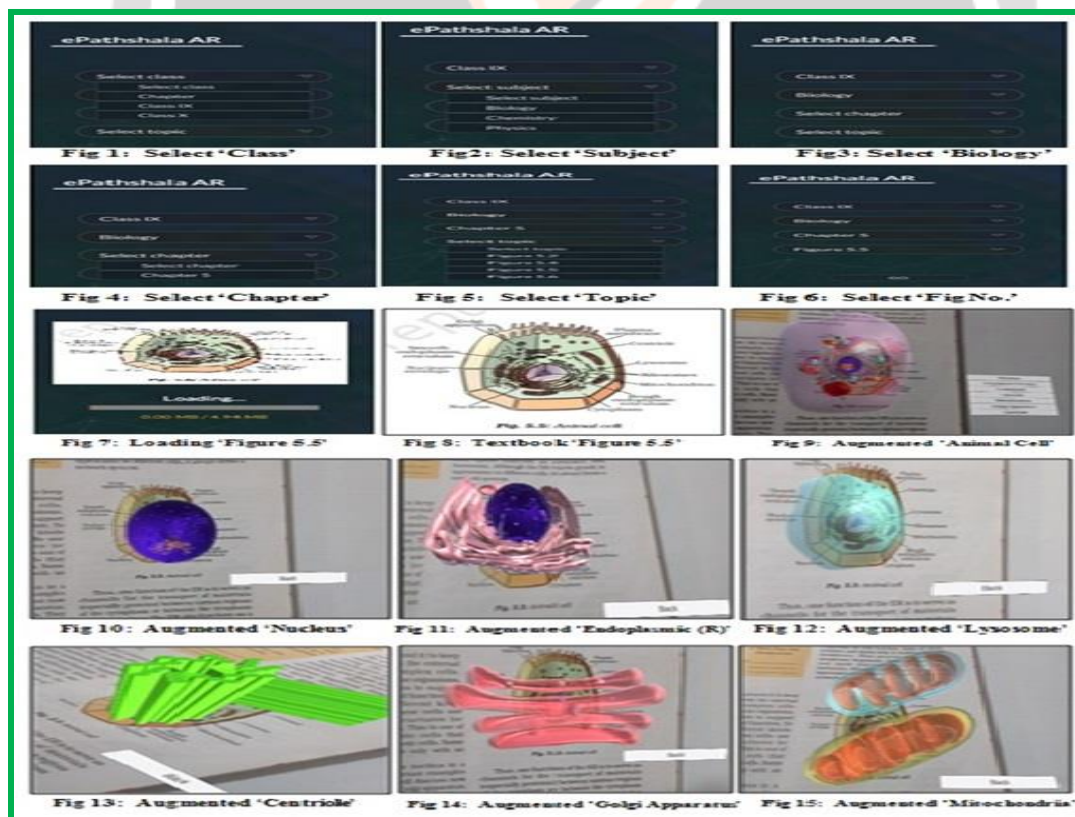


Figure 1. Augmented Reality view of Animal Cell

3.3.2 Chemistry: Augmented Reality based activity of separation of dyes in black ink given figure 2. All the steps followed by a left to right and top to bottom. During the access and use of a particular section, the process may be increased or decreased.

