

Comparative Analysis of NEP 2020 Instructional Pedagogy and Traditional Learning on Academic Achievement in Chemistry

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Abstract: This research paper will discuss how teaching pedagogies advanced by the national education policy (NEP) 2020 have influenced the academic performance of learners studying chemistry as compared to the traditional teaching and learning approaches. The design used was a comparative experimental design, whereby two groups were used; an experimental group that was exposed to innovative pedagogies based on NEP 2020 and a control group taught using traditional methods. Standardized chemistry tests were used as a measure of academic achievement. Hypothesis testing and statistical analysis was performed to determine the significance of the differences between the two groups. The results show that the students who received instructional strategies of NEP 2020 achieve much better academic results than the students who received instructional strategies that were traditionally used. The findings substantiate the alternative hypothesis and emphasize the effectiveness of innovative, learner-centered pedagogies to enhance the results of teaching chemistry. This research offers empirical support to the use of NEP 2020 in classroom practices.

Keywords: NEP 2020, Chemistry Education, Instructional Pedagogy, Academic Achievement, Traditional Learning, Experimental Study

Introduction

Education systems all over the world are rapidly changing to comply with the needs of the 21st century where critical thinking, problem-solving and application-based learning are focused more than memorizing [1]. Science education, especially chemistry, has been characterized by the traditional modes of teaching that are mostly lecture based, teacher centered and restrict the student to be actively involved and conceptually understand the material at hand [2]. Consequently, students often fail to relate theoretical materials with practical uses, which negatively affect academic performance and decrease their interest in the topic

To overcome these obstacles, the Government of India has put forward NEP 2020, which promotes the shift towards paradigm shift in the traditional approach to teaching to the innovative, learner-centered teaching methodologies [3]. NEP 2020 focuses on experiential learning, inquiry learning, multi-disciplinary education and incorporation of technology in the teaching learning process [4]. These pedagogical changes are expected to create a better comprehension, increase student engagement, as well as improve the overall academic performance of students.

Such innovative methods are especially beneficial in chemistry, which is both conceptual and experimental. Activities like learning by doing, problem-solving exercises, and contextualization of complex chemistry using real-life examples can go a long way in making students understand and remember complex chemical concepts [5]. Nevertheless, although NEP 2020 presents theoretical benefits, empirical research is required to prove whether these didactic pedagogies can indeed lead to better academic performance in comparison with the traditional one.

Hence, this research paper aims at carrying out a comparative analysis of NEP 2020 teaching pedagogy and the conventional learning strategies in the context of teaching chemistry. The main aim is to determine how effective they are in relation to improving the academic performance of the students. The study aims at testing the hypothesis that NEP 2020-based pedagogical practices will result in much better academic performance in comparison to traditional teaching methods by applying a systematic experimental design and statistical analysis. This research is likely to add to the existing literature on educational reforms and offer practical implications to educators, policymakers, and institutions that will seek to apply NEP 2020 in science education in the best way possible.

Literature Review

An increasing literature indicates the shortcomings of conventional lecture-based pedagogy in the teaching of science, especially in chemistry, where abstract ideas are usually best understood visually, experimentally, and actively. Conventional methods of learning are basically teacher-centered where the emphasis of teaching is on what is being taught and not the student [6]. Research has always indicated that these approaches can result in surface learning, decreased retention, and decreased academic performance among chemistry students.

Conversely, new studies in education focus on the power of learner-centered pedagogies, which coincide with the concepts presented in the NEP 2020. Experiential learning, inquiry-based learning, problem-based learning and collaborative learning are innovative methods of instruction that have demonstrated to produce a substantial impact on conceptual learning as well as academic achievement of students [7]. These strategies promote active learning, critical thinking, and practical application of knowledge, which is critical in learning complicated scientific topics such as chemistry.

