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Role of Innovative Pedagogies in Achieving Excellence in Teaching of Science at Primary School Level

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Abstract
The main purpose of the current study was to investigate the role of innovative pedagogies in achieving excellence in teaching of science at primary school level. To achieve the objectives of this study researcher used descriptive survey design. All the primary school teachers from districts of Multan Division constituted the population for this study. As the population of teachers was heterogeneous, therefore, the researcher used stratified proportionate random sampling technique to select the sample. Finally, 880 (477 male and 403 female) primary school teachers were selected as sample of the study. Nine hundred questionnaires were distributed among the participants and 880 finally were returned. Researcher used the statistical techniques to analyze the collected data of 880 participants by using SPSS. From the findings of data analysis, it is concluded that in general, role of innovative pedagogies in achieving in excellence in teaching of science at primary school's level behavior more positive than negative. Furthermore, from the comparisons made on the basis of teachers' demographics i.e. gender, area, age, years of teaching experience, academic qualification and professional qualification, it is concluded that there is significant difference in the views of teachers.
Keywords: Innovative Pedagogy, Excellence, Teaching of Science

1. Introduction

Teaching and learning are centered on pedagogy. Ensuring that young individuals are equipped to tackle modern challenges requires a thorough evaluation and enhancement of the teaching methods employed by educators. Nevertheless, despite the growing number of reports on teachers and schools implementing innovative practices, schools are still widely perceived as resistant to change. It brings together renowned experts to provide insights into crucial aspects of pedagogy (Peterson et al., 2018).

Ammar et al. (2024) reviewed 42 studies. They explained that in today's competitive global environment, students need advanced skills and knowledge to navigate complex challenges. STEM practices are crucial in cultivating these capabilities from a young age. With the rapid advancement of technology, STEM education has evolved, integrating various technologies. K-12 students must stay updated with these innovations using pedagogical approaches. This review explores current trends and future directions of pedagogical practices in K-12 STEM education. It examines factors affecting innovation development in students, focusing on their characteristics and environmental perceptions. These selected studies show that personalized pedagogical approaches positively impact innovation and increase STEM literacy in K-12 education. The discussion also addresses limitations in teacher competencies and school facilities for implementing different pedagogical approaches.

Abdullah et al. (2021) assessed the creativity levels and teaching practices of science teachers in primary schools, with a focus on any variations based on school location. Data was collected from 20 participants using the Torrance Tests of Creative Thinking (TTCT) to obtain qualitative data. Additionally, a questionnaire was administered to 409 participants to gather quantitative data. The findings indicated that although the level of teacher creativity was generally low, educators believed that they implemented highly innovative approaches. There were no discernible disparities in the environment, teaching aids, skills, and science process skills of teachers in urban and rural areas. Teachers in rural areas demonstrated a higher level of expertise in creativity, whereas their urban counterparts excelled in its practical application. This study presents foundational evidence on the current practices in creative teaching methods among science teachers across the country.

Barak (2017) analyze the instructional methods and technologies used by teacher educators, identify key attributes for effective learning and teaching in the twenty-first century, and establish a pedagogical framework to encourage the meaningful utilization of advanced technologies. Data was collected through surveys, personal interviews, and written reflections. The study found that teacher educators often fail to provide adequate examples of promoting reform-based practice through web 2.0 environments like Wikis, blogs, social networks, and cloud technologies. Four key attributes are crucial for teaching and learning in the modern era: adaptability to frequent changes, collaboration in decentralized environments, data generation and management, and encouraging exploration by relinquishing control. The study proposes a pedagogical framework for promoting the effective use of advanced technologies in science teacher education courses, drawing on social constructivist paradigms and contemporary teaching attributes.

Instructional methods give systems to the large number of choices instructors need to make about how they educate. Development in teaching methods, similar to any sort of advancement, takes existing considerations, gadgets or practices and joins them in better ways to deal with tackle issues when current practice isn't adequately

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tending to needs. To now, the choice of instructional technique has often times have been made uniquely designated or subject to whatever a teacher had encountered in their educator preparing or their own mentoring. However, where teachers are maintained by incredible educator tutoring and strong master establishments, they are engaged to make deliberate decisions about instructional strategy, going about as organizers of learning by picking approaches with a sensible sensation of their proposed influence (Vialful , 2012).