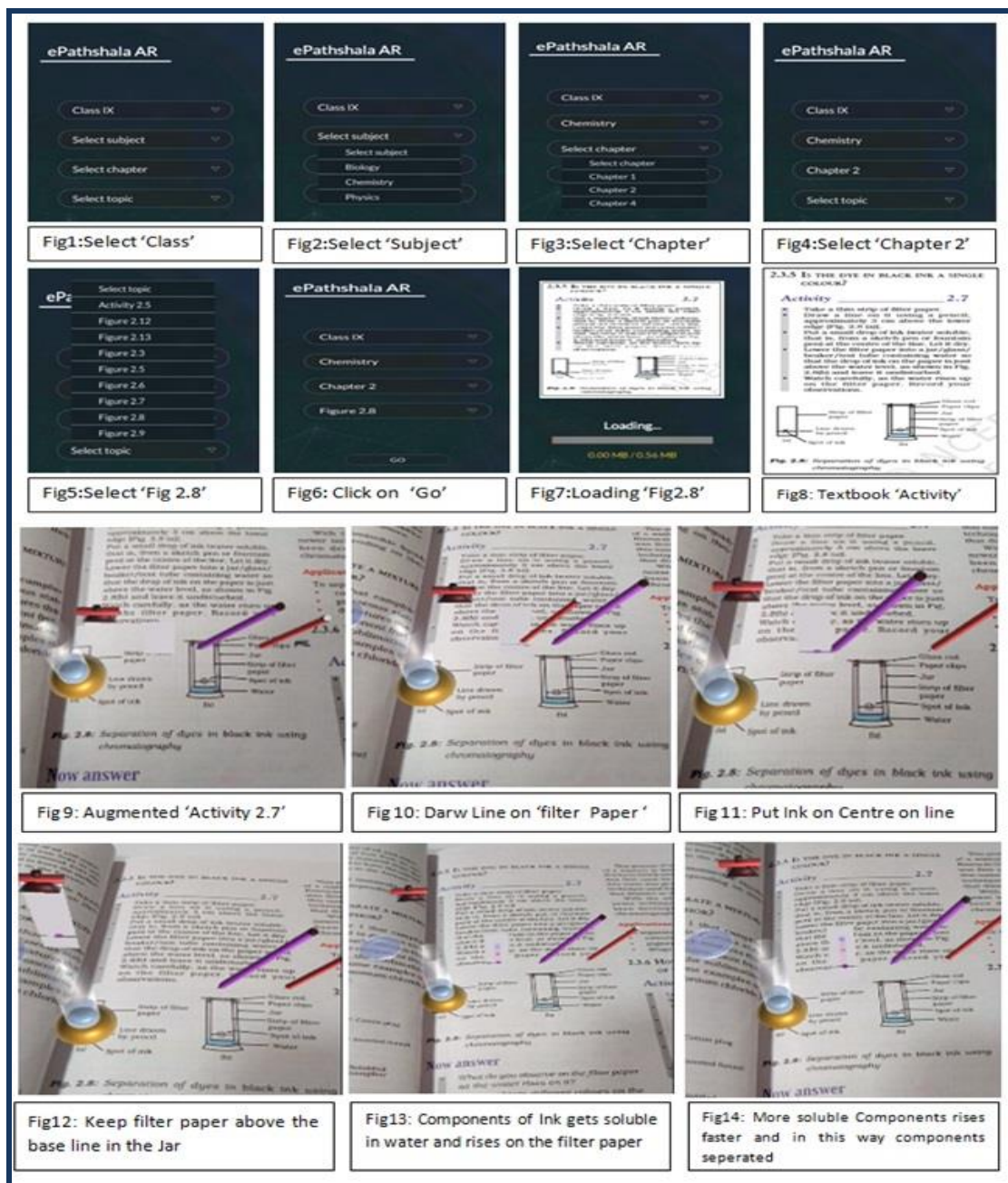


Figure -2: Augmented Reality based activity of separation of dyes in black ink

3.3.3 Physics: Augmented Reality based Electric Generator 'Deflection of Current occur in Galvanometer' given figure 3. All the steps followed by a left to right and top to bottom. During the access and use of a particular section, the process may be increased or decreased.

