

Adaptability and Awareness of Augmented Reality in Teacher Education

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Received: 22-05-2021

Revised: 24-07-2021

Accepted: 11-08-2021

ABSTRACT

As an emerging technology, Augmented Reality has a huge potential for the educational field. Teacher education is the root of all other professions so the current study was intended to explore the resources available in the teacher education institute and the awareness about augmented reality among the teacher educators and pre-service teachers. The data was collected by two self-developed questionnaires i.e. Resources Availability and Awareness Questionnaire for Pre-Service Teacher & Resources Availability and Awareness Questionnaire for Teacher Educator, the result revealed that the teacher education institutes of Odisha and the TEs & PSTs have adequate resources to use augmented reality in the classroom but the awareness level among them found to be very low.

Keywords: augmented reality (AR), teacher educators (TE), & pre-service teachers (PST), adoptability, awareness

Teaching is the one profession that creates all other professions. A good teacher can inspire, hope, ignite the imagination, and install a love of learning.

—Brad Henry

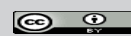
Over the past few years, the dimension of learning has changed so far. The definition of being educated is now replaced with more comprehensive terms such as being a skilled professional. The professionals of educational field are now striving to provide real life experience to students by shifting the classroom beyond the four walls. It is not always possible to provide real life experiences and first hand exposure of various practical aspects of education especially in the field of STEM. Some of the science activities are very risky to conduct in a classroom and even unethical. Students' interest to choose science as discipline is decreasing day by day; they find the subjects to be abstract and complex (Saidin, *et al.* 2015) but with the emergence of immersive technologies such as virtual reality, augmented reality & mixed reality it is now possible to do impossible things in the classroom. Among the immersive technologies, 42% of consumers adopted

Augmented Reality (AR) over the last 12 months, making it the most emerging technology in the field of medicine, education and industry over the world (Perkins Coie LLP, *et al.* 2020). Marker based AR and mobile based AR (MAR) have been chosen widely for the education purpose during the COVID-19 pandemic (Sirkaya & Sirkaya, 2020; Vuta, 2020).

Augmented reality (AR) has vast application in educational sector; it has potential to offer seamless interaction between the real and the virtual world (Birt & Vasilevski, 2021; Ghare *et al.* 2017; Kesim & Ozarslan, 2012) also increase peer interaction (Patel & Panchotiya, 2020). AR technology in the classroom has potential to improve and promote learning

How to cite this article: Tripathy, M.K. and Panda, B.N. (2021). Adaptability and Awareness of Augmented Reality in Teacher Education. *Educational Quest: An Int. J. Edu. Appl. Soc. Sci.*, 12(2): 107-114.

Source of Support: None; **Conflict of Interest:** None



abilities, motivation, problem-solving abilities and learning achievement among students (Vuta, 2020; Lafargue, 2018). It could be employed to promote self directed learning, problem solving skills, & self motivation among students (Renner, 2014; Wu *et al.* 2013) and it promote interest to learn (Petrov & Atanasova, 2020; Celik *et al.* 2020; Piovesan *et al.* 2012). Although AR technologies are very promising in the STEM fields but need improvement and experiments in social science context (Radianti *et al.* 2020). Various advantages of AR in educational field were, it improve academic gain, the retention of learning extended to a longer period of time and students feel like motivated to learn through AR applications (Garzon *et al.* 2019).

Augmented Reality

Augmented Reality (AR) is an immersive technology which allows the users to superimpose a digital content such as 3D images, texts, video and sound over a real object or real world environment. The earliest version of augmented reality was designed to provide an immersive mixed reality experience. It emerged in the early 1900s and the term "Augmented Reality" was coined by P Caudell. There are various type of AR used all over the world, these are

1. *Projection based Augmented Reality:* As per the name the projection based AR projects the virtual image into the real world for superimposition. For example: digital keyboard on the desk.
2. *Recognition based Augmented Reality or Marker based Augmented Reality:* It is the most famous type of AR which allows the users to scan an image or a mark and the preinstalled come to live. Once the marker image is scanned with a smart phone it is replaced with a corresponding image that is prefixed earlier.
3. *Location based Augmented Reality:* In the smart devices, location based AR uses the GPS, accelerometer & compass features to enhance the experience of map. It is mostly integrated with Google map to show some interesting information about the map.
4. *Superimposition Augmented Reality:* It is most popular among gamers. This type of AR replaces the entire object or a part of it with

the augmented reality contents, mostly used in FPS games.

