



Use of Effective Teaching Strategies for Learning Chemistry in the Era of NEP-2020 in Secondary and Higher Secondary Schools of Bargarh District of Odisha

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Abstract

In the context of the National Education Policy (NEP) 2020 this abstract explores the critical role of effective teaching strategies in modifying and increasing chemistry learning. The NEP 2020 emphasizes a paradigm shift towards the holistic, experiential and inquiry-based education. It merely focuses on shifting traditional teaching practices into child centred leaning. It helps in moving away from rote learning. Chemistry is a subject often perceived as challenging due to its abstract concepts and mathematical representation. The adoption of innovative pedagogical approaches becomes paramount. This paper proposes various integrating strategies such as problem-based learning, collaborative learning, hands-on experimentation, concept mapping and technology-enhanced learning environments. These can significantly improve the engagement of students in learning, conceptual understanding, and critical thinking skills. This highlights the necessity of fostering scientific literacy and practical application of chemical knowledge which is in aligning with the focus of NEP-2020 on developing 21st-century skills. By utilising these effective strategies, teachers, educators can empower students to not only catch the complex chemical principles but also develop a lifelong appreciation for the subject. It thereby contribute to a scientifically literate society as envisioned by the NEP 2020.

Keywords – paradigm shift, concept mapping, chemistry learning, NEP- 2020, holistic development

Chapter -I Introduction

The National Education Policy (NEP) 2020 is a comprehensive framework for education in India. It aims to transform the country into a knowledge community. This was announced by the Government of India in July 2020 and this was the third education policy the previous National Policy on Education of 1986. NEP 2020 focuses on making education more holistic, flexible, multidisciplinary and to meet the needs of the 21st century.

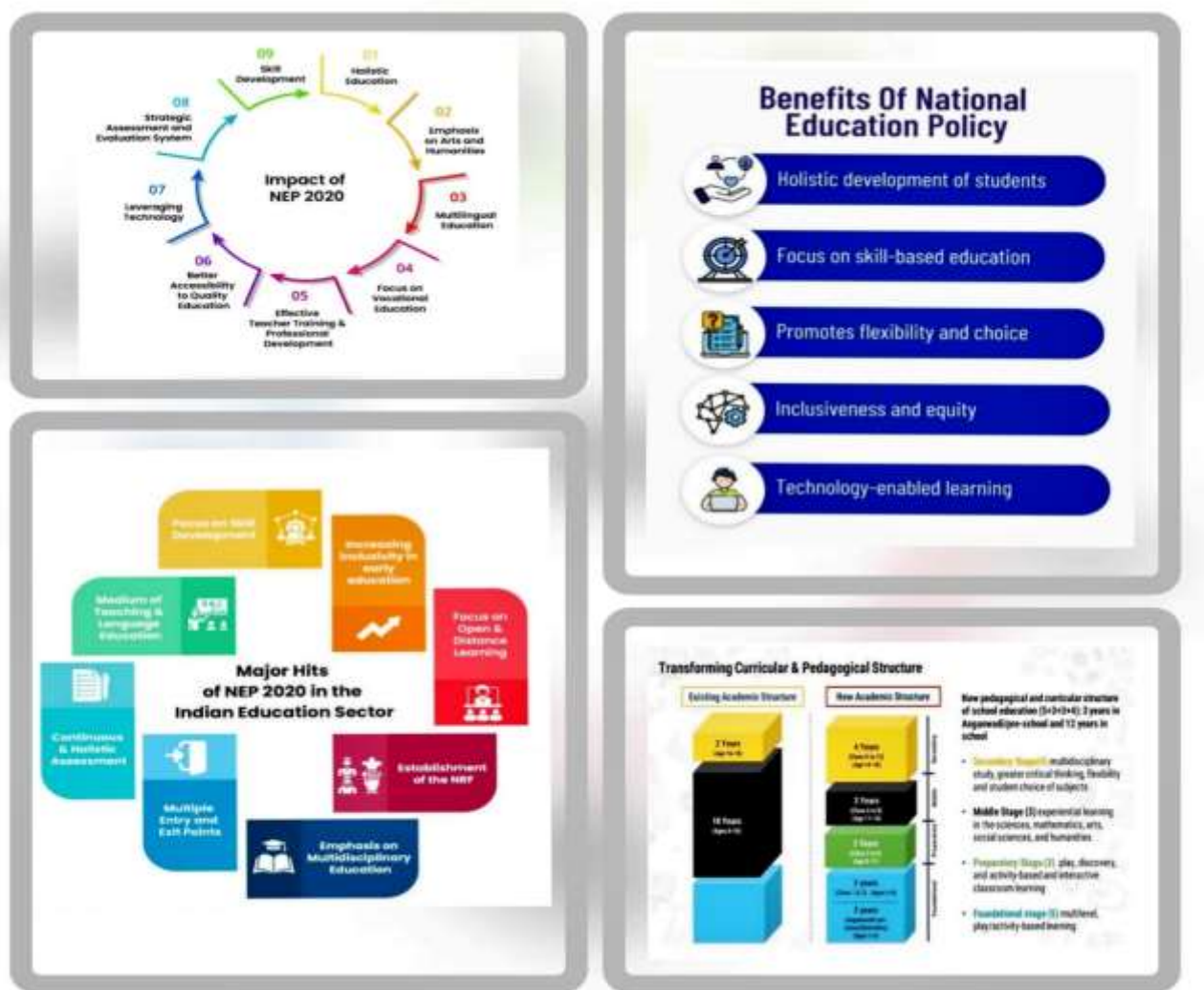
The National Education Policy (NEP) is built upon four core pillars