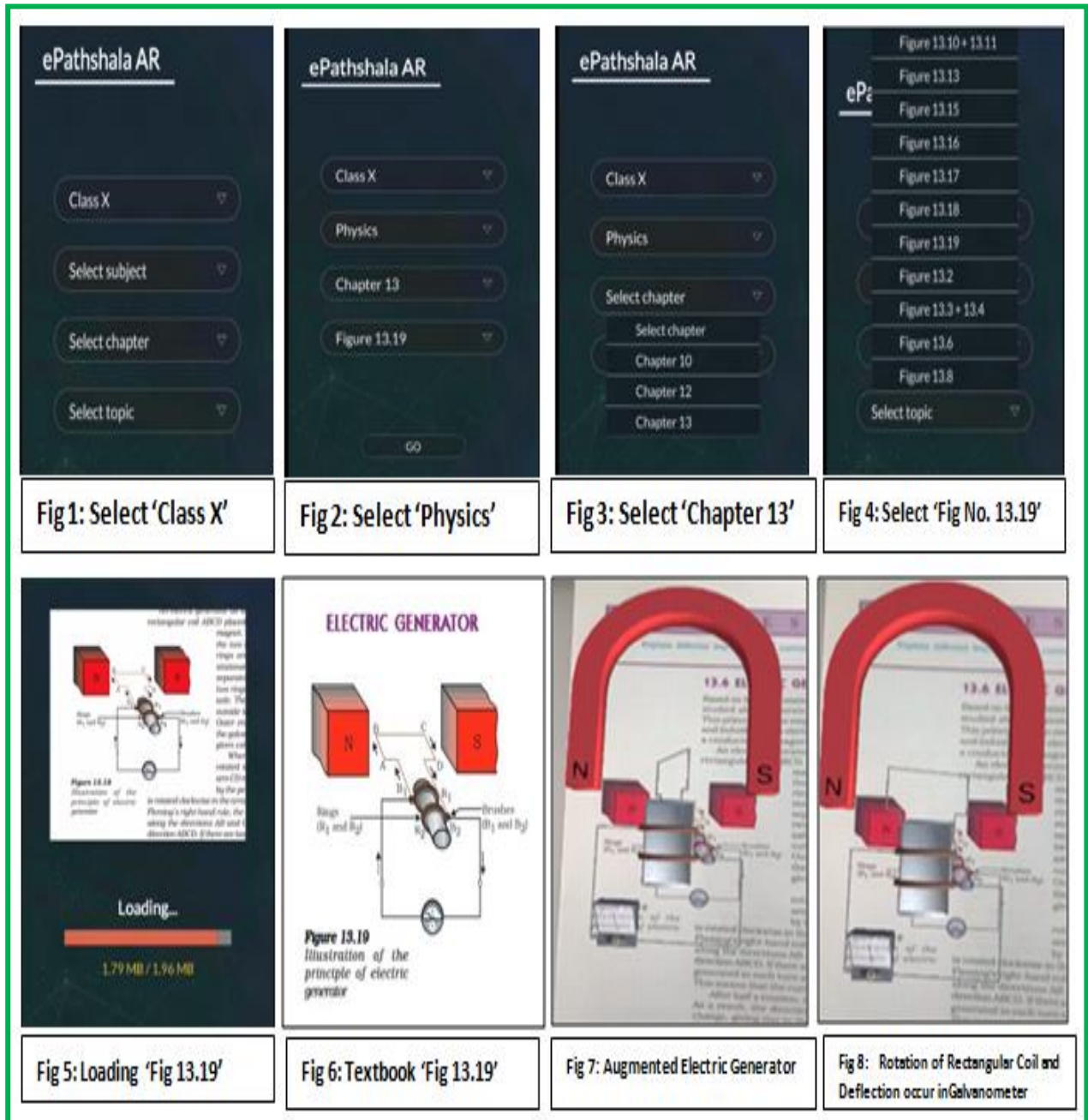


Figure-3: Augmented Reality Electric Generator 'Deflection of Current occur in Galvanometer'

4. Important parameters of Augmented pedagogy in Science education

4.1 Cognitive Effort: Under this parameter learner discover learning in 3Dimension; see the unseen and juxtaposing information related to their textbooks. Psychological feature effort is concerning however, the quantity of psychological feature effort required to unravel a task may have an effect on learning. Several as troublesome perceive Science and it usually needs a high degree of abstraction. AR helps to scale the element of images and activities in many ways in which option of affordance provide assistance to see the invisible area of relative content of learning. For an example of 'Animal cell' helps to shows the knowledge concerning the varied elements to the learner to quickly see however the varied elements area unit reticulate and have an effect on one another, which may offer students a lot of psychological feature capability to grasp the different components of a system as a full. Such switch considered in increasing the psychological improvement.

4.2 Motivation: Students increase involvement in learning science, and positive attitudes towards science through motivation that shows greater progression. Motivated students can create an additional effort to troublesome tasks and attain their skills. Once student developed, their skills then make an extra effort to learn difficult tasks and achieve higher learning.

4.3 Situated learning: Augmented Reality enhances the way to present the information and knowledge and the sense of presence, Immersion, immediacy, cooperation, interaction and location. It generate the worth of that learning happens in associate manner with authentic context, either as a result of it ends up in exaggerated commitment and motivation, depth understanding or ends up in cooperation between student's community of learners.

4.4 Inquiry based learning:

Inquiry-based learning: Interaction and textbook-based initiatives that area unit highlighted is dynamical teaching from being deductive to be inquiry-based. Inquiry-based teaching in science promotes students' curiosity and interest in science. Additionally, it may also facilitate to develop students' social skills and their ability to handle open-ended problem solving. Associate degree educational learner-centered approach integrates theory and observes, and develops data and skills for an answer to an outlined downside. Students need to solve the basic level, conduct independent learning and work in groups to create their own affiliation, creation, and organization for future application in similar issues.