A number of researches have shown that instruction grounded in activities and questions enhancement is effective in the interest and performance of students in science subjects. One example is the study of inquiry-based learning which shows that students gain a better comprehension of the concept of chemistry when they engage in exploration, questioning and experimentation of the concepts as opposed to passive knowledge provision [8]. On the same note, experiential learning models, based on practical activities and real-life problem solving have been observed to enhance motivation and retention resulting to improved academic performance.

One more important area of NEP 2020 pedagogy is the integration of technology in education, which has also been actively researched. Digital instruments, simulations, and virtual laboratories can provide students with an opportunity to visualize intricate chemical processes and perform experiments within a safe and interactive environment [9]. Research indicates that learning with technology can greatly boost the performance and inquisitiveness of students in chemistry as opposed to conventional approaches.

Besides, comparative research done on innovative and traditional methods of teaching has always yielded better results in favor of learner-centered approaches. Such studies point out that students who are exposed to the contemporary pedagogical strategies have better test scores, better problem-solving skills and are more conceptually clear compared to those who are taught using the traditional lecture method [10]. The majority of these studies, however, are carried out within the general science education framework, and the research on the specifics of implementing and assessing the effects of NEP 2020 pedagogical changes on chemistry education is relatively limited.

Although the advantages of using innovative teaching strategies are identified, the shift to NEP 2020-based instructional methods brings a number of obstacles, such as the insufficient training of teachers, resource shortage, and the unwillingness to change teaching methods. Thus, empirical research is needed to determine the true effectiveness of NEP 2020 instructional strategies in the actual classroom. In this regard, the current research seeks to address this gap in research by comparing NEP 2020 pedagogy of instruction and conventional approaches to learning with regard to the academic performance of students in chemistry. The study offers evidence-based information and helps to comprehend the practical implications of NEP 2020 in terms of improving educational outcomes.

Methodology

This paper will use a systematic approach to compare the efficacy of NEP 2020 instructional pedagogy to traditional teaching methods based on their effect on the academic performance of students in chemistry. The data collection procedure presented in figure 1, is designed in a way that would provide reliability, validity and objective hypothesis testing.

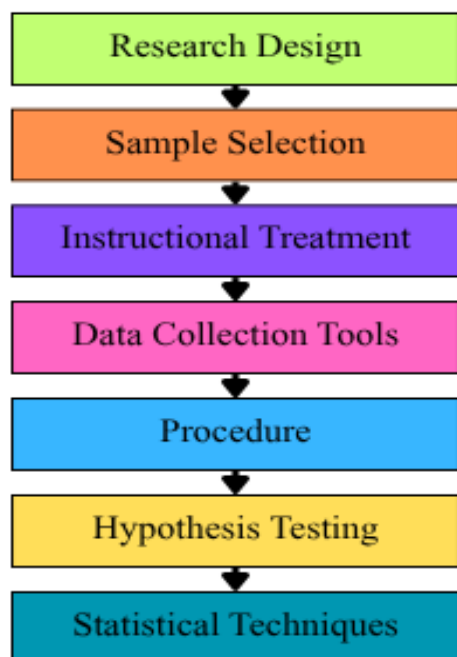


Figure 1: Pre-Test–Post-Test Control Group Design

A. Research Design

The study used a quasi-experimental research design with a pre-test, post-test control group design. Two samples of the students were picked, that is, the experimental group and the control group. Instructional pedagogies based on NEP 2020 were used to teach the experimental group and traditional teaching was used to teach the control group. This study design allowed a comparative analysis of learning outcomes of students pre- and post-intervention through instruction, which could be used as a consistent template to evaluate the efficacy of the two pedagogical strategies.

B. Sample Selection

The study sample was 60 students of chemistry at the secondary level in two groups of 30 each. To avoid selection bias and homogenize the results, a random sampling method was applied. The experimental and control groups were similar with regard to previous performance in school, age, and background, which made the results of the study fair and valid.