- Access
- Equity
- Quality
- Accountability

Key aspects and goals of NEP 2020:

- i. Holistic and multidisciplinary learning – This education policy motivate students to explore diverse subjects and disciplines. This breaks down the traditional wall between arts and sciences and make all round development of learners.
- ii. Focus on foundational learning - It gives the importance of early childhood care and education. It particularly focuses in developing foundational literacy and numeracy skills of learners during their early childhood ages.
- iii. Integration of technology - NEP 2020 promotes the use of technology in teaching, learning, and assessment, including the development of digital learning platforms and resources.
- iv. Vocational education- The policy is emphasizing compulsory integration of vocational education from Grade 6 onwards. This is helpful in integrating students with practical skills for job requirements of the market value.
- v. Teacher training and development - NEP 2020 emphasizes the importance of teacher training and professional development. This includes initiatives like the National Professional Standards for Teachers (NPST) and Integrated Teacher Education Programme (ITEP).
- vi. New curricular structure - The policy proposes a new curricular and pedagogical structure (5+3+3+4), which replaces the early 10+2+3 education system. In this new structure 5 years represent foundational education, 3 years for preparatory stage, 3 years for middle stage and 4 years for secondary education.
- vii. Emphasis on language - NEP 2020 encourages the use of the mother tongue or local language as the medium of instruction, particularly in the early grades.
- viii. Assessment reforms - The policy proposes reforms in board exams, including the redesign of exams to encourage holistic development and the introduction of a new National Assessment Centre called PARAKH.
- ix. Increased public investment - NEP 2020 recommends the 2x more public investment in education to achieve a 6% GDP expenditure on education sector.

The National Education Policy 2020 (NEP-2020) can be regarded as a paradigm shift in the educational landscape of India by emphasizing holistic development, critical thinking, problem solving skills and experiential learning. So far the transformative framework is concerned, the teaching and learning of science (particularly chemistry) holds a significant role in fostering scientific temper and preparing future generations of science learning. Earlier the traditional pedagogy was used in education sector which in all branches of study in chemistry also. These methods were less engaging and it was quite difficult to let them practically learn about a genuine understanding of its fundamental concepts or practical experience. This in turn creates demand and requirement for critical examination and integration of effective teaching strategies that align with the vision of NEP-2020.



[Fig 1- these are the images collected from google to support the theory of NEP -2020.]

The imperative for effective teaching strategies in chemistry learning within the NEP-2020 framework has following consideration.

- NEP-2020 strongly suggests for a paradigm shift from rote memorization onto a deeper understanding of subject matter.
- It blends the concepts through inquiry-based learning, experiential activities and critical thinking.

