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ICT/ Educational Technology

1. Research Abstract

1. Theme/Subject:	ICT/ Educational Technology
2. Stage of Education:	Secondary and Senior Secondary Stages
3. Topic of Research:	Integration of Information and Communication Technology (ICT) in Teaching and Learning of Vocational Subjects
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5. Name of the Institution where the Research was conducted	PSS Central Institute of Vocational Education (PSSCIVE), Shyamla Hills, Bhopal – 462002
6. Category: **(**Research study/Action research/ Other)	Research Study
7. Language of Research Report:	English
8. Year of Completion:	2024
9. Published/Unpublished:	Unpublished

10. Introduction:

The rapid advancement of digital technologies has significantly transformed contemporary educational systems, reshaping teaching–learning processes across disciplines. Vocational education, which emphasizes practical skills and industry readiness, stands to benefit substantially from the effective integration of Information and Communication Technology (ICT). ICT tools such as digital content, simulations, learning management systems (LMS), virtual laboratories, and online collaboration platforms have the potential to enhance learner engagement, support experiential learning, and bridge the gap between classroom instruction and workplace practices.

In the Indian context, initiatives such as Digital India, Samagra Shiksha, and the National Education Policy (NEP) 2020 strongly advocate the use of technology to improve access, equity, and quality in education. Despite these policy directions, the extent and effectiveness of ICT integration in school-level vocational education remain uneven across regions. This study was undertaken to examine the status of ICT integration in vocational subjects across six states and Union

Territories—Madhya Pradesh, Jammu & Kashmir, Andaman & Nicobar Islands, Ladakh, Nagaland, and Puducherry. The research focused on identifying existing ICT facilities, patterns of use by teachers and students, challenges faced at the institutional level, and policy implications for strengthening technology-enabled vocational education.

11. Objectives:

(a) To assess the availability and adequacy of ICT infrastructure in government secondary and senior secondary schools offering vocational subjects.

(b) To examine the extent and manner of ICT usage by vocational teachers in classroom instruction and practical training.

(c) To study the use of ICT by students in learning vocational subjects.

(d) To identify challenges and constraints faced by teachers in integrating ICT into vocational education.

12. Methodology:

The study adopted a mixed-methods research design, combining quantitative and qualitative approaches to obtain a comprehensive understanding of ICT integration in vocational education. The sample comprised 24 government schools offering vocational subjects across six states/UTs. A total of 48 vocational teachers and 480 students participated in the study.

Data were collected using structured questionnaires for teachers and students to capture information on ICT availability, usage patterns, digital competencies, and perceived benefits. Checklists were used to assess school-level ICT infrastructure, including availability of computers, internet connectivity, smart classrooms, and vocational-specific digital tools. Qualitative data were gathered through open-ended responses to understand contextual challenges and best practices. Quantitative data were analyzed using percentage analysis, while qualitative responses were subjected to thematic analysis. This methodological approach enabled triangulation of data and ensured reliability and validity of findings.

13. Findings:

The findings of the study indicated that ICT integration had a positive impact on vocational teaching and learning processes. Both teachers and students reported improved engagement, motivation, and conceptual understanding when digital resources were used. Most vocational teachers possessed intermediate to advanced ICT skills; however, many expressed the need for continuous training to keep pace with emerging technologies and digital pedagogies.

Significant regional disparities were observed in ICT infrastructure and internet connectivity. Schools in urban and better-connected regions reported higher usage of digital tools, while those in remote and geographically challenging areas faced limitations due to inadequate infrastructure and unreliable internet access. Learning Management Systems and virtual learning platforms were found to be underutilized, despite their potential for blended and self-paced learning.

Students benefited from ICT-enabled learning but faced challenges related to limited access to devices, insufficient teacher support, and infrastructure gaps. Overall, the study highlighted the transformative potential of ICT in vocational education, while emphasizing the need for systemic support and capacity building.

14. Implications:

The study offers several policy and practice-oriented implications for strengthening ICT integration in vocational education. At the policy level, there is a need for sustained investment in ICT infrastructure, including reliable internet connectivity, digital devices, and vocational-specific technologies, to ensure equitable access across regions. Capacity building of vocational teachers through continuous professional development programmes is essential to enhance ICT competencies, pedagogical innovation, and confidence in technology integration.

Curriculum frameworks should explicitly embed ICT-based teaching–learning strategies and technology-enabled assessment methods to promote digital literacy, problem-solving abilities, and industry-relevant skills. Region-specific ICT implementation plans are recommended to address contextual challenges related to geography, infrastructure, and access. Additionally, robust monitoring and support systems should be established to provide technical assistance, track implementation progress, and ensure sustainability of ICT initiatives.

Overall, effective ICT integration can significantly enhance the quality, relevance, and reach of vocational education, aligning it with national digital transformation goals and workforce requirements.

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16. Keywords: ICT Integration, Vocational Education, Teacher Training, Digital Infrastructure, Policy Recommendations

2.Research Abstract

1. **Theme/Subject:**	ICT/ Educational Technology
2. **Stage of Education:**	Secondary stage
3. **Topic of Research:**	Augmented Reality (AR) based Science & Mathematics Lab activities as a sustainable supplement to traditional Lab at secondary stage
4. **Name and Address of the Investigators(s) with email:**	Prof. P.K. Chaurasia, drpraveenc1@gmail.com
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6. **Category: (**Research Study/Action research/Other**)**	Research Study
7. **Language of Research Report:**	English
8. **Year of Completion:**	2020-21
9. **Published/Unpublished:**	Published (AR App available on Google Play Store)

10. **Introduction:**

Teaching Science and Mathematics at the secondary stage faces persistent challenges: limited laboratory infrastructure, safety constraints, and resource gaps that prevent students from experiencing critical hands-on experiments. Augmented Reality (AR) offers a practical supplement by simulating complex, slow, hazardous, or resource-intensive experiments in an accessible, interactive virtual environment. This study investigates the design and deployment of AR-based Science and Mathematics lab activities to support conceptual understanding, procedural skills, and inquiry-based learning. The AR content was developed to align with the existing curriculum and was delivered alongside teacher training to ensure pedagogical integration. By situating experiments in a risk-free, repeatable, and visually rich environment, AR is expected to bridge the gap between theory and practice, increase student engagement, and provide teachers flexible tools to demonstrate phenomena that are otherwise difficult to replicate in school labs.