C. Instructional Treatment

The training intervention took place within a fixed duration of time to both groups. Innovative, learner-centered methods that are included in NEP 2020, such as experiential learning, inquiry-based learning, activity-based teaching, collaborative learning, and use of digital tools and simulations were taught to the experimental group. Conversely, the control group was taught through the traditional methods of teaching, which included lectures, chalk-and-talk, and instruction by a teacher. This difference made it possible to clearly judge the effectiveness of modern pedagogical strategies, in comparison to traditional ones.

D. Data Collection Tools

The standardized Chemistry Achievement Test that was used to determine the academic performance of students was used to gather data. The exam had objective and subjective questions on important concepts in chemistry. Pre-test was carried out prior to the intervention to measure baseline knowledge and post-test was carried out at the end of the instructional period to determine the learning outcomes. Subject experts were used to validate the test instrument to guarantee its content validity and reliability.

E. Procedure

The research was carried out in a scientific method by first administering a pre-test to both groups in order to achieve baseline equivalence. This was then followed by introduction of the instructional intervention whereby each group was taught in accordance with the teaching method of the group. A post-test was also done after the instructional period in

order to determine the level of achievement by the students academically. The scores obtained were then tabulated and compared to evaluate the performance of the two groups.

F. Hypothesis Testing

Two hypotheses were used to direct the study. The null hypothesis (H_0) was that there exists no significant difference between academic achievement of students taught through NEP 2020 pedagogy and students taught through traditional methods. The second hypothesis (H_2) was that students who are taught by NEP 2020 instructional pedagogy perform much better in academics compared to those taught by traditional teaching methods. Appropriate statistical techniques were used to test these hypotheses.

- H_2 (Alternate Hypothesis): NEP 2020 instructional pedagogy leads to higher academic achievement in chemistry compared to traditional learning methods.
- H_0 (Null Hypothesis): NEP 2020 instructional pedagogy does not lead to higher academic achievement in chemistry compared to traditional learning methods.

G. Statistical Techniques

The data gathered were statistically analyzed in order to establish the effectiveness of the teaching strategies. The performance of the two groups was compared using descriptive statistics like mean and standard deviation. Also, an independent samples t-test was used to determine the statistical significance of the difference in academic achievement between experimental and control group. The significance level was established at 0.05 in order to make the results reliable.

In this way, the methodology used will be an objectively structured framework to compare the effectiveness of NEP 2020 instructional pedagogy with the traditional approach to learning in improving academic performance in chemistry.

Results and Discussion

Systematic analysis of the data gathered to support the effect of NEP 2020 instructional pedagogy on the academic performance of students in chemistry is discussed in the results and discussion section against the traditional methods of learning. The pre-test and post-test scores, and gain scores are used to evaluate the baseline equivalence and the learning outcomes. Mean, standard deviation and independent samples t-test were used as statistical measures to determine the significance of differences between experimental and control groups. The results are illustrated in tables and graphical format to give a clear and holistic picture regarding the effectiveness of the instructional methods.

Table 1: Pre-Test Comparison

Group	N	Mean	Standard Deviation
Experimental Group	30	41.20	5.80
Control Group	30	40.75	6.10

The results, shown in Table 1, suggest that the average scores of both the experimental and the control group in the pre-test are almost equal and that there is a slight variation in the average scores between the two groups. This similarity implies that both groups shared similar knowledge and background of learning concepts of chemistry prior to the introduction of the instructional intervention. This baseline equivalence is vital in determining whether or not the experimental study is valid since it will ensure that any variation that is realized in the post-test will be as a result of the instructional strategies but not because of differences that existed in the beginning. Thus, the groups may be deemed alike, which will offer a solid basis in further comparative study.

Table 2: Post-Test Comparison

Group	N	Mean	Standard Deviation
Experimental Group	30	78.60	6.25
Control Group	30	68.10	7.05

Table 2 shows a significant difference in the mean scores of the two groups in post-test with the experimental group having a higher score than the control group. This shows that, students who received instructional pedagogy based on NEP 2020 performed better in chemistry than those who received conventional teaching. The enhancement can be explained by the utilization of new, student-oriented teaching methodologies that facilitate active learning, clarity of concepts, and understanding. Conversely, the comparatively poorer performance of the control group would indicate that traditional teaching methods are not as efficient in improving the learning outcomes of students.