- Chemistry is often perceived as abstract and challenging and can greatly benefit from these approaches ultimately transforming it from a subject of formulas and reactions to a fascinating exploration of the material world.
- Effective strategies such as problem-based learning, collaborative learning and the integration of technology can foster this deeper engagement and understanding.
- This emphasizes the importance of developing higher-order thinking, skills, including analysis, evaluation and synthesis.
- Traditional lecture-based methods often fail to cultivate these crucial skills. In the other hand, active learning strategies like debates, presentations and application of chemical principles to real-world settings can empower students to think critically and apply their knowledge effectively.
- This alignment with the focus of policy on holistic development ensures that chemistry education contributes not only to scientific literacy but also to the overall intellectual growth of learners.
- NEP-2020 promotes flexibility and learner autonomy. Effective teaching in chemistry can incorporate differentiated instruction significantly to diverse learning styles and paces.

By utilizing a variety of resources, assessment methods, it provide opportunities for self-directed learning for students and can empower them to take ownership of their learning journey by fostering intrinsic motivation and a lifelong interest in science.

The integration of technology is a key aspect of NEP-2020. It offers immense potential for enhancing chemistry education. Virtual simulations, interactive models and online resources can make abstract concepts more tangible and accessible. Effective teaching strategies will leverage these technological tools to create engaging and immersive learning experiences, bridging the gap between theoretical knowledge and practical application.

This research aims to explore and highlight the significance of employing innovative andragogical methods in chemistry education to enhance student engagement, conceptual clarity and fostering a more meaningful and impactful learning experience in the context of the new educational policy. By investigating the application and outcomes of various effective teaching strategies, this study aims to contribute to the ongoing discourse on how chemistry education can be revitalized to meet the evolving needs and aspirations of learners in the 21st century under the guiding principles of NEP-2020.

Research Objectives

1. To identify the effective teaching strategies currently being employed by chemistry teachers in secondary and higher secondary schools in Bargarh district in the context of NEP-2020
2. To examine the extent to which these teaching strategies align with the principles and recommendations of NEP-2020 in secondary and higher secondary schools of Bargarh district
3. To assess the impact of specific teaching strategies on academic achievements of students of secondary and higher secondary schools in chemistry in Bargarh district
4. To explore the challenges faced by chemistry teachers in implementing effective teaching strategies in line with the guidelines of NEP-2020 in secondary and higher secondary schools in Bargarh district

5. To analyse the professional development needs of chemistry teachers to effectively adopt and implement teaching strategies that are in accordance with NEP-2020 in secondary and higher secondary schools in Bargarh district

Research Questions

1. What are the effective teaching strategies currently being employed by chemistry teachers in secondary and higher secondary schools in Bargarh district according to the context of NEP-2020 ?
2. What are the extent to which these teaching strategies align with the principles and recommendations of NEP-2020 in the Bargarh district?
3. What are the impact of specific teaching strategies (according to NEP-2020) on academic achievement of students in chemistry in Bargarh district?
4. What are the challenges faced by chemistry teachers in implementing effective teaching strategies in line with the guidelines of NEP-2020 in Bargarh district?
5. What professional development does the teachers need to teach chemistry effectively for adoption and implementation of teaching strategies that are in accordance with NEP-2020 in secondary and higher secondary schools in Bargarh district?

Chapter -II Review of the Related Literatures

- 1) Nkurunziza J and Mugabo L (2025) conducted a study on ‘The use of improvised chemicals and materials in teaching and learning chemistry in two selected districts of Rwanda’. This study investigates the teaching practices of chemistry teachers in two districts of Rwanda. This paper focuses on the use of chemicals and materials in resource-constrained settings. For this study, the researcher has used qualitative phenomenological design. Data were collected through interviews, classroom observations and document analysis from eight experienced chemistry teachers. This study explores the delivery mechanism of chemistry concepts by the teachers, the challenges they face in conducting practical sessions and the effectiveness of improvised materials in enhancing student learning. Findings of the study revealed that theoretical teaching dominates due to material shortages, improvised chemicals like ash, lemon and eggshells are occasionally used to bridge the gap between theory and practice. Limited resources, large class sizes and insufficient training are the challenges in full integration of practical sessions. This study highlights the potential of improvised chemicals and materials to improve student engagement and understanding of complex concepts. Recommendations for this study include targeted teacher training and resource support to enhance chemistry education in resource-limited schools.
- 2) Chhangani M and Gupta S (2023) conducted a study on the ‘Innovative approaches in chemistry education for talent cultivation’ in Udaipur- Rajasthan. This paper aims to explore new concepts of chemistry teaching that lines with the evolving requirements for talent cultivation. This paper highlights the importance of incorporating new concepts into chemistry education. By embracing innovative teaching contents and methods, educators can equip students with the necessary skills and knowledge to thrive in dynamic environments. This involves reevaluating traditional teaching concepts and integrating