Teacher & Augmented Reality

Teachers are the creators of society, they make the future generation as various professionals. As we know, knowledge is never fixed, it is evolving over time. So it is important to install the learning abilities such as exploration, investigation, experiment and discovery among learners. As a teacher, it is not always possible to provide real life experience in every context of the educational field; but with the emergence of augmented reality, it is now possible. It is now easy to create AR contents and handle augmented reality applications for education and entertainment purposes by using simple smart phones (Vuta, 2020) & augmented reality applications have high levels of personalization capacity (Petrov & Atanasova, 2020).

Review of Related Literature

Various literatures related to Augmented Reality reviewed in light of the education and learning field. The summary of the reviews was mentioned below.

Evolution: The trends of research on immersive technology increase sharply until 2017 and become steady till the end of 2018, but in the educational area the trend is still moving upward (Garzon *et al.* 2019; Muñoz-Saavedra *et al.* 2019). Equipment sales, in-app purchase, product placement and advertising increased significantly over the years in the field of AR (Perkins Coie LLP *et al.* 2020).

Potential for Education: AR technology in classroom has potential to improve and promote learning abilities, motivation, problem-solving abilities and learning achievement among students (Vuta, 2020; Lafargue, 2018) also promotes the motivation level of pre-service teachers (Petrov & Atanasova, 2020; Khan *et al.* 2019). Most of the elementary teachers used AR applications in Kuwait due to it motivating and engaging students in classroom activities (Almoosa, 2018) even it also promotes intrinsic motivation among learners (Hanatono *et al.* 2018). AR applications decrease task completion time and error rate hence reduce mental workload (Jeffri & Rambli, 2021).

Usability: It is easy to create AR contents by using simple smart phones (Vuta, 2020) & have a

high level of personalization capacity (Petrov & Atanasova, 2020).

Challenges: AR is not effective for overcrowded classrooms (Liano *et al.* 2020). Many of the users reported being frustrated while using AR tools outdoors (Saidin *et al.* 2015). The main problem of adopting immersive technology was its cost of equipment (Holly *et al.* 2021; Rehman-Shams, 2019).

Attitude and Acceptance: Pre-Service teachers were intending to use immersive technology in their classrooms and they desired more professional development in this field (Eutsler & Long, 2021). 10th and 12th grade students have a positive attitude towards AR applications, and it increases their learning achievements (Harun *et al.* 2019). The student teachers reported that, Immersive technology such as VR can be a good way of teaching due to its flexibility in approach, high degree of interaction with the real and virtual world and risk free usability (Holly *et al.* 2021).

Rationale of the Study

Teaching is always a challenging task. Teachers need to be up-to-date with the current knowledge and information, and need to induce various teaching strategies to be successful in the teaching field. Teacher education programmes encompass teacher training, increase competencies and empower the teachers to deal with the current educational demands. However, due to tremendous development of the technological field and future demand of students, technology is considered a very important part of teacher education as well as in the professional life of a teacher.

Various studies have been conducted across the world on teacher education with reference to immersive technology. From the reviews, it was found that augmented reality has huge potential for development of education. It can provide real life experience in a safe way and promote problem solving ability, retention of learning and motivation to learn among students. It was also found that creating such contents is very handy and easy. It is very popular among student teachers as it reduces workload and provides seamless interaction between the real and the virtual world. However some studies resulted negatively such as, there are very minimal applications of AR available for special need users (Garzon *et al.* 2019). It promotes

cognitive overload among learners and teachers can not add & modify learning contents in AR applications (Hanatono *et al.* 2018). AR enabled classrooms were not as effective as traditional classroom instruction (Renner, 2014). Almost all the teacher participants (95%) Saudi Arabia agreed that school doesn't have adequate ICT infrastructure for implementation of immersive technology & about ¾ no of participants don't have appropriate IT skills to use AR applications in school (Alkhatabi, 2017).