Table 3: t-Test Analysis (Post-Test)

Parameter	Value
t-value	5.87
Degrees of Freedom	58
p-value	< 0.05
Significance Level	0.05
Result	Significant

Table 3 statistical analysis indicates that the t-value calculated was higher than the critical value in the 0.05 level of significance. This implies that the research is statistically significant and not by chance that the difference in academic achievement between the experimental group and the control group is significant. This leads to the rejection of the null hypothesis (H_0) and the acceptance of the alternate hypothesis (H_2). This result is a good indication that NEP 2020 instructional pedagogies can positively influence the academic performance of students in chemistry by a large margin and this confirms the efficacy of the innovative teaching strategies, compared to the traditional teaching strategies.

Since $t_{\text{calculated}} > t_{\text{critical}}$, the result is statistically significant.

- Null hypothesis (H_0) is rejected
- Alternate hypothesis (H_2) is accepted

Table 4: Gain Score Comparison

Group	Mean Gain (Post - Pre)
Experimental Group	37.40
Control Group	27.35

Table 4 shows the difference in the gain scores between the two groups with the experimental group recording a significantly higher gain than the control group. This is to suggest that students who were taught under NEP 2020 pedagogical strategies not only improved in the post-test but also showed improvement in learning through the instruction time. Higher gain scores indicate the effectiveness of activity based, inquiry based and experiential learning in improving the comprehension and retention of chemistry concepts in students. In such a way, the findings again support the effectiveness of NEP 2020 teaching pedagogy to enhance academic success.

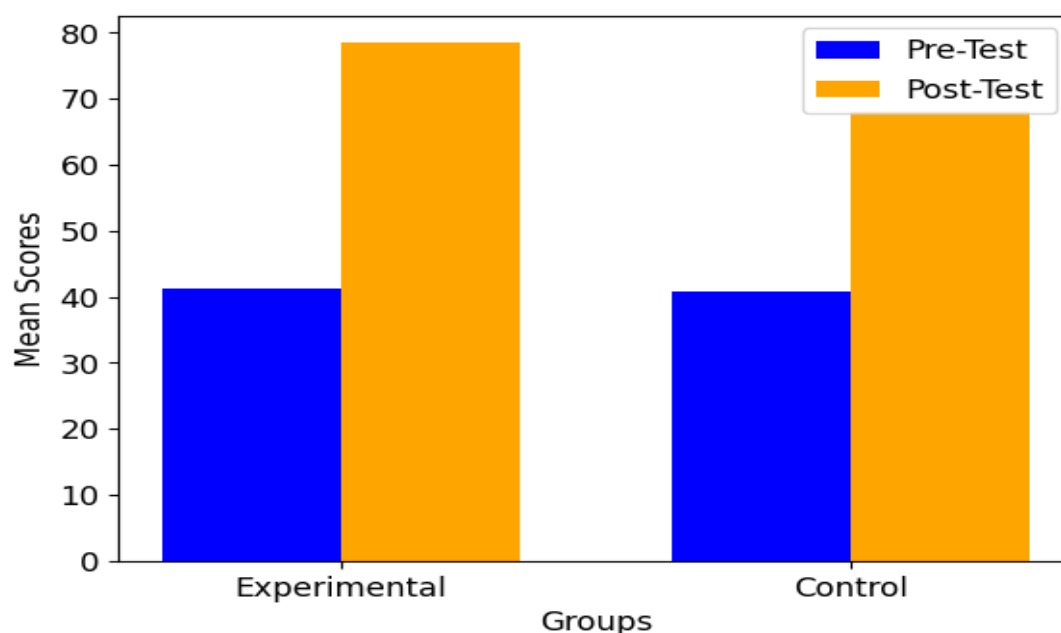


Figure 1: Pre-Test vs Post-Test Comparison

Figure 1 shows the comparison of pre-test and post-test mean scores of the experimental and control groups. As can be seen, both groups had almost equal pre-test scores, which validates the equivalence of the baseline. Nevertheless, the post-test scores in the experimental group rise significantly as compared to the control group. This visual aid can convincingly illustrate how NEP 2020 instructional pedagogy can be applied to improve the academic performance of students in chemistry. The drastic increase in the performance of the experimental group reveals the beneficial influence of new teaching techniques in comparison with the traditional ones.

