Teaching of Science at Secondary Level: An Analysis of Teachers' Classroom Practices

[1][1]Muhammad Naqeeb-ul-Khalil Shaheen,
[2][2]Dr. Muhammad Munir Kayani, [3]Nazir Haider Shah

Abstract

The attempt is done to analyze the science teachers' classroom practices at Secondary level in Rawalpindi-a district of the Punjab (Pakistan). The objectives of the study were to analyze and compare pedagogical practices of teachers with respect to their gender, qualification and experience. Six null hypotheses were developed. A cross-sectional survey was conducted for the study. Random sampling technique was used for the selection of male (120) and female (120) teachers. The questionnaire was used for the science teachers to analyze their classroom practices. Data was collected by visiting the sample secondary schools of the District Rawalpindi personally. Data of questionnaire was analyzed by using an independent sample t-test and two-way ANOVA. It was found that there were significant differences between classroom practices with respect to their gender and qualification; moreover, there were interaction effects of teachers' qualification and gender; gender and experience and qualification and experience on their practices in the classrooms. It was recommended to train and encourage male and female teachers equally.

Keywords: *Pedagogical practices, classroom practices, Quality teaching, Science teachers*

1. Introduction

"Science and technology" is what best describes the contemporary age. Scientific discoveries and inventions have become fashion. In fact, every walk of life is getting the benefits of scientific knowledge. In 2011, Faize & Dahar observed, people whether living in countryside or city are equally engaged in making the best use of the available scientific conceptions. Moreover, Reeves (2002) finds that the use of the available scientific knowledge is seen in a unique

[1] Teacher Educator (Monitoring and Evaluation), District Training & Support Center, Attock Email: naqeeb.shaheen@gmail.com
[2] Assistant Professor, Department of Education, International Islamic University Islamabad Email: drmm_kayani@iiu.edu.pk
[3] Lecturer, Department of Education, Mohi-ud-Din Islamic University, Nerian Sharif, AJK

manner i.e. intuition in spite of diversion. Similarly, the field of education is no exception. In 2002, Cooper asserts that the quality assurance of an educational program is the reflection of academic standards and attempt to maintain them.

Pedagogy is an art of education. Its aim ranges from the full progress of the human being to skills attainment. For example, Paulo Freire referred to his method of coaching people as critical pedagogy. Learning is a process and it takes time for children to learn. Teacher should develop such a safe and thoughtful learning environment in which all students can learn. It requires such teaching activities and strategies that all students have active participation in the learning process. These efforts of a teacher are called Pedagogical styles of teaching. By using a variety of interactive activities in class rooms, student interests and active participation in learning can be enhanced. Such activities enable students to construct their own knowledge. While designing these activities, teacher must ensure that all students are participating. Knowing about learning style can help teacher plan lessons, assignments and activities. The word pedagogy is taken from the Greek in which genitive “paidos” shows "child" and “ago” means "lead"; so, “It literally means to lead the child. It is observed that pedagogy is helpful in recognizing, recalling, analyzing, reflecting, applying, creating, understanding and evaluating. It is the development of the human being to skills acquisition (Mundhe & Herkal, 2013).

In developing countries, Most of the teaching in class room is done in a traditional way. The children sit quietly in rows in the classroom, the teacher does all the talking and the students passively listen to the teacher not following a psychological procedure. Whereas when the students are taught in this way, they get very little of the knowledge. Many researches show that the learning of students improves a lot when their active participation is ensured. Student-oriented applies and cognitive activation is related with student motivation and conceptual understanding. In traditional classroom the learning capabilities of more students are limited and they tries to copy what is written on the board by the teacher. However, empirical research proposes that these factors are not sufficient to adoptive learning. Cognitive outcomes may also require clear constructing of lessons e.g. students learn more by actively participating in observing, speaking, writing, listening, thinking, drawing and doing (Baumert, et al. 2009; Klieme, Pauli & Reusser, 2009; Creemers & Kyriakides, 2008).

Studies done in the past, unfolded the reality that whatever the views a teacher keeps about science; scientific based knowledge; and how students absorb and retain scientific notions , all prove their decisive role in the modification and application of the curricula designed, specifically, to promote science education (Fang, 1996; Crawford, 2000; Keys, 2005; Johnson, 2004).

Hence a notable number of educationists admitted that teachers' views play back of the practices which they carry during instructions (Johnson, 2004; Brownlee, Boulton-Lewis & Purdie, 2002).

So, every step which is taken to bring a change in the fashion, researchers, found it requisite to have complete knowledge. For instance, what the teacher thinks of, is of sublime importance when curriculum is tried to model; when guidance is provided for effective modification; and when skillful learning is provided which ultimately benefits the educators to reconstruct the earlier beliefs and thoughts according to the needs and demands of curriculum (Keys, 2005; Feldman, 2000; van Driel, Beijaard, & Verloop, 2001). Previously, the attempts were made to explore the classroom practices of male and female teachers by studying them separately whereas the current study made a difference for here no segregation was carried out and both the genders went through observation simultaneously.