However, there is no study conducted on resources availability among the TEs, PSTs and teacher education institute in India to effectively use AR applications and no study has covered assessing the awareness level of teacher educators and student teachers with reference to augmented reality. With such contradictory review findings and research gaps, it is a pertinent question before the investigator to explore the concern area.

Research Question

1. What are the resources available in teacher education institutions for successful implementation of Augmented Reality in Classroom?
2. Do the teacher educators have adequate resources to use Augmented Reality and its applications in the teaching process?
3. Do the pre-service teachers have adequate resources to use Augmented Reality and its applications in the teaching and learning process?
4. Do teacher educators are aware about Augmented Reality and its applications?
5. Do pre-service teachers are aware about Augmented Reality and its applications?
6. Do teacher educators and pre-service teachers are competent enough to use Augmented Reality for teaching and learning?

Objectives of the Study

1. To find out the resources available in the teacher education institutes for effective use of the Augmented Reality technology and its application.
2. To find out the resources available among teacher educators to use the Augmented

Reality technology and its application in their teaching effectively.

3. To explore the current practices of teacher educators and pre-service teachers in the educational field in terms of use of technology.
4. To find out resources available among pre-service teachers to use Augmented Reality technology and its application in their teaching and learning process.
5. To explore the level of awareness and application about the technology of Augmented Reality among teacher educators and pre-service teachers.

Statement of the Problem

In the present study the researcher was interested in exploring the resources available among the teacher educators and pre-service teachers. The intention was to find out the awareness level of application of Augmented Reality in the educational field. Thus the study was entitled as, “*Adaptability and Awareness about Augmented Reality in Teacher Education.*”

Method

Exploratory research design was used for this present research, and survey method was used to collect the data.

Population and Sample of the Study

The population of the study was teacher educators and pre-service teachers of teacher education institutions of Odisha, i.e., both 2-year and 4-year integrated B.Ed students and the Teacher Educators who were assigned to teach them. The sample of the study consisted of 21 educators and 216 pre-service teachers from various teacher education institutes of Odisha and the sample was selected by using the voluntary response sampling technique.

Tools Used for the Present Study

The researcher developed questionnaire as tool for the present research which were:

1. Resources Availability and Awareness Questionnaire for Pre-Service Teacher.
2. Resources Availability and Awareness Questionnaire for Teacher Educator.

Analysis and Interpretation of the Data.

1. Availability of Resources in Teacher Education Institutes

Responses of teacher educators and pre-service teachers regarding resources available in teacher education institutes were presented in Table 1.

Table 1: Resources Available in Teacher Education Institutes

| Resources | TEs (N=21) | PSTs (N=216) |
|-----------------------------|------------|--------------|
| A computer lab | 20(95.2%) | 165(76.4%) |
| Broadband connectivity | 4(19%) | 12(5.6%) |
| Wi-Fi connectivity | 12(57.1%) | 64(29.6%) |
| Projector in Classroom | 13(61.9%) | 161(74.5%) |
| Smart board in Classroom | 9(42.9%) | 64(29.9%) |
| Speaker & Microphone | 13(61.9%) | 102(47.2%) |
| Web Camera facility | 6(28.6%) | 39(18.1%) |
| E- Library or E-respiratory | — | 145(77.1%) |

From the Table 1, it was found that, 95% TE and 76.4% of PST said that they have a computer lab, 57.1% TE & 29.6% argued that they have Wi-Fi connectivity, 61.9% TE & 74.5% PST said that they have projectors in the classroom, 42.9% TE & 29.9% PST said that they have smart board in the classroom and 77.1% PST said that they have an E-library in their institution.