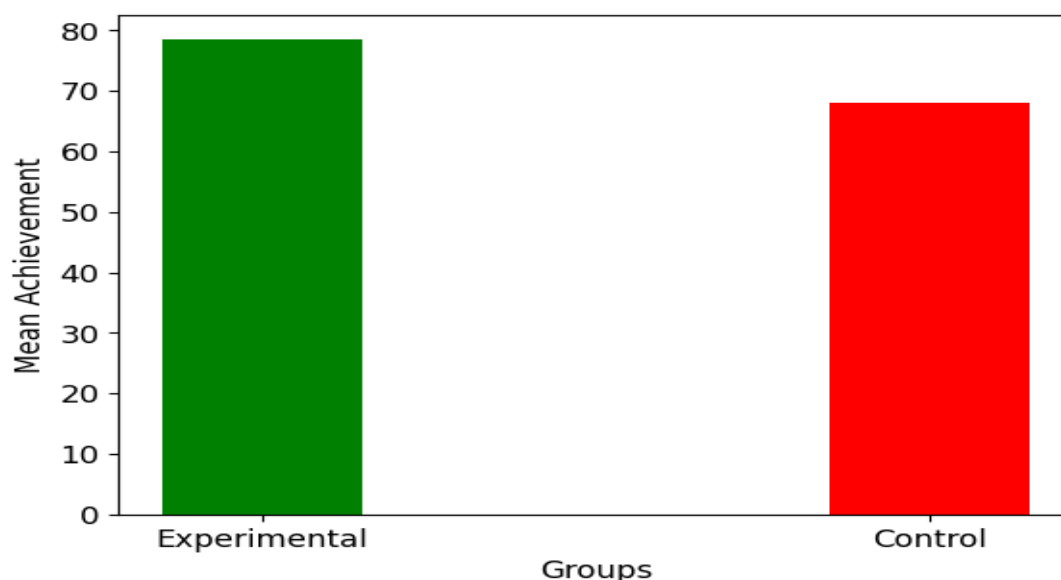


Figure 2: Mean Achievement Comparison

Figure 2 provides a direct comparison of post-test mean achievement score of both groups. The difference in the mean score is significantly greater in the experimental group than in the control group, which demonstrates the excellent nature of NEP 2020-based instructional strategies. This contrast is a visual support of the statistical results and suggests that the learner-centered pedagogies lead to better performance and comprehension of chemistry. The figure is useful in highlighting the difference in levels of achievements between the two teaching methods.