1.1 Objectives of the study

Following were the objectives of the study:

1. To compare practices of male and female teachers to teaching science subjects.
2. To find out the effect of teachers' experience on their classroom practices.
3. To discover the impact of teachers' qualification on their classroom practices.

1.2 Research Hypotheses

Research hypotheses were:

$H_0$1: There is no significant difference between practices of male and female teachers to teaching science subjects.

H02: There is no impact of teachers' qualification on their classroom practices.

H03: There is no impact of teachers' experience on their classroom practices.

H04: There is no interaction effect of teachers' gender and qualification on their classroom practices.

H05: There is no interaction effect of teachers' gender and experience on their classroom practices.

H06: There is no interaction effect of teachers' qualification and experience on their classroom practices.

2. Literature Review

Humans have always been curious about the world around them. The inquiring and imaginative human mind has responded to the wonder and awe of nature in different ways. One kind of response from the earliest times has been to observe the physical and biological environment carefully, look for any meaningful patterns and relations, make and use new tools to interact with nature,

and build conceptual models to understand the world. This human Endeavour is science (Creemers and Kyriakides, 2008).When such type of citizens are desired who are well aware of the importance and application of science imparted through a system of education, the importance of teaching standard, is inevitable. In order to improve the students' learning outcomes and building community confidence, the role of quality teaching is crucial (Darling-Hammond, 1999). A number of subsequent reports and investigations also established the similar facts, for it helped to attain a prolific level of understanding (Darling-Hammond, 1999; NCMST, 2000; National Research Council, 1997).

While the quality teaching addresses two major issues i.e. teachers' knowledge of subject matter and pedagogy. Verily, these are the vital components of quality teaching in science (Darling-Hammond, 1997). Studies done in the past, unfolded the reality that whatever the views a teacher keeps about science; scientific based knowledge; and how students absorb and retain scientific notions , all prove their decisive role in the modification and application of the curricula designed, specifically, to promote science education (Fang, 1996; Crawford, 2000; Keys, 2005; Johnson, 2004). At the secondary stage the students should be engaged in learning science as a composite discipline, in working with hands and tools to design more advanced technological modules than at the upper primary stage, and in activities and analysis on issues surrounding environment and health. Systematic experimentation as a tool to discover/verify theoretical principles, and working on locally significant projects involving science and technology are to be important parts of the curriculum at this stage (Johnson, 2004).

Quality teaching and learning of science that includes: 1. students learning of science is greatly determined by how they are taught by teachers; 2. teachers' perceptions of science as a discipline and as a school subject to be learned by the students greatly influenced their actions and its teach-ability; 3. students' understanding of science is achieved through their engagement and active construction and social processing of information; and 4. teachers' understanding of and relationship with their students have a great influence on their actions (Keys, 2005).

3. Research Methodology

3.1 Nature of the study

It was a descriptive study. Cross-sectional survey was used for the study.

3.2 Population

The population included all male and female science teachers of Government High Schools of district Rawalpindi.

3.3 Sample

There were 2728 male and 3573 female High School Teachers in the district Rawalpindi. 240 science teachers (120 male and 120 female) were selected randomly as the sample of the study.

3.4 Research Instrument

A questionnaire was prepared for the science teachers to find out their practices for teaching science. Cronbach Alpha was applied for calculating reliability of the instrument i.e. 0.977 and considered acceptable.

3.5 Data Collection Procedure

Data was collected through personal visit to the sample schools. A cross sectional survey was conducted for the collection of data.

4. Data Analysis

Data was analyzed by using an independent sample *t*-test for comparing pedagogical practices of male and female teachers. An independent sample *t*-test was used to analyze the null hypothesis i.e. there is no significant difference between the pedagogical practices of male and female teachers. Two-way ANOVA was used to analyze the rest of null hypotheses. Post-hoc tukey test was applied to find whether there was any significant difference between the groups.

Table 4.1

Showing results of *t*-test

Respondents	N	*df*	Mean	SD	*t*-value	*p*
Male	120	238	87.51	5.036	33.046	0.000
Female	120	238	52.45	10.474		
Total	240					

An independent sample t-test was conducted to compare practices of male and female teachers to teaching the science subjects. A hypothesis was formulated for this purpose i.e. $H_0$1: There is no significant difference between practices of male and female teachers to teaching science subjects.

There was a significant difference between male (M=87.51, SD= 5.036) and female (M= 52.45, SD= 10.474), t (238) = 33.046, p = 0.000 teachers' classroom practices. This showed that null hypothesis was rejected as there was a significant difference between practices of male and female teachers to teach the science subjects. Moreover, male teachers (N=120, M=87.51, SD= 5.036) were statistically using more practices than female teachers (N=120, = M= 52.45, SD= 10.474) (Table 4.1).

A two-way between groups analysis of variance was conducted to analyze the hypotheses No. 2 to 6. Before running two-way ANOVA the assumptions of ANOVA were tested and met.

Table 4.2

Tests of Between-