5. Current Science Textbooks

The textbook is the primary source of reference for data in an exceedingly schoolroom science learning atmosphere in India. The existence of textbooks in an exceedingly learning method continues to be wide welcome because of sure criteria like transportability, mobility, and strength. However, some limitations of the textbooks a reason for low achievements among students. These embrace limitations of textbooks in convincing sure terms within the 3D model Associate in Nursing in remodelling time-related data in an animated manner like motion and textbook's non-interactive options, like static text, 2D colour pictures, and straightforward illustrations. So as to overcome the restrictions, in this paper try to elaborate the intervention of technology through the addition of multimedia systems (MM) parts like video, 3D objects, animation and audio to the present science textbook as counselled by researchers and academicians. Besides that, ePathshala AR application computer code additionally tries to to make easier to access and use within the teaching and learning environment.

6. Augmented Reality (AR) in Science Learning

AR enhances the users' perception with the real world, stimulates creativity, enhances students' comprehension of the topic, and provides a multisensory learning atmosphere that perpetually engages students within the learning method. AR has created a positive impact on the students in terms of acting effectively in-class assessments. AR offers first-hand experience in science learning that cannot be experience through the normal teaching and learning technique.

Teachers can utilize their real-time experience throughout the lecture session to motivate teachers and their learners with innovation and confidence to use the new dimension of technologies that measure embedded in modern education. The intervention of ICT with a traditional method of the teaching-learning process provides a positive path to boost student's psychology that helps to the engagement of students in the classroom.

7. User of Augmented Reality app

This application software can be used by the different stakeholders viz., students, teachers, educators, and parents. It provides access to the following manner as given below:

7.1 Students

- Understand and access images in more depth and perform Laboratory experiments 24x7 hr. any time, any were through adopting augmented reality app at secondary Stage (IX and X class) for Science textbooks. Its provide self-learning instructions with more elaborative and interactive through ePathshala AR app that contain (text, audios, videos, animation, and graphics, etc.)

7.2 Teachers

- High cost, non-availability of resources, and precautions, these kinds of problems can be removing by using ePathshala AR app software.
- Teachers can enhance teaching competencies before delivering the lecture with rich informative content within lecture time allotted.
- Provide a new method of Teaching Process and engage the students to utilize their mobile phones in learning science with curiosity.
- ePathshala App works as supplementary teaching Aids.
- ePathshala AR app helps to achieve expected learning outcomes
- Motivate to design and develop a new augmented reality app that could support the teaching-learning process.

7.3 Educators

- Can try to reduce the gap of psychological behaviour of the teaching-learning process related to regular or correspondence or distance mode of the education process.
- Cater more learners to access and use of ePathshala AR app to deliver training and workshops.
- Motivate and generate new ideas, thoughts and creativity among learners to gain and support science.

7.4 Parents

- They can involve with their children in learning science using ePathshala AR app like favorite games.
- can interact with children to gain expected learning outcomes
- With the help of using traditional method of teaching means using textbooks, they can easily access, use simple, and easily accessible ePathshala AR app for their children in interactive way.

8. Further areas of Research and Development

- comparative study on different AR app
- study on effectiveness of AR app in the teaching-learning process upto Senior secondary stage
- Find out the gap areas that required enhancing through Augmented Reality
- design and development of interactive programme to access and used of AR Technology.
- Graphical and Tabulated data presentation through Augmented Reality app

9. Conclusion

Science education is also a valuable part of the inclusive classroom include with other subjects and disciplines. It will also increase the employment opportunities at different stages accordingly to the qualification and skills of the students. Integration of Educational Technology is an essential need in the inclusive classroom that works as an organism to strengthen the quality of education at different stages. It helps to support the teachers, educators, students, and parents, etc. As safety reasons augmented reality is very dynamic in digital nature and environmentally friendly helps to save lives during unusual dissection, reduce cost, pollution, and injuries happened in the laboratories. Students can get in-depth knowledge about their particular piece of content. CIET, NCERT has done rejuvenated work to give the light for other disciplines and subjects that need to uncover for real-time access and use. Dissemination knowledge through augmented reality related to physics, chemistry and biology in the inclusive classroom for pedagogical processes will create curiosity and positive output. To get the benefits of this interactive technology, organizations need to promote practical implementation as much as possible. This technology will also improve the learning outcomes at the senior and senior secondary stages through its characteristics and functional approach.

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