The researcher investigated the most recent creative pedagogies for achieving excellence in science instruction at the primary school level, and the findings differed from previous studies. This study seeks to investigate existing ways of teaching science in schools and propose alternative, innovative approaches to teaching science in schools.

2. Statement of the Problem

The study aimed to investigate the role of innovative pedagogies in achieving excellence in teaching of science at primary school level.

2.1.1. Objectives of the Study

These were the objectives of this study:

To investigate the opinion of teachers regarding the role of innovative pedagogies for excellence in teaching of science at primary level.

To ascertain the difference between rural and urban area teachers' opinion about role of innovative pedagogies in achieving excellence in teaching of science at primary school level.

To ascertain the difference between male and female teachers' opinion regarding the role of innovative pedagogies in achieving excellence in teaching of science at primary school level.

To investigate the difference between the teachers' opinion on the basis of different demographic i.e. gender, academic qualification, professional qualification, locality, age etc.

2.1.2. Research Questions

The research questions for this study comprise the following:

What is the opinion of teachers about the role of innovative pedagogies for teaching of science at primary level?

What is the difference between rural and urban teachers' opinions about the role of innovative pedagogies in achieving excellence in teaching of science at primary school level?

What is the difference between male and female teachers' opinions about the role of innovative pedagogies in achieving excellence in teaching of science at primary school level?

What are the differences between teacher's opinions on the basis of different demographics i.e. gender, academic qualification, professional qualification, locality, age?

2.1.3. Research Design

This study used descriptive survey design. The foremost benefit of this research design is, it allows the researcher to measure the circumstances within the study area at the time of the study

2.1.4. Population

In the present study population comprised of all the male and female teachers in primary schools of Multan Division. There were 2,024 female primary school teachers in 3,848 schools, while total numbers of male teachers were 1,824 in 3,848 schools of Multan division.

2.1.5. Sample

The researcher used proportionate stratified random sampling technique to select the sample. Consequently, male 477 and female 403, teachers representing both urban and rural population were comprised in representative sample. The sample size was decided with the help of a formula established by Krejci and Morgan (1970) for determining sample size. As a result, a total sample of 880 teachers (477 male and 403 female) were selected.

2.1.6. Research Tool

Researcher used adopted tool in this survey to investigate the teacher's opinions about role of innovative pedagogies in achieving excellence in teaching of science at primary school level. Tool was adopted from (Shear, et al., 2010).

Teachers were expected to respond to the items on 5-point Likert scale. The research tool was validated through pilot testing of 25 teachers randomly selected from primary schools of district of Multan Division. In this research both the inferential and descriptive technique were used to examine the facts. In descriptive statistics means, standard deviation, frequencies and their percentage were used. Similarly, in statistical technique independent sample t-test and one way ANOVA were used.

Analysis of Difference between Teachers' Responses about the Role of Innovative Pedagogies in Achieving Excellence in Teaching of Science at Primary Level based on Demographics.

This section reveals the analysis of data to find the difference between teachers' responses about the role of innovative pedagogies in achieving excellence in teaching of science at primary level based on demographics i.e. gender, locality, teaching experience, age group, academic qualification and professional qualification. One way ANOVA and independent sample t- test were used to analyze the data.

Table 1: Difference between Male and Female Teachers' Opinion

Variable	Category	N	Mean	SD	Df	*T*	Sig.
Gender	Male	477	92.21	38.53	878	7.65	.00
	Female	403	75.67	21.61			

Significance Level **P ≤ .05

Table 1 shows the difference between teachers' responses by gender. The mean score of male teachers (92.21) is greater than the mean score of (75.67) the female teachers which indicates that male teachers are more positive than female teachers for the usage and impact of innovative pedagogies. The significance value (.00) is lesser than (0.05), which indicates that there is significant difference between male and female teachers' opinion about the role of innovative pedagogies in achieving excellence in teaching of science at primary level.

Table 2: Difference between Teachers' Opinions by Professional Qualification

Variable	Category	N	Mean	SD	Df	*t*	Sig.
Professional Qualification	B.Ed.	598	83.54	30.95	878	1.44	.15
	M.Ed.	282	86.96	36.79			

Significance Level **P ≤ .05

Table 2 shows the difference between teachers' responses by professional qualification. The mean score (86.96) of teachers having M.Ed. professional qualification is greater than the mean score (83.54) of the teachers having B.Ed. which indicates that M.Ed. teachers are more positive than female teachers about the role of role of innovative pedagogies in achieving excellence in teaching of science at primary level. The calculated significance value (.15) is greater than significance level (0.05), which indicates that there is no significant difference between the teachers having different professional qualification i.e. B.Ed. and M.Ed. about the role of innovative pedagogies in achieving excellence in teaching of science at primary level.