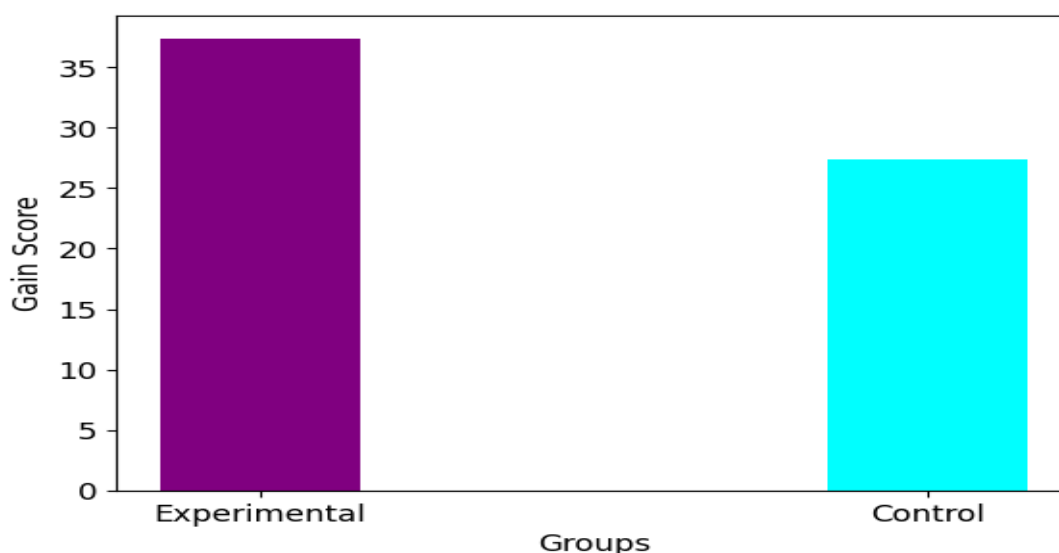


Figure 3: Gain Score Comparison

The figure 3 shows the gain scores of experimental and control groups which is the improvement of performance between pre-test and post-test. The experimental group has a considerably greater gain score than the control group, which shows a higher level of learning. This implies that not only does NEP 2020 increase final achievement, but also the total learning process. The figure illustrates the efficiency of the activity-based and experiential learning in nurturing the sustained academic progress.

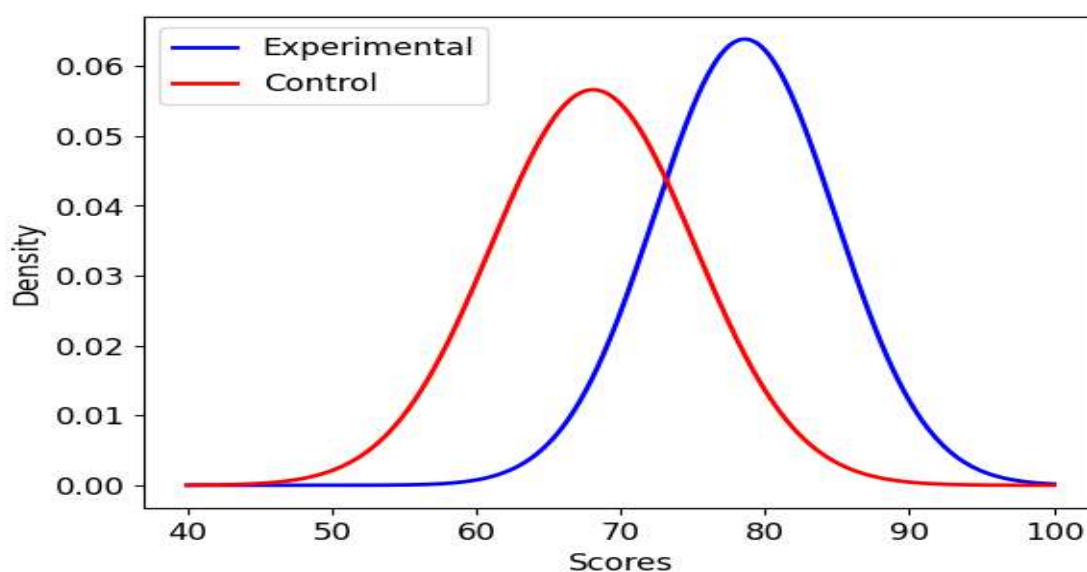


Figure 4: Distribution Curve (Optional Advanced)

The distribution curves of the post-test scores of both groups are indicated in figure 4. The experimental group curve is tilted to a higher value of score than the control group, which shows that the experimental group performed better in general. Also, the spread of the experimental group seems more focused, indicating uniform performance among students. This visual representation supports the fact that NEP 2020 pedagogy of instruction results in increased and more consistent academic performance in chemistry as compared to traditional teaching practices.