2. Availability of Resources among Teacher Educators and Pre-Service Teachers

Responses of TEs & PSTs regarding resources available among them were collected and presented in Table 2.

Table 2: Resources Available among Teacher Educators and Pre-Service Teachers

| Resources | TEs (N=21) | PSTs (N=216) |
|------------------|------------|--------------|
| Laptop | 17(81%) | 100(46.3%) |
| Desktop | 1(4.8%) | 17(7.9%) |
| Broadband/ Wi-Fi | 9(42.9%) | 36(16.7%) |
| Smart Phone | 21(100%) | 213(98.6%) |
| Modem | 1(4.8%) | 5(2.3%) |
| Mobile Data | 19(90.5%) | 208(96.3%) |

From the table 2, it was found that 81% of TE has a portable laptop, 4.8% of them have a desktop and 42.9% of them used broadband/ Wi-Fi, 90.5% used

mobile data & 4.8% used modem for communication, all the teacher educators have a smart phone.

From the table it was also found that 81% of PSTs have a portable laptop, 4.8% of them have a desktop and 42.9% of them used broadband/ Wi-Fi, 90.5% used mobile data & 4.8% used modem for communication, 98.6% of them have a smart phone.

3. Teaching and Learning Online

Table 3: Methods of Assessment used by Teacher Educators to Assess Growth of Pre-service Teachers

| Method of Assessment | TEs (N=20*) | PSTs (N=216) |
|----------------------|-------------|--------------|
| E assessment | 9(45%) | 98(45.4%) |
| E-presentation | 17(85%) | 84(38.9%) |
| Portfolio | 3(15%) | 25(11.6%) |
| Project | 6(30%) | 74(34.3%) |
| Offline test | 2(10%) | 133(61.6%) |
| No assessment | 1(5%) | 9(4.2%) |

*As 1 TE mentioned that he/she had not take any classes in online mode during the COVID-19 pandemic, he/she was excluded from the calculation.

Teacher Educators

- ❑ Out of 21 TEs, 20 (95.2%) TEs were teaching their students through online media during lockdown.
- ❑ 25% of TEs mentioned all of their students, 55% mentioned that most of their students & 20% mentioned that some of their students have adequate devices to attend online classes.
- ❑ 10% of TEs mentioned all of their students, 60% mentioned that most of their students & 30% mentioned that some of their students have adequate internet connection to attend online classes.
- ❑ 5% TEs mentioned that all of their students interact with them while teaching, while 70% said most and 25% said some of their students interact with them while teaching online.
- ❑ 5% of TEs mentioned that all of their students were asking questions for clearing the doubt, while 55% said most & 20% some of their students were asking questions for clearing the doubt during the online classes.
- ❑ All the TEs used Google meet platform for teaching purposes while 25% used Zoom app

& 10% used other platforms to teach students online.

- ❑ 45% TEs mentioned that they used E-assessment tools for Assessing students, while 85% mentioned E-presentation, 15% mentioned Portfolio, 30% mentioned project, & 10% mentioned offline tests they used to assess the students progress. 5% TEs said that they are not assessing the student growth during the lockdown.

Pre-Service Teachers

- ❑ Out of 213 (98.6%) PSTs; 37.6% (80 No.) used the same mobile over 3 year of time, 24.9% of them used for 2-3 years, 22.5% of them used for 1-2 years and 15% of them buy a new mobile recently.
- ❑ 72.7% of PSTs had teaching experience; 68.6% got the experience during internship, 11.1% in formal school and 27.3% of them had no teaching experience.
- ❑ 0.9% of the PSTs spend less than 1 hour on internet, 21.8% of them spend 1-3 hour daily, 32.4% spend 3-5 hours daily, 23.6% spend 5-8 hours daily, 11.1% spend 8-10 daily, 10.2% of the PSTs spend more than 10 hours daily on internet.
- ❑ The % of use of online meeting applications by PSTs as: Google meet 92.6%, Zoom 44.4, Microsoft team 2.8%, other 11.6%.
- ❑ For self learning purposes 64.4% of PSTs prefer to use their own books, 40.3% prefer library, 25.5% prefer e-library, 63.4% prefer Google search, and 51.4% prefer online learning apps.
- ❑ For clearing any academic doubts, 12.5% of PSTs contact the concerned educators over mail, 40.3% of them over voice call, 32.9% over text message, 48.1% over Whatsapp, 78.2% of them during online classes and 3.7% of the PSTs prefer not to contact.
- ❑ While preparing the assignment 69.4% of the PSTs prefer books, 81.5% prefer searching online, 58.3% prefer to discuss with peers to complete the task.
- ❑ 64.4% of PSTs mentioned that their educators used the Lecture method during teaching online, 73.6% mentioned the Discussion method, 33.8%