11. **Objectives:**

(i) To develop A.R. based Science and Mathematics Lab activities at secondary stage.

(ii) To compare the effectiveness of both types of Laboratory sessions on the basis of mean scores obtained.

(iii) To study AR based Science and Mathematics lab as a sustainable supplement to traditional lab at secondary stage.

12. Methodology:

The study was conducted through experimental Research design:

The study followed an experimental research design. By involving a few government secondary schools, teachers in different areas with basic science and computer lab facilities were selected by the respective teachers. In each school, classes were divided into an experimental group (EG) using AR-based lab activities and a control group (CG) using traditional laboratory methods. Teachers oriented for development of scripts and use of AR content (ten modules for science and ten for mathematics); a subsequent five-day capacity building programme trained the teachers for classroom implementation. Pre- and post-tests were administered for both groups; SPSS was used for statistical analysis to compare mean score differences and compute effect sizes.

13. Findings:

The study found that students exposed to AR-based laboratory activities showed statistically significant improvement in conceptual understanding and procedural skills compared to their peers in traditional labs. Post-test mean scores for the experimental group were higher (mean difference meaningful at $p < 0.05$) and effect-size calculations indicated a moderate to large educational effect in several modules, particularly where physical experiments were hazardous or impractical. Qualitative feedback from teachers and students reported increased engagement, stronger visualization of microscopic or abstract concepts (particle-level and symbolic representations), and greater willingness to attempt inquiry-based tasks. AR also reduced safety concerns and material costs for repeated practice. While some technical issues (connectivity and device availability) were noted, the overall pattern suggests AR can enhance learning outcomes when combined with guided instruction and teacher facilitation.

14. Implications:

The positive outcomes imply that AR-based labs can function as a sustainable supplement to traditional science and mathematics laboratories, especially in resource-constrained schools. For policy and school leaders, integrating AR resources can expand the range of feasible experiments, lower recurring costs for consumables, and minimize safety risks. Teacher training is critical: pedagogically-aligned AR content and capacity-building guarantee meaningful classroom use rather than one-off demonstrations. At the system level, investment in shared device pools, localized content development, and offline-capable AR modules would improve scalability. Future implementations should monitor equity

of access, provide maintenance plans, and blend virtual and hands-on experiences to preserve tactile laboratory skills while leveraging AR's strengths for visualization and repeated practice.
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16. Keywords: Augmented Reality, Science education, Mathematics education, Virtual lab, Secondary education, Teacher training

3. Research Abstract

1. **Theme/Subject:**	ICT/ Educational Technology
2. Stage of Education:	Secondary Stage
3. Topic of Research:	Development of Entry Level Module for Augmenting Learning of Science at Secondary Level
4. Name and Address of the Investigators(s) with email:	Dr. Anand Kumar Arya, Regional Institute of Education, NCERT, Ajmer-305004 anandarya@rieajmer.ac.in
5. Name of the Institution where the Research was conducted	Regional Institute of Education, NCERT, Ajmer
6. Category: (Research study/Action research/Other)	Research Study
7. Language of Research Report:	English
8. Year of Completion:	(Report RMSA-PAB 2017-18)
9. Published/Unpublished:	Report Published

10. Introduction

In the context of Universalization of Secondary Education (USE), RMSA has priority to enhance access and to improve quality of education at secondary stage. At the secondary stage, science is learned as a composite discipline and the concepts beyond direct experience occupy an important place in the curriculum. The secondary curriculum also demands analysis and interpretation of directly observable science phenomena studied at upper primary stage. This significant increase in the difficulty level of the science curriculum from upper primary to secondary level can be interpreted as additional challenges for the students who are at the entry level to secondary stage of schooling. There are reports that the students who are exiting upper primary level and entering secondary level of schooling are not having sufficient knowledge of the content. These students may benefit from need-based support to bridge the gaps in learning of science. There is a need to augment the learning of these students to ensure not only the quality education and meaningful learning at secondary level, but also for smooth transition from upper primary to secondary school. The present study was planned to keep in view the need of the upper primary students entering the secondary level.

11. Objectives:

1. To explore existing gaps in the understanding of concepts of science at secondary level.
2. To develop need specific modules for individualized learning of science for meaningful entry at secondary level.

12. Methodology:

For improving the attainment of Learning Outcomes (LOs)at secondary stage, it is aimed to develop the need-based support material for individualized pace of learning of students addressing the existing gaps for their transition from upper primary to secondary level and difficulties faced by the teachers and students in learning of science concepts. The study adopted a mixed method. The existing gaps in understanding the concepts in learning of science from upper primary to secondary level were explored through a questionnaire. The questionnaire was developed in a workshop mode for the students studying in class IX and X and for the teachers teaching science at upper primary and secondary level. The questions were aimed to identify the topic(s)/ concept(s)/ sub-concept(s), which makes learning of science at secondary level difficult due to insufficient prerequisite knowledge, introduction of concept(s) formally for the first time, lack of appropriate learning material and text language issues. The separate questionnaires were developed for students and teachers and administered to 222 students and 39 teachers of 5 states— Rajasthan, Uttarakhand, J & K, Haryana and Madhya Pradesh. The project team also interacted with the teachers and students and probed further which supplemented the answers received through questionnaire. The qualitative data in the form of responses from students and teachers were converted into frequency tables and analyzed. The difficulties in learning various topic(s)/concept(s) and sub-concept(s), reported by the students and teachers, were tabulated along with reported perceived causes. The reported difficulties in learning a specific topic/ theme /subtopic were also expressed in percentage. The reported learning gaps of identified topics/themes were correlated with the content expressed in the textbook, and perceived causes behind reported difficulty in learning were explored.

13. Findings

The existing gap in the understanding of concepts of science both from the perspective of students and teachers were analyzed along with their perceived reported causes. The qualitative data of responses of teachers and students of various topic(s)/concept(s) and sub-concept(s) in terms of frequency and percentage gave a listing of learning gaps. Most of the topic(s)/concept(s) having

learning difficulties reported by students and teachers were the same. The nature of difficulty and probable reasons were reported differently. Most of the students reported that learning gaps are due to the introduction of concepts for the first time, insufficient prerequisite previous knowledge, tough language, lack of self-explanatory diagrams of the concerned topics. While teachers reported a lack of suitable teaching-learning material, a smaller number of examples, along with the poor connection to previous knowledge as probable reasons. On these identified learning difficulties, the need-based support modules were developed for an individualized pace of learning.

14. Implications:

The exploration of existing gaps during the transition from upper primary (middle) to secondary will help bridge the gaps in learning of science. The augmented learning strategy will not only help in understanding the concepts of science through activities, experimentation, inference drawing and encouraging rational thinking, relating it with concepts learned at the upper primary level, but also for a smooth transition from upper primary (middle) to secondary school.

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16. Keywords: National Achievement Survey (NAS), Holistic Learning, Post NAS Interventions

4. Research Abstract

1. **Theme/Subject:**	ICT/ Educational Technology
2. Stage of Education:	Secondary
3. Topic of Research:	Effectiveness of Flipped Classroom on the learning of concepts of Physics at senior secondary level.
4. Name and Address of the Investigators(s) with email:	Dr. Ved Prakash Arya, Prof. S.V. Sharma Assist. Prof. of Physics, R.I.E., Ajmer (aryavedp@yahoo.com)
5. Name of the Institution where the Research was conducted	D.M.S., R.I.E., Ajmer
6. Category: **(**Research study/Action research/Other)	Minor Research Project
7. Language of Research Report:	English
8. Year of Completion:	2019
9. Published/Unpublished:	Unpublished

10. Introduction:

This study examined the effectiveness of the flipped classroom on the learning of concepts of Physics at the senior secondary level. The study was done on 21 students of class XI. The concepts covered were from the topics of Motion in a Plane and Laws of Motion. The control group had already learnt these topics in a conventional lecture format. A pre-test was administered on the group to know their conceptual understanding. On the basis of the analysis of the pre-test, suitable material was identified/developed in video and other formats. The group was then treated by the flipped classroom mode of learning for almost one month and the performance was then checked by a post-test. The results revealed that the flipped classroom had a positive impact on their learning, but improvement in learning outcomes is nominal.

11. Objectives:

- To study the learning difficulties of students in Physics at the senior secondary level.
- To see the effect of flipped learning on the understanding and application of concepts of physics.
- To see the effect of flipped learning on achieving higher-level learning objectives.
- To suggest appropriate learning strategies based on the analysis of the study.

12. Methodology:

(i) Design of the Study: Quasi-experimental method

(ii) Sample: The sample of the study comprised the students of the Demonstration Multipurpose School, Regional Institute of Education, Ajmer for class XI of CBSE. The total number of students was 21 including 9 girls and 12 boys.

(iii) Tools: Single group pre-test post-test (control group design)

(iv) Procedure of data collection

1) The assessment of the whole group was carried out through the pre-test and alternative frameworks of the students were recorded.

2) Learning resources were developed on the identified concepts in workshop mode by the subject experts.

3) A WhatsApp group named "Let's enjoy Physics" was created for the flipped classroom.

4) The group was then treated with the flipped classroom strategy for almost one month. In flipped classes, the studied topics were discussed in detail by participating students to the maximum extent.

At the end of the flipped classes, a post-test was conducted on the same group.

(v) Data Analysis (in brief descriptive, statistics used, etc.)

Preliminary statistical interpretations are made regarding the effectiveness of the Flipped classroom on the learning of concepts of Physics at the Senior Secondary level.

13. Findings:

The measure of dispersion (standard deviation) in the post-test is 8.36, which is slightly higher than in the pre-test. The fractional deviation from the average value is 0.18 for the pre-test and 0.21 for the post-test. It is clear that there is improvement in the learning of the students as a consequence of the flipped classroom strategy. This is important to note here that this improvement occurred in spite of not full utilization and review of video lectures on the learners' part.

14. Implications:

- The flipped classroom mode has better potential for effective teaching-learning processes and it should be encouraged.
- The conventional mode of teaching and the mental burden on students for the sake of their school examinations is a hurdle to achieving the full potential of flipped classrooms.

➢ Alternative frameworks do play an important role in learning. They are so deeply rooted that even after treating the group by the flipped classroom strategy, alternative frameworks persist. For right concepts to develop, Continuous and systematic efforts are required. ➢ The conventional notion of syllabus completion in a one-way process by the teacher should be discouraged.
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16. Keywords: Learning theory, Flipped learning, alternative frameworks, teaching-learning process, motion, force

5. Research Abstract

1. Theme/Subject:	Educational Technology / ICT
2. Stage of Education:	Secondary Stage
3. Topic of Research:	Impact of Smart Classroom on Improving Teaching Learning Processes at Secondary Level in West Bengal
4. Name and Address of the Investigator(s) with email:	Dr. Ramakanta Mohalik E-mail Id: mohalikrk@gmail.com
5. Name of the Institution where the Research was conducted	Regional Institute of Education, Bhubaneswar
6. Category: **(**Research study/Action research/Other)	Research Study
7. Language of Research Report:	English
8. Year of Completion:	2019
9. Published/Unpublished:	Unpublished

10. Introduction:

The modern trends and paradigms in education are moving forth in a path embracing technology for teaching, learning and assessment. Further the integration of Information and Communication Technology (ICT) has revolutionized education by shifting from traditional instructions to learner-centric and interactive modes. Initiatives like Digital India Campaign and Digital Initiatives in education have emerged as the bridges for digital divide and enhance the quality of education in schools by providing digital interactive content. Within this framework, the Government of West Bengal introduced 'Smart Classrooms,' notably through the 'KYAN' project, to make learning engaging via digital content and audio-visual tools. A smart classroom, in essence is a technologically enhanced learning space that comprise of interactive whiteboards, projectors, computers and internet facilities. It helps foster active participation, collaboration, and deeper conceptual understanding among all groups of learners. While there are researches that highlight significant benefits for students' engagement and achievement, there exist some research gaps specifically for the secondary schools in West Bengal as there were few studies conducted. This study therefore investigates the impact of smart classroom on Improving Teaching Learning processes at the secondary level in West Bengal. It further aims to analyze its influence on pedagogical methods, students' outcomes, and practical

challenges faced, providing crucial insights for optimizing this digital transformation in the education system of West Bengal.

11. Objectives:

- To assess the availability and adequacy of ICT infrastructure and resources for smart classrooms in selected secondary schools of West Bengal.
- To examine the process of using smart classrooms by teachers and students.
- To find out the impact of smart classroom teaching on students' achievement.

12. Methodology:

The study employed a survey method to examine the impact of Smart Classrooms on teaching and learning in secondary schools of West Bengal.

The sample for the research was drawn from 25 secondary schools from three districts: Hooghly, Darjeeling (Siliguri Educational District), and Jalpaiguri, which included 25 headmasters, 73 teachers, and 175 students selected randomly. The sample was selected by use of multistage sampling techniques. Data was collected using multiple self-developed tools. A detailed 57-item checklist assessed six components: availability and functional status of digital devices, ICT teacher training, usage frequency, technical staff support, classroom infrastructure, and subject-specific software. Classroom practices were observed through a 50-item observation schedule focusing on introduction, presentation, and assessment phases. An observation schedule was used to examine usage of Smart Classrooms by teachers and students followed by Focus group discussions with students about their experiences in using these digital tools. A Proforma for Class X board examination results 2017-2018 was used to collect the academic achievement of students from schools. Content validity of the tools was ensured by taking expert opinion during the tool development and finalization process. The investigator conducted school visits between September and December 2018. The collected data were coded, entered into MS Excel, and analyzed using descriptive statistics such as frequency and percentage and average with the help of SPSS-20.

13. Findings:

- All schools have desktops and projectors. 50% of teachers in Science, Mathematics, Social Science and English are not trained for taking classes in Smart classrooms.
- 88% of schools do not use Smart classrooms every day for teaching Science, Mathematics and English.

- All schools have KYAN projector, multimedia pen and mouse but do not have interactive boards.
- The students felt enthusiastic and energetic to learn in a Smart classroom.
- The majority of teachers scheduled Smart class according to their convenience in the disciplines of Science, Mathematics and English.
- Content availability was critically low: 84-96% of schools lack subject-specific software across disciplines.
- The percentage of AA, A+ and A grade has decreased in the year 2018 whereas an increase in the percentage of B+, B and C grade is observed in the year 2018.
- The effect of smart classrooms on students' achievement in class X board examinations was not visible as the smart classroom project was implemented in the schools in 2017.
- Despite positive student feedback, operational challenges persist like uncontrolled usage (no timetables), fast-paced content (particularly in Mathematics), and English-only materials hinder effectiveness. Power outages further disrupt classes.

14. Implications:

The findings of the study highlight critical implications that include an urgent need for infrastructure enhancement. While basic hardwares exist, the absence of interactive boards and inadequate peripherals significantly limits the pedagogical potential of the smartboards. The government should provide essential missing components: interactive whiteboards, wireless microphones, and proper projection surfaces.

Secondly, the study underscores an urgent need for comprehensive teacher capacity building. So, there should be training programs that are required to bridge the skill gaps of teachers. The training should focus on technological proficiency, pedagogical integration, and creating structured timetables for equitable subject coverage. Further, all teachers must be oriented in the development of e-contents and use of digital initiatives of the Govt. of India like ePathasala, NROER etc.

Thirdly, content development requires immediate attention. The unavailability of subject-specific software (84-96% across subjects) and language barriers in existing materials necessitate developing multilingual, curriculum-aligned digital resources based on the West Bengal school board. Collaboration with institutions like NCERT-CIET could facilitate quality content creation.

Finally, the findings advocate for a paradigm shift towards blended learning models. Teachers need orientation on national platforms (ePathshala, SWAYAM) and training in using ICT for interactive assessments and feedback mechanisms. Strategic implementation of these recommendations could transform smart classrooms from basic audio-visual setups into dynamic learning environments that genuinely enhance educational outcomes.

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16. Keywords: Smart Classroom, Teaching Learning Processes, Educational Technology, KYAN project, Students' achievement

6. Research Abstract

1. **Theme/Subject:**	ICT/ Educational Technology
2. Stage of Education:	Secondary Stage
3. Topic of Research:	Effectiveness of virtual laboratory on achievement in science at secondary school level
4. Name and Address of the Investigators(s) with email:	Prof. RASHMI SINGHAI
5. Name of the Institution where the Research was conducted	RIE Bhopal
6. Category: (Research study/Action research/Other)	Research
7. Language of Research Report:	English
8. Year of Completion:	2019-20
9. Published/Unpublished:	Unpublished

10. Introduction: Science education plays a crucial role in shaping students' understanding of the natural world, fostering critical thinking, and developing problem-solving skills. Traditional science teaching methods in secondary schools often rely on textbooks, lectures, and conventional laboratory experiments. While conventional laboratories provide hands-on experience, they are sometimes limited by resource constraints, safety concerns, and time restrictions, which can affect the learning outcomes of students. With the advancement of technology, virtual laboratories (VL) have emerged as an innovative tool to complement traditional teaching methods. Virtual labs allow students to perform experiments in a simulated digital environment, providing opportunities to explore complex scientific concepts in an interactive and safe manner. These digital platforms can enhance student engagement, reinforce theoretical knowledge, and encourage self-directed learning by allowing repeated practice of experiments without the limitations of physical resources. The present study aims to investigate the effectiveness of virtual laboratories in improving students' achievement in science at the secondary school level. By comparing conventional and virtual laboratory approaches, the study seeks to determine how digital interventions can support science education, address learning difficulties, and foster a deeper understanding of scientific principles among class IX students.