fresh perspectives to meet the evolving demands of talent cultivation. For data collection they have taken various viewpoints and strategies, offering insights creative ways of chemistry teaching. For more results they have examined the changing needs of students and the skills demanded by emerging industries. The findings of the study revealed that the teaching practices and concepts need to be updated continuously and methods should design to meet the evolving requirements for talent cultivation in the face of new situations.

- 3) Chand J and Dayal P (2022) conducted a study on “Effective Teaching and Learning Strategies in a Chemistry Classroom” in New Zealand Journal of Educational Studies 57(3). This paper discusses the significance of model-based teaching on the topic of ionic and metallic bonding in 12th class Chemistry in a New Zealand secondary school. For conducting this study, effective visual aid tool was prepared to support students conceptualization of the sub-macro level understanding of the bonding structure and properties of ionic and metallic compounds, models and drawings. To obtain a pre-test and post-test the performance of four sequential classes and the results obtained were analysed. The results in the post-test show that the concept of ionic bonding was easier to retain as compared to metallic bonding. This is attributed to the misconceptions developed by the students while learning metallic bonding without the use of visual strategies. This paper suggests that teaching Chemistry concepts such as metallic and ionic bonding, without the use of visual strategies results in inability of learners to clearly retains the topic. This research demonstrates that models and drawings have many advantages while teaching such abstract concepts in 12th class Chemistry. The finding of the study revealed that students in this research were non-native speakers of English and therefore this may have further impacted upon their inability to retain the concepts when taught without concrete visual strategies.
- 4) Senapati S et.al (2022) conducted a study on ‘Chemical Education and Research in India: Challenges, Perspectives and Future Opportunities in Line with the National Education Policy 2020’. For this study the researcher has studied the proposed changes in the educational system and also discussed a brief history of chemistry education and research in India and its present scenario. For this study the researcher have examined the growing trend of the increasing number of students pursuing science, particularly in chemistry. They found out that PhDs in chemistry accounting for almost 20% of PhDs in science in India. They also debated the quality and impact of research publications from India. They found out that PhDs in chemistry accounting for almost 20% of PhDs in science in India. They found out the challenges faced by chemistry education in India and explored different opportunities based on the new NEP to reach the full potential of chemistry education and research in India.
- 5) Anand S (2021) conducted a study on the ‘Flipped pedagogy- Strategies and technologies in chemistry education’. For this study the academic achievements of students were taken. This research aims to understand the strategies and technologies of the flipped classroom in chemistry education. For data collection they used the reports published in the international reputed publications. The implementation approaches and the outcome of the flipped framework were analysed and used for the discussion. The findings of the study revealed that this literature survey put forward that the flipped pedagogy provide a

guide to chemistry educators. This also provide opportunities for researchers to develop methodologies and implementation plans for an effective student-centric learning model.

Chapter – III Research Methodology

Research methodology outlines the systematic approach. It uses to address a specific research question. It is a detailed plan that explains the data collection, analysis and interpretation. It ensures the validity and reliability of the findings. This involves the type of data to collect (qualitative or quantitative), the sampling strategy, data collection methods and data analysis techniques.

3.1) Method adopted for present study

For this present study, the researcher had used stratified random sampling and then randomly selecting teachers and intact classes of students from these schools.

3.2) Data collection tools and techniques

Data were collected through interviewing, semi structured questionnaires, discussion with students, interacting with teachers. Practical laboratory observation were done by the researcher along with ongoing classroom learning set-ups.