mentioned the Demonstration method, 35.6% mentioned the Narration method, and 9.7% said that their educators used other methods while teaching online. 88% of PSTs (190 no.) mentioned that online teaching is not adequate to learn effectively.

4. Problem faced by Teacher Educators & Pre-Service Teachers

Responds from both the TEs and PSTs related to problem faced during online classes mentioned in the Table 4.

Table 4: Problem faced by Teacher Educators & Pre-service Teachers while Online Classes

| Problem Faced | TEs (N=20) | PSTs (N=216) |
|-----------------------------|------------|--------------|
| Connection issues | 15(75%) | 164(75.9%) |
| No or Less interaction | 6(30%) | 121(56%) |
| Resources Unavailable | 2(10%) | 52(24.1%) |
| Teacher centric approach | 8(40%) | 92(42.6%) |
| Assessment issues | 4(20%) | 95(44%) |
| No scope for doubt clearing | 1(5%) | 30(13.9%) |
| Low attendance | 1(5%) | — |
| Less no of classes | 1(5%) | — |

From the Table 4 it was found that both the TEs and PSTs faced various problems during online classes these are; 75% TEs & 75.9% PSTs mentioned that they face connection issues during online classes, 30% TEs & 56% PSTs mentioned that less or no interaction with peers and educators, 10% TEs & 24.1% PSTs mentioned that they don't have the adequate resources, 40% TEs mentioned that they forced to choose teacher centric approach & 42.6% PSTs mentioned that teacher centric approach was not sufficient for learning, 20% TEs & 44% PSTs mentioned that they face problem while assessment, 5% TEs & 13.9% PSTs mentioned other issues such as limited scope for clearing the doubt, and less no of classes they have provided.

5. Awareness of Teacher Educators & Pre-Service Teachers about Augmented Reality

The concerned data collected and presented in Table 5.

From the table 5, it was found that:

- TEs (21 no.) had scored as mean 2.90 and SD 1.95 in terms of knowing about AR, (in which maximum score possible was 7).

- TEs (21 no.) had scored as mean 2.90 and SD 1.95, in terms of using AR directly or indirectly in various fields such as taking photos, (in which max score possible was 7).
- TEs (21 no.) had scored as mean 2.43 and SD 0.87, in terms of intention to use in teaching and other fields, (in which maximum score possible was 3).

Table 5: Awareness of Teacher Educators & Pre-service Teachers about Augmented Reality

| # | Awareness (Range 0 to 7) | | | Using (Range 0-7 for TE, 0-8 for PST) | | | Intention to Use (Range 0-3) | | |
|-----|--------------------------|------|------|---------------------------------------|------|------|------------------------------|------|------|
| | N | M | SD | N | M | SD | N | M | SD |
| TE | 21 | 2.90 | 1.95 | 21 | 2.90 | 2.26 | 21 | 2.43 | 0.87 |
| PST | 216 | 4.56 | 1.98 | 157 | 4.27 | 2.50 | 216 | 2.40 | 0.96 |

- PSTs (216 no.) had scored as mean 4.56 and SD 1.98 in terms of knowing about AR, (in which maximum score possible was 7).
- PSTs (157** no.) had scored as mean 4.27 and SD 2.50, in terms of using AR directly or indirectly in various fields such as taking photos, (in which max score possible was 8).
- PSTs (216 no.) had scored as mean 2.40 and SD 0.96, in terms of intention to use in teaching and other field, (in which maximum score possible was 3).