The findings reveal that experimental and control groups do not differ significantly in pre-test, which proves the equivalence at baseline. Nevertheless, post-test results indicate that the experimental group (Mean = 78.60) has improved significantly as compared to the control group (Mean = 68.10). The t-value (5.87) is significant at the 0.05 level and this results to the null hypothesis being rejected. In addition, the gain score analysis indicates that the experimental group had higher improvement as compared to the control group. These results show that NEP 2020 instructional pedagogy

has a strong positive impact on the academic success of students in chemical courses in contrast to the traditional modes of learning.

Conclusion:

This paper involves a comparative analysis of NEP 2020 pedagogy on instruction and traditional learning approach on academic performance of students in the science of chemistry. The results indicate that, students who are taught using NEP 2020-based teaching methods achieve significantly higher results compared to those taught using traditional methods. The comparison of the post-test scores and gain scores through statistical analysis shows that there exist a significant difference and thus null hypothesis is rejected and alternate hypothesis is accepted. The better performance of the experimental group can be explained by the fact that the strategies employed, e.g. the learner centered ones, i.e. experiential and inquiry-based learning, provide better conceptual knowledge, critical thinking and retention. Conversely, conventional learning restricts student involvement and further learning. The research indicates the usefulness of innovative pedagogies in enhancing academic performance and justifies the use of NEP 2020 in classroom activities. Nevertheless, there are drawbacks like the sample size and duration. Research in the future ought to be done in larger samples, longer periods, and using cross-disciplinary to further validate and generalize the findings.

References

1. Shoukat, R., Ismayil, I., Huang, Q., Oubibi, M., Younas, M., & Munir, R. (2024). A comparative analysis of blended learning and traditional instruction: Effects on academic motivation and learning outcomes. *PloS one*, 19(3), e0298220. <https://doi.org/10.1371/journal.pone.0298220> (Retraction published PLoS One. 2024 Apr 18;19(4):e0302484. doi: 10.1371/journal.pone.0302484.)
2. Chakraborty, R. (2022, September). Strategies to Implement Integrated Teacher Education Programme in Respect to NEP 2020. *International Journal of Novel Research and Development*, Volume 7, (Issue 9), 359-364. www.ijnrd.org
3. P Mishra (2022) Emotional and Spiritual Intelligence; Why does it matter for teachers? *Arahant multidisciplinary international educational journal*, ISSN 2278-5655.56. Pratima Samay ki Mang: Digital Path Akram. Board Shiksha Patrika 42 (Issue 6-9), Page no 65- 6727.
4. P Mishra, KDV Prasad, Kumar, T Dwivedi (2022) Stress, pressure & anxiety of competitive exams– an empirical study on student psychological approach.57. MR Joshi, P Mishra (2022) A Study of The Effectiveness of Activity-Based Teaching Learning of Mathematics At 8th Standard Students *Educational Resurgence Journal* vol.5, issue1.Pg.no.83-92
5. P Mishra, A Study of Universal Awareness Component of Spiritual Intelligence Of B Ed College Students. *International Journal of Research and Analytical Reviews* 2023 IJRAR March 2023, Volume 10, Issue 1
6. P Mishra (2023) A Study of roller coaster ride between stress and emotional intelligence pg 112 *Education and Society UGC CARE LISTED JOURNAL Special issue -1 volume-1 Indian Institute of Education J. P. Naik Path, Kothrud Pune.*
7. T K Karmakar, M Mustaqeem P Mishra (2023) *Teacher Education: Skills and Practices* AGPH Publication First Edition pg. 205
8. P Mishra (2022) Quality of life (QOL): role of IQ, EQ, and SQ. *International Journal of Multidisciplinary Educational Research* ISSN:2277.
9. Dr. Pratima Mishra, DMK Jaisal, P Ghosh, DR Bansal, G Manoharan (2022) Perception towards blended learning at the time of covid-19 pandemic. *European Journal of Molecular & Clinical Medicine*, 2022, Volume 9, Issue8 (6)
10. P Mishra (2022) The digital world of Education System: good side effect of COVID-19 Pandemic. *Journal of Emerging Technologies and Innovative Research* (ISSN: 2349-5162)