3.3) Population

A population can be defined as the group on which information is being gathered and analysed. A sample is a representative selection of the population.

Population can be following types.

- Finite Population - It is the population with a countable number of individuals. It can be counted one by one. Eg: number of students in a school.
- Infinite Population- It is the population having uncountable number of individuals or units. It can't be counted with numbers. Eg. number of grains of sand on a beach.
- Existent Population- It is the real tangible group of individuals or objects. It is physically present and can be studied directly. Eg: the population of a city.
- Hypothetical Population- It is the population that does not currently exist in reality. This could be assumed. Eg: the potential number of people who might respond to a survey.

For the present research, chemistry teachers at higher secondary (Grades 11-12) levels, Students enrolled in chemistry courses at the higher secondary levels, school administrators of Bargarh district can be taken as population. This includes a sum of total teachers 178 chemistry teachers in both secondary and higher secondary schools. Total students 4108

Total number of schools (secondary+ higher secondary) in Bargarh district taken as population	Total number of school heads and administrative members in secondary and higher secondary schools of Bargarh district	Total number of chemistry teachers in secondary and higher secondary schools of Bargarh district as population	Total number of study chemists in secondary and higher secondary schools of Bargarh district as population
178	$178 + 661 = 839$	442	4108

3.4) Sample

It can be called as a subset of a larger group or population. It is selected to represent the characteristics of the entire population. It is a smaller portion of the population that is studied to make inferences about the whole population.

For this particular research, the researcher had first divided the geographical area into urban and rural regions and then randomly selected schools .

Total number of schools (secondary+ higher secondary) in Bargarh district taken as sample	30% of 178 = 53
Total number of school heads and administrative members in secondary and higher secondary schools of Bargarh district taken as sample	30% of 839 = 251

Total number of chemistry teachers in secondary and higher secondary schools of Bargarh district as sample	30 % of 442 = 132
Total numbers of students who study chemistry in secondary and higher secondary schools of Bargarh district taken as sample	40% of 4108 = 1643

3.5) Data analysis and Interpretation

Data can be analysed by using descriptive statistical method. For the present study data were analysed using

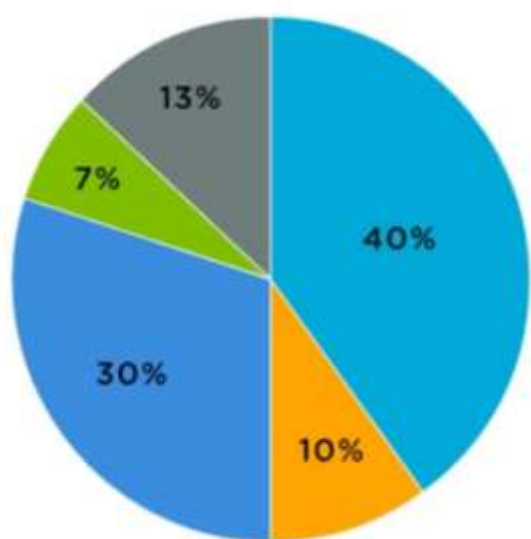
- Percentage
- Average/ simple mean
- Standard deviations

Data can be interpreted in such a way that they have clear visual appearance. For this study the data were interpretation in pie chart, graph and tabular form.

Chapter -IV Results and Findings

Objective 1 - To identify the effective teaching strategies currently being employed by chemistry teachers in secondary and higher secondary schools in Bargarh district in the context of NEP-2020. Chemistry teachers are initiatively giving emphasis on active learning, student-centric instruction and the integration of technology. These strategies also include inquiry based learning and project based learning. The teachers are giving emphasis on development of scientific attitude and scientific behaviour of students. Teachers are making students to think

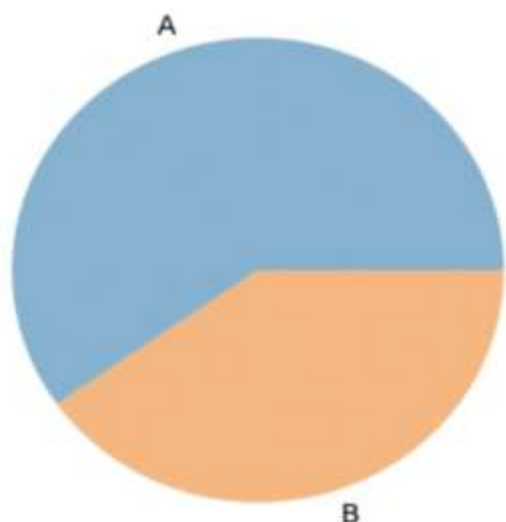
for higher order thinking skills like analysis, critical thinking and problem- solving for higher secondary school students in Bargarh district.