**as 57 PSTs mentioned that they have no teaching experience, they were excluded from the calculation of USE domain of AR.

RESULTS AND DISCUSSION

- Most of the teacher education institutes have adequate resources for implementation of augmented reality applications in the classroom. The result was differ from the findings of the study Alkhatabi (2017), as it mentioned most of the institutions does not have adequate equipments to implement AR in classroom
- All the teacher educators have smart phones and internet connections which were sufficient for implementation of AR in the classroom. The finding contrasted by the result of the study Alkhatabi, 2017, as it mentioned ¾ of the educators does not have adequate resources.
- TEs used various platforms (100% used Google meet, 25% used Zoom & 10% used other

platforms) to teach their students and they mostly assessed their students by online assessment tools (85% used E-presentation, 15% used portfolio and 45% used E-assessment techniques).

- ❑ 98.6% of PSTs have smart mobile devices and 46.3% of them have portable laptops and most of them have an adequate internet connection, which was adequate for implementation of AR in the classroom. This finding was in contrast with Garzon *et al.* (2019), as it found that students have very minimal tools to use AR. 37.6% of PSTs mentioned that they used the same smartphone for over 3 years, which may not support the latest AR applications.
- ❑ Most of the PSTs mentioned that they spend 1-5 hours daily on the internet for browsing social media, self-study, assignment and entertainment purposes.
- ❑ Although 73.6% TEs used discussion methods for teaching, most of the PSTs (88%) teachers mentioned that online teaching is not sufficient for learning.
- ❑ The major problems faced by both TEs and PSTs were connection issues (75% & 75.9% respectively or respectively for TEs & PSTs) and problems with interaction with peers and educators (30% & 56% respectively for TEs & PSTs).
- ❑ Most of the teacher educators does not well aware about AR and its applications (M= 2.90 & SD= 1.95) but they somehow used the AR applications in life during taking photos etc. the TEs have positive attitude towards AR & its applications, most of them are interested to learn about AR and to use in their classroom (M= 2.43 & SD= 0.87). The findings were supported by Wu, *et al.* (2013); Eutsler & Long, (2021); & Holly *et al.* (2021), but it differed from the findings of Alkhatabi, 2017; as it resulted in teachers being very restricted to change and use AR in their teaching practice.
- ❑ PSTs were more aware about AR & its applications than TEs, but the score was still low (M = 4.56 & SD = 1.98). They used AR in various fields such as in taking photos and in teaching their students; but the score was just above the mean value which is not very

high (M=4.27 & SD= 2.50). PSTs also have a positive attitude towards AR & its applications, most of them are interested to learn about AR and to use it in their classroom (M= 2.40 & SD= 0.96). the findings was supported by the studies Holly *et al.* (2021); Radianti *et al.* (2020); & Almoosa (2018); but the result slightly differ from the findings of the study Raber, 2020; as it found that motivation to use AR decreased & Saidin *et al.* (2015) reported that most of the participants reported being frustrated after using AR.

Educational Implication

The result of the study revealed that teacher education instructions, TEs and PSTs have adequate resources to use Augmented Reality in teaching and learning purposes but awareness level among them was very poor. The study will help the participants to explore AR and its potential in education. The study will also help them frame various activities, workshops on AR uses and application. The study will surely help the concerned authority to take care of this area for technological advancement in teacher education institutions.

Suggestion for Further Research

The present study has certain limitations and augmented reality has a wide area of study so various suggestions regarding the future study.

1. Future study can be extended to various other educational areas such as school education & technical education, and a large sample can be taken for better generalization.
2. Various other dimensions such as mental workload, teaching experience, socio economic status and various disciplines can be integrated in the AR study for a comprehensive picture.
3. Further influence, opportunity, challenges & potential of AR and its Application can be explored in future research.

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