Table 3 Difference between Teachers' Opinions by Locality

Variable	Category	N	Mean	SD	Df	*T*	Sig.
Locality	Urban	682	83.02	32.22	878	2.75	.00
	Rural	198	90.19	34.88			

Significance Level **P ≤ .05

Table 3 shows the difference between teachers' responses by locality of school. The mean score (90.19) of urban schools teachers is greater than the mean score (83.02) of the rural schools' teachers which indicates that urban school teachers are more positive than rural school teachers about the role of innovative pedagogies in achieving excellence in teaching of science at primary level. The calculated significance value (.00) is less than significance level (0.05), which indicates that there is significant difference between the urban and rural school teachers about the role of innovative pedagogies in achieving excellence in teaching of science at primary level.

Table 4 Difference between Teachers' Responses by Teaching Experience

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	59956.95	3	19985.65	19.56	.000
Within Groups	894673.85	876	1021.31		
Total	954630..80	879			

Table 4 indicates the difference between participants about the role of innovative pedagogies in achieving excellence in teaching of science at primary level by teaching experience. The calculated significance value is (.000) which is less than significance level (0.05). The significance value shows that there is statistically significant difference between participants having different teaching experience about the role of innovative pedagogies in achieving excellence in teaching of science at primary level of different designation. F value (19.56) also supports the claim.

Table 5 Difference between Teachers' Responses by different Age Group

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	24594.00	3	8198.00	7.722	.000
Within Groups	930036.80	876	1061.68		
Total	954630..80	879			

Table 5 indicates the difference between opinions of participants about the role of innovative pedagogies in achieving excellence in teaching of science at primary level by different age groups. The calculated significance value is (.000) which is less than significance level (0.05). The significance value shows that there is statistically

significant difference between participants having different age about the role of innovative pedagogies in achieving excellence in teaching of science at primary level of different designation. F value (7.72) also supports the claim.

Table 6 Difference between Teachers' Responses by different Academic Qualification

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	23923.45	3	7974.48	7.50	.000
Within Groups	930707.35	876	1062.45		
Total	954630..80	879			

Table 6 indicates the difference between participants about the role of innovative pedagogies in achieving excellence in teaching of science at primary level by academic qualification. The calculated significance value is (.000) which is less than significance level (0.05). The significance value shows that there is statistically significant difference between participants having different academic qualification about the role of innovative pedagogies in achieving excellence in teaching of science at primary level of different designation. F value (7.50) also supports the claim.

3. Discussion

As educators, researchers and policy makers in different parts of the world continue to debate the standards and qualities of good science teaching (Bolyard and Moyer-Packenham, 2008) and of pre-administration education of science educators (Darling-Hammond, 2010; Windschitl, 2009), there are some points where most stakeholders agree. One of these points of agreement is on the importance of teacher's coursework in science in predicting science achievement of their students (Rice et al., 2003). We recognize that the level of science teachers' content knowledge is not simply a function of the number of courses the science teachers take in the pre service programs. The results of this study were also same as previous studies mentioned above.

4. Conclusions

Following conclusions were dawn on the base of findings.

Use of innovative pedagogical methods like problem-solving activities and class discussions can enhance student engagement and learning outcomes.

Traditional methods in public schools often lead to dry and boring science subjects.

Shortage of science teachers in high schools results in overcrowded classrooms.

Teachers struggle to provide proper attention and use modern teaching methodologies.

Quality of science teaching is poor at primary and middle levels.

5. Recommendations

Science teachers can utilize innovative pedagogies in their lesson delivery so as to enhance students' active participation in their lesson.

Intensive in service training programs can be organized to get the science teacher acquainted with and trained on how to effectively utilize innovative pedagogies in science education.

Science teachers can be allowed to visit schools that are utilizing innovative practice to observe new methods and materials in action.

Science teachers and principals can be encouraged to the use of creative and modern teaching methods that take advantage of technology and new approaches to engage students.

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