[Fig – shows the data representation w.r.t. objective -1] In this representation, the proportion in dark blue(30%) indicates the traditional teaching practices, the portion in light blue (40%) indicates the teaching practices employed with experimental learning along with demonstration methods, the portion in orange (10%) indicates the discussion method in classroom learning, the portion in grey (13%) indicates the project based learning and the portion in green (07%) indicates the discussion method of learning during ongoing classroom learning.

Objective 2 - To examine the extent to which these teaching strategies align with the principles and recommendations of NEP-2020 in secondary and higher secondary schools of Bargarh district. Chemistry teachers are starting teaching chemistry in a newer version in secondary and higher secondary schools that can be aligned with the principles of NEP-2020. They are prioritising more holistic and student centered learning approach. They are giving multidisciplinary learning approach and focusing on developing higher order thinking. They are trying to make chemistry teaching through project based activities and practical hands on experience. They are attempting to integrate Indian knowledge systems and historical context into the curriculum.

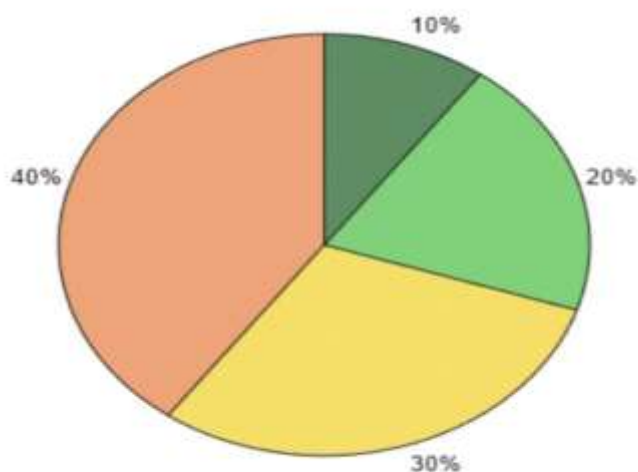
Objective 3 - To assess the impact of specific teaching strategies on academic achievements of students of secondary and higher secondary schools in chemistry in Bargarh district .The new and innovative teaching



approaches have impact on student academic performance. The teaching learning during classroom transaction, critical thinking and scientific curiosity in chemistry education. This potentially leads to improved academic achievement of students. Specific strategies include integrating practical work, fostering innovation and leveraging technology to enhance learning.

[Fig – shows the data representation w.r.t. objective -3] In this fig, the portion in blue indicates the teaching practices that are accomplished with innovative teaching approaches have better academic success and the portion in orange indicates the traditional teaching practices and academic success.

Objective 4 -To explore the challenges faced by chemistry teachers in implementing effective teaching strategies in line with the guidelines of NEP-2020 in secondary and higher secondary schools in Bargarh district . This includes adapting to the new curriculum structure, integrating technology effectively and ensuring adequate resources for practical learning. Chemistry teachers are facing problems in utilising digital tools which requires access to adequate laboratory equipment, chemicals and resources. Implementing the NEP -2020 can be challenging due to factors like time management issues, limited availability of resources and the requirement for ongoing professional development. The evaluation process for this newly adopted teaching practices can be challenging as compared to traditional exams. The teachers who are recently appointed have adequate knowledge of digital learning integrating to the classroom education but the teachers who are posted or appointed 10 years ago or before have very limited knowledge regarding this.



[Fig – shows the data representation w.r.t. objective -4] In the figure about, the different colours in this pie chart shows the proportion of challenges that are faced by the chemistry teachers in implementing the modern education policy. The portion in red indicates the insufficient knowledge of digital tools, the portion in yellow indicates the insufficient continuous professional development, the portion in light green indicates the unavailability of resources in schools to accompany the new education policy and the portion in dark green includes other challenges.