11. Objectives: The primary objective of this study is to examine the effectiveness of virtual laboratories in enhancing students' achievement in science at the secondary school level. Specifically, the study aims to assess how the use of virtual laboratory tools can improve students' understanding of scientific

concepts, experimental procedures, and analytical skills compared to traditional laboratory methods. It also seeks to explore whether virtual labs can engage students more effectively in the learning process, promoting active participation, curiosity, and critical thinking. Another objective is to identify any differences in learning outcomes based on gender, investigating whether male and female students benefit equally from virtual laboratory interventions. Additionally, the study aims to gather teachers' and students' perceptions regarding the usefulness, accessibility, and practicality of virtual labs as a teaching-learning resource. By understanding the impact of virtual laboratories on achievement, the study intends to provide insights into how technology-integrated teaching strategies can complement conventional science education, reduce resource limitations, and enhance overall learning outcomes. The findings are expected to inform curriculum planners, educators, and school administrators about the potential of virtual labs to strengthen science instruction, promote experiential learning, and support innovative pedagogical practices at the secondary school level.

12. **Methodology:** The study was conducted at Demonstration Multipurpose School, Bhopal, focusing on Class IX students at the secondary school level. A pre-test and post-test two-group experimental design was employed to examine the effectiveness of virtual laboratories in science. The sample consisted of students and teachers from the school, selected purposively based on their participation and willingness to engage with the virtual lab package. The experimental group was exposed to virtual laboratory interventions, while the control group continued with conventional laboratory methods. The intervention involved structured activities and experiments using a developed virtual laboratory package, designed to cover key science concepts. Data collection tools included a pre-tested questionnaire to measure students' achievement, along with an observation schedule to record students' engagement and interaction during virtual lab sessions. Qualitative data on teachers' and students' perceptions of the virtual lab were also collected. Quantitative data were coded, tabulated, and analyzed using SPSS software to compute mean scores, standard deviations, t-tests, and ANOVA, comparing pre-test and post-test results across groups. Qualitative responses were analyzed thematically to understand the participants' experiences and perceptions. This methodology ensured a rigorous examination of the impact of virtual laboratories on learning outcomes while capturing both statistical and experiential insights.

13. Findings: The study revealed a significant improvement in students' achievement in science when using the virtual laboratory (VL) compared to conventional laboratory methods. Quantitative analysis of pre-test and post-test

scores showed that students in the experimental group demonstrated higher understanding of scientific concepts, improved problem-solving skills, and better retention of theoretical knowledge. The mean post-test scores of the experimental group were notably higher than the control group, indicating the effectiveness of virtual labs in enhancing cognitive learning outcomes. Observation data highlighted increased engagement, curiosity, and active participation during virtual lab sessions. Students reported that the interactive simulations, visualizations, and step-by-step guidance helped them understand complex experiments more clearly. Qualitative feedback from teachers suggested that VL provided opportunities to address individual learning differences, encouraged self-paced learning, and allowed repeated practice without resource constraints. Gender-based analysis indicated that both male and female students benefited equally from the virtual lab intervention, showing no significant difference in achievement outcomes. The study also found that virtual laboratories enhanced collaborative learning, as students discussed procedures and results in groups, fostering peer learning. Overall, the findings suggest that integrating virtual laboratories in secondary school science can effectively supplement traditional teaching methods, improve achievement, and make science learning more enjoyable, meaningful, and accessible for all students.

14. **Implications:** The findings of this study have several important implications for science education at the secondary school level. First, integrating virtual laboratories (VL) into the curriculum can significantly enhance students' conceptual understanding, engagement, and achievement in science, making learning more interactive and meaningful. Teachers can use VL as a supplementary tool to demonstrate complex experiments that may be difficult or resource-intensive to perform in conventional labs, thereby overcoming infrastructural and material limitations. The study also indicates that VL promotes individualized and self-paced learning, allowing students to revisit experiments, correct mistakes, and reinforce understanding, which is particularly beneficial for students with diverse learning needs. From a pedagogical perspective, virtual laboratories encourage collaborative learning and critical thinking, as students analyze data, discuss results, and apply theoretical knowledge practically. Additionally, the study demonstrates that VL can be equally effective for both male and female students, supporting gender-inclusive science education. Education policymakers and school administrators can consider investing in virtual lab technologies and training teachers in their effective use to modernize science teaching. Overall, incorporating VL into science education can bridge the gap between theory and practice, foster scientific inquiry, and cultivate students'

curiosity and problem-solving skills, ultimately improving the overall quality and effectiveness of science education in schools.
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16. Keywords: Virtual Laboratory, Science Achievement, Secondary Education, Experimentation, Gender, Pedagogy

7.Research Abstract

1. **Theme/Subject:**	ICT/ Educational Technology
2. Stage of Education:	Elementary Stage
3. Topic of Research:	Effect of ICT mediated interdisciplinary approach of learning mathematics on elementary students
4. Name and Address of the Investigators(s) with email:	R.K Nayak
5. Name of the Institution where the Research was conducted	RIE Bhopal
6. Category: (Research study/Action research/Other)	Research
7. Language of Research Report:	English
8. Year of Completion:	2017-18
9. Published/Unpublished:	Unpublished

10. Introduction:

Current mathematics assessment practices in Indian schools are predominantly behaviorist, focusing on product-based outcomes rather than process-oriented learning. Summative assessments emphasize knowledge recall and understanding, with minimal attention to higher-order thinking, affective, and psychomotor domains. Although CBSE has introduced some value-based questions, textbooks and classroom practices do not adequately represent such contexts. Constructivist pedagogy, as advocated in NCF 2005 and forming the backbone of Continuous and Comprehensive Evaluation (CCE), emphasizes knowledge construction through active learning, collaboration, and authentic problem-solving. However, in practice, CCE is often implemented ritualistically, with teachers either unaware of constructivist principles or perceiving them as idealistic. There is a pressing need to transform mathematics classrooms to focus on the learning process, interdisciplinary applications, and values inculcation, without compromising conceptual understanding. The present study proposes developing ICT-mediated interdisciplinary mathematics content using projectors, laptops, and smartphones for class VIII students at DMS, Bhopal. This approach integrates real-life scenarios, cross-disciplinary artifacts, and collaborative problem-solving tasks to promote process skills, critical thinking, and affective domain development. By replacing artificial textbook contexts with authentic situations from students' surroundings, the study aims to enhance conceptual

clarity, promote values, and demonstrate the practical feasibility of integrating ICT-mediated constructivist strategies in Indian secondary mathematics classrooms.

11. Objectives:

To develop ICT-mediated interdisciplinary mathematics content using projectors, laptops, and smartphones for class VIII students at DMS, Bhopal. This approach integrates real-life scenarios, cross-disciplinary artifacts, and collaborative problem-solving tasks to promote process skills, critical thinking, and affective domain development. By replacing artificial textbook contexts with authentic situations from students' surroundings, the study aims to enhance conceptual clarity, promote values, and demonstrate the practical feasibility of integrating ICT-mediated constructivist strategies in Indian secondary mathematics classrooms.

12. Methodology:

This study employed a quasi-experimental pre-test and post-test design involving two sections of class VIII students from DMS, Bhopal, each comprising 35 students. One section was randomly selected as the experimental group to receive ICT-mediated interdisciplinary mathematics instruction, while the other served as the control group using conventional teaching methods. The intervention spanned 14 weeks, with lessons incorporating real-life contexts, interdisciplinary artifacts, and collaborative tasks facilitated through projectors, laptops, and smartphones. Pre-tests were administered to both groups to assess baseline achievement and interest in mathematics. The experimental group engaged in activities such as calculating material quantities in construction scenarios to learn ratio, proportion, and practical problem-solving, while values like honesty and vigilance were embedded within tasks. Post-tests measured academic achievement, process skills, and interest levels, and qualitative data were collected through observations, structured interviews, questionnaires, and feedback from teachers and parents. Quantitative data were analyzed using SPSS software, employing t-tests, means, variance, and covariance at a 0.05 significance level. Qualitative data were interpreted using thematic analysis to evaluate changes in student interest, engagement, collaboration, and values development. Mixed-methods triangulation ensured a comprehensive assessment of cognitive and affective outcomes, validating the effectiveness of ICT-mediated constructivist pedagogy.

13. Findings:

The study revealed that ICT-mediated interdisciplinary mathematics significantly improved students' academic achievement and process skills compared to the control group. The experimental group demonstrated enhanced conceptual

understanding of mathematical topics such as ratio, proportion, and measurement, facilitated by real-life problem-solving contexts. Observations indicated higher levels of engagement, collaboration, and motivation, as students actively participated in authentic tasks and group activities. The integration of values into mathematics learning, including honesty, responsibility, and vigilance, was effective, with students demonstrating awareness of ethical considerations during problem-solving. Differential analysis showed that students across achievement levels benefited, though bottom-line and below-average students displayed notable gains in engagement and comprehension. Teacher and parent feedback highlighted increased student enthusiasm and confidence in applying mathematics to real-life situations. Multimedia facilitation through projectors, laptops, and smartphones enabled visualization, interactive discussions, and immediate feedback, further reinforcing learning outcomes. The study also found that collaborative learning fostered critical thinking and knowledge construction, consistent with constructivist pedagogy. Overall, the results suggest that ICT-mediated interdisciplinary approaches enhance both cognitive and affective outcomes, support process-oriented learning, and provide a sustainable model for integrating real-life applications and values into mathematics instruction in Indian secondary schools.

14. Implications:

The findings underscore the transformative potential of ICT-mediated interdisciplinary mathematics instruction for secondary education. By integrating authentic, real-life contexts and values into lessons, educators can shift the focus from rote learning to process-oriented learning, enhancing students' conceptual understanding, engagement, and motivation. The study provides evidence that collaborative, constructivist activities facilitated through projectors, laptops, and smartphones can effectively develop process skills, critical thinking, and affective outcomes alongside academic achievement. Teacher educators and pre-service trainees can use these insights to design curricula and classroom strategies that balance content mastery with values inculcation. Policymakers should consider incorporating ICT-mediated interdisciplinary approaches into mainstream mathematics instruction and professional development programs, promoting wider adoption of constructivist pedagogy. Curriculum developers can develop materials that link mathematics concepts to real-life applications, encouraging students to engage in ethical decision-making and problem-solving. Furthermore, assessment practices can be modified to capture process-oriented learning and values integration. Overall, the study demonstrates that ICT-mediated interdisciplinary strategies offer a practical, replicable model for improving

mathematics teaching and learning, fostering holistic development, and preparing students for real-world challenges, thereby enhancing the quality and relevance of secondary mathematics education in India.

15. Abstract Prepared /Submitted By: R.K Nayak
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16. Keywords: Mathematics assessment, Constructivist pedagogy, ICT integration, Interdisciplinary learning, Critical thinking, Affective domain

8. Research Abstract

1. **Theme/Subject:**	ICT/ Educational Technology
2. Stage of Education:	Primary Stage
3. Topic of Research:	Effectiveness of Audio-Video materials for developing reading skills in fourth-grade students of DMS, Bhopal
4. Name and Address of the Investigators(s) with email:	Dr.Jose J.Kurisunkal
5. Name of the Institution where the Research was conducted	RIE Bhopal
6. Category: (Research study/Action research/Other)	Research
7. Language of Research Report:	English
8. Year of Completion:	2017-18
9. Published/Unpublished:	Unpublished

10. Introduction:

The integration of Information and Communication Technology (ICT) into constructivist pedagogy has emerged as a crucial approach to enhance learning outcomes in secondary education. Traditional teaching methods, often lecture-based, have shown limitations in engaging students and fostering critical thinking. The ICT Integrated Constructivist Approach provides learners with interactive, technology-driven experiences that encourage active participation and collaborative problem-solving. This method aligns with the National Curriculum Framework (NCF) 2005, emphasizing constructivist pedagogy that focuses on knowledge construction rather than rote memorization. By combining ICT tools with constructivist teaching, educators can create dynamic learning environments, enabling students to explore concepts through experimentation, simulations, and collaborative projects. For 8th-grade students, particularly in subjects like mathematics, this approach facilitates the development of higher-order cognitive skills such as analysis, synthesis, and evaluation. It also addresses affective and psychomotor domains, fostering attitudes of curiosity, persistence, and precision. The present study aims to assess the effectiveness of this integrated approach in improving both academic achievement and engagement. By implementing performance-based learning tools and ICT-driven activities, the research seeks to provide evidence of enhanced learning outcomes, demonstrating that the combination of technology and constructivist pedagogy can transform traditional

classrooms into vibrant, student-centered environments conducive to holistic development.

11. Objectives:

The primary objective of this study is to evaluate the effectiveness of ICT-integrated constructivist pedagogy in enhancing academic achievement and learning processes among 8th-grade students. Specifically, the study aims to:

(1) develop performance-based learning materials aligned with constructivist principles and integrate ICT tools into mathematics instruction;

(2) assess the impact of these materials and ICT-mediated activities on students' learning outcomes, including comprehension, problem-solving skills, and higher-order cognitive abilities;

(3) examine changes in students' attitudes toward learning mathematics, particularly regarding engagement, curiosity, and motivation;

(4) analyze differential responses among student subgroups based on achievement levels (bottom-line, below average, average, and above average) and socioeconomic status (SES);

(5) provide insights for teachers and curriculum developers on the practical feasibility of combining ICT with constructivist approaches;

(6) generate evidence for policymakers to support ICT-enabled constructivist pedagogical interventions in secondary education; and

(7) create a model for teacher training in implementing performance-based ICT-integrated learning activities. Overall, the study seeks to provide a comprehensive understanding of how integrating technology with constructivist pedagogy can enhance learning outcomes, improve student engagement, and inform future classroom practices.

12. Methodology:

The study employed a quasi-experimental pre-test and post-test design with two groups of 8th-grade students from DMS, Bhopal. Two sections, each comprising 35 students, were randomly selected; one served as the experimental group receiving the ICT-integrated constructivist treatment, while the other served as the control group with traditional instruction. The treatment involved using performance-based learning tools, ICT-enabled demonstrations, simulations, and collaborative tasks aligned with constructivist pedagogy. A pre-test measured students' baseline achievement in mathematics, and post-tests were administered after a six-month intervention to assess gains. Qualitative data on student attitudes and engagement were collected through structured interviews, observation schedules, and feedback questionnaires from teachers and parents. Mixed-method research techniques were applied to triangulate quantitative test

scores with qualitative insights. Data were statistically analyzed using SPSS software to calculate means, variance, covariance, and t-tests at a 0.05 significance level. Qualitative data were interpreted using thematic analysis to examine changes in motivation, problem-solving skills, and collaboration. The methodology allowed for evaluating both cognitive gains and affective outcomes, providing a holistic assessment of the effectiveness of ICT-integrated constructivist pedagogy in secondary mathematics education.

13. Findings:

The study revealed significant improvements in students' academic performance, particularly in problem-solving, analytical reasoning, and conceptual understanding of mathematical concepts. The experimental group exposed to ICT-integrated constructivist pedagogy outperformed the control group across all post-test measures. Observations indicated increased engagement, motivation, and collaboration among students in the experimental group, who actively participated in discussions, simulations, and group problem-solving tasks. The integration of ICT tools facilitated visualization of complex concepts, enabling students to construct knowledge effectively. Differential analysis showed that students across achievement levels benefited, although above-average students demonstrated the most pronounced gains. Qualitative feedback from teachers and parents indicated positive attitudinal changes, with students exhibiting curiosity, persistence, and confidence in applying mathematical concepts. Additionally, the use of performance-based assessments allowed teachers to evaluate process skills alongside content mastery. Overall, the study confirmed that ICT-integrated constructivist pedagogy not only enhanced academic outcomes but also promoted deeper learning, engagement, and skills development, highlighting its potential as a sustainable approach for secondary mathematics instruction.

14. Implications:

The findings emphasize the importance of integrating technology with constructivist pedagogy to enhance secondary education outcomes. Teachers can adopt performance-based, ICT-enabled learning strategies to foster critical thinking, collaboration, and problem-solving skills. The study highlights the need for professional development programs to train educators in designing and implementing constructivist activities using ICT tools. Policymakers should invest in infrastructure and digital resources to support the adoption of such pedagogical innovations. Curriculum developers may incorporate ICT-integrated modules to align with constructivist learning principles, ensuring that students engage in higher-order thinking and process-oriented learning. The approach also underscores the value of formative assessments and performance-based

evaluations, providing insights into students' cognitive and affective development. By demonstrating improved academic achievement and positive attitudinal changes, the study advocates for wider implementation across schools to enhance learning outcomes in mathematics. Furthermore, the approach can serve as a model for integrating ICT into other subjects, promoting interdisciplinary constructivist learning and fostering 21st-century skills. Ultimately, these strategies contribute to creating dynamic, student-centered classrooms, enabling equitable access to quality education and preparing learners to thrive in an increasingly technological world.
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16. Keywords: ICT, Constructivism, Mathematics, Performance-based, Engagement, Secondary

9. Research Abstract

1. **Theme/Subject:**	ICT/ Educational Technology
2. Stage of Education:	Higher Secondary
3. Topic of Research:	Effectiveness of Virtual Laboratory over Actual Laboratory: A Comparative Study of PU I year Students of Karnataka, on Learning Achievements
4. Name and Address of the Investigators(s) with email:	Dr. Tamilselvan pt_selvan@hotmail.com
5. Name of the Institution where the Research was conducted	Regional Institute of Education, Mysore
6. Category: **(**Research study/Action research/Other)	Research Study
7. Language of Research Report:	English
8. Year of Completion:	2016-17
9. Published/Unpublished:	Published

10. Introduction:

Traditional teaching approaches in science, and especially chemistry, often do not facilitate the active involvement of students in class activities. In chemistry, laboratory work is widely recognized as one of the most effective methods for acquiring knowledge, promoting the development of cognitive comprehension at the macroscopic, symbolic, and particle levels. In recent years, there has been growing interest in using virtual laboratories as an alternative or supplement to actual laboratory practice, particularly in situations where traditional laboratory exercises are not feasible due to limited resources, risk factors, or time constraints. Virtual laboratories provide several important advantages: they allow learners to visualize molecular and symbolic dimensions, focus on process rather than mere manipulation of materials, and experiment through simulation in a risk-free environment. This study sought to systematically compare the effectiveness of a virtual laboratory with that of an actual laboratory for class 11 chemistry students. The aim was to empirically assess the impact of each approach on learning achievement, particularly in the context of practical laboratory skills and conceptual understanding. The comparative study was motivated by both the promise of technological innovation in education and the practical challenges faced by schools in maintaining and upgrading real laboratories, especially in resource-constrained settings.

11. Objectives:

- To verify the comparative effectiveness of a virtual chemistry laboratory versus a conventional laboratory with respect to students' learning achievement.
- To assess and compare how each approach supports student understanding at the macroscopic, symbolic, and particulate levels in chemistry.
- To examine student attitudes towards learning chemistry through virtual and conventional laboratories.
- To analyze the influence of variables such as gender, location, social category, migration status, living status, primary education background, and parental education and occupation on students' laboratory learning experiences and achievements

12. Methodology:

This research utilized a didactic experimental design involving two groups of first-year pre-university college students from Jawahar Navodaya Vidyalaya and Demonstration School, Mysore. Students were assigned to either a control group (CG), taught by conventional laboratory methods, or an experimental group (EG), taught using a virtual chemistry laboratory (VLab-Chem) designed for digital learning. Achievement data were collected through pre-tests and post-tests for both groups, focusing on chemistry practical skills, conceptual understanding, and equipment recognition. Lessons in both groups were carefully structured to cover equivalent content and were delivered using either the conventional laboratory or the O-labs program for the virtual laboratory. The study also included a swapping phase post-intervention, wherein groups exchanged modalities and completed follow-up surveys assessing attitudes and experiences. Data analysis was performed using SPSS (version 20.0). Differences within and between groups were analyzed using t-tests, and various demographic variables were studied for their influence on learning outcomes. The methodology accounted for both quantitative achievement measures and qualitative feedback from student surveys and interviews to ensure a comprehensive understanding of the virtual and actual lab experiences and their respective effects on students' learning achievements.

13. Findings:

Analysis of pre-test scores showed that both experimental and control groups initially exhibited low levels of chemistry achievement, largely attributable to insufficient laboratory exposure. Following the interventions, a significant improvement was observed, with the experimental group (virtual lab) registering an 8.15% increase and the control group (actual lab) showing an 8.16% increase in achievement. In DMS, the experimental group saw a drop in achievement post-intervention by 9.33%, while the control group increased by 11.89%, but

overall the comparative effect between virtual and conventional laboratory teaching was not statistically significant. Demographic factors such as gender, location, social category, migration status, parental education and occupation, and students' primary education background had no significant moderating influence. Notably, the virtual laboratory produced several positive effects: it enabled process-focused learning, allowed detailed exploration of molecular and symbolic levels, encouraged independent problem-solving, and maximized interactivity, making students active participants. The swapping phase confirmed students' appreciation for both modalities; 26 out of 28 enjoyed both labs, but all 28 preferred actual laboratory experiences due to the hands-on aspect and the sense of responsibility it fostered. The findings support the view that virtual labs are an effective complement, though not a substitute, for real laboratory experiences in chemistry education.

14. Implications:

The research provides strong evidence that virtual laboratories can serve as effective alternatives in situations where traditional laboratory work is not possible—for example, due to limited resources, hazardous materials, or overcrowding. Schools lacking science laboratories but possessing computer clusters can adopt virtual labs to offer otherwise inaccessible practical experiences. Simulations can also replace demonstrations in overcrowded settings or where equipment shortages prevent hands-on experimentation. Nevertheless, real laboratory experiences are pivotal for developing key practical and manipulative skills, sustaining long-term enthusiasm for chemistry, and deepening conceptual understanding through tactile engagement and observation. While virtual labs offer iterative, interactive, and risk-free experimentation that supports concept reinforcement, they cannot fully replace the hands-on skills and enthusiasm derived from actual laboratory work. The study suggests the integration of virtual and actual laboratory methods to achieve both breadth and depth in chemistry teaching, facilitating broader access to practical science education without compromising on essential skill development. In conclusion, supplementing physical laboratory work with virtual laboratory experiences will help reinforce abstract concepts and may popularize science among students by making practical activities accessible, safe, and repeatable in different learning contexts.

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16. **Keywords:** Chemistry, Virtual Laboratory, Actual Laboratory, Experimental Group, Learning Achievement, Pre-university Students