Objective 5 -To explore the effective teaching strategies in line with the guidelines of NEP-2020 in secondary and higher secondary schools in Bargarh district . This includes adapting to the new curriculum structure, in2020 in secondary and higher secondary schools in Bargarh district. To effectively teach chemistry aligned with the new education policy, teachers need professional development. This professional development focused on pedagogical skills, content knowledge and the integration of new technologies and approaches to the current existing educational transaction. This includes hands on lab experiences, the use of innovative teaching resources. The professional development is crucial for fostering a deeper understanding of chemistry concepts to make students learn of secondary and higher secondary grades. Teachers should be adept at using a variety of resources such as simulations, online tools and interactive materials.

4.1) Summary of the study

This research paper ‘Use of Effective Teaching Strategies for Learning Chemistry in the Era of NEP-2020’ highlight a shift in both educational philosophy and pedagogical approaches. This lies with the National Education Policy 2020. This focuses on problem solving and higher order skills along with practical activities. This mainly focuses the holistic development of learners rather than rote memorisation. This is mean to break down the rigid subject boundaries that are integrating chemistry with other sciences, arts, humanities and vocational streams. This paper provide a well-rounded education system that is meant for the growing demand of chemistry learning for secondary and higher secondary students. Teachers empowerment need to be emphasized more and inclusive education is emphasized. It ensures that chemistry education is accessible to all students including those with disabilities, through tailored digital tools and diverse learning needs.

4.2) Suggestions for further research

- Isolation and evaluation of the effectiveness of individual teaching strategies in enhancing specific chemistry concepts such as understanding of chemical bonding, stoichiometric calculations etc
- Role of integration of chemistry with other subjects such as biology, physics, environmental science, arts that affects students holistic understanding of chemistry and their career choices.
- Assessing the challenges and benefits of designing and implementing truly interdisciplinary chemistry curricula.
- Exploring the effective ways to integrate relevant ancient Indian contributions to chemical sciences and traditional practices into the modern chemistry curriculum and evaluating their impact on student scientific understanding.
- Evaluating the effectiveness of NEP 2020-aligned teacher training programs in equipping chemistry teachers with the necessary pedagogical skills, content knowledge and technological proficiency.
- Designing and validating robust assessment tools and methodologies for evaluating competency-based learning outcomes in chemistry, moving beyond traditional rote learning assessments.
- Studying the optimal balance and integration of formative and summative assessments in competency-based chemistry education and their impact on student learning and motivation.

- Exploring the use of digital tools, AI and adaptive testing platforms for conducting effective and personalised chemistry assessments aligned with NEP 2020.
- Conduct empirical studies on the effectiveness of specific digital tools such as virtual labs, simulations, interactive platforms, AI-powered tutors in improving chemistry learning outcomes.
- Investigating the optimal integration of specific digital tools into traditional classroom settings.
- Exploring the design of inclusive digital content that caters to diverse learning needs.
- Evaluating the extent to which existing chemistry curricula and textbooks align with the principles of NEP 2020

Chapter -V References

- 1) Anand, S. (2021). 'Flipped pedagogy- Strategies and technologies in chemistry education'.
- 2) Chand, J. & Dayal, P. (2022). 'Effective Teaching and Learning Strategies in a Chemistry Classroom'. New Zealand Journal of Educational Studies 57(3).
- 3) Chhangani, M. & Gupta, S. (2023). 'Innovative approaches in chemistry education for talent cultivation'. Udaipur- Rajasthan.
- 4) <https://journals.sagepub.com/doi/10.1177/00195561241230244>
- 5) Kumar, S(31 July 2020). 'New education policy: The shift from 10+2 to 5+3+3+4 system'. Times Now. 11 August 2020.
- 6) Nkurunziza, J. & Mugabo, L. (2025). 'The use of improvised chemicals and materials in teaching and learning chemistry in two selected districts of Rwanda'.
- 7) Senapati, S. (2022). 'Chemical Education and Research in India: Challenges, Perspectives and Future Opportunities in Line with the National Education Policy 2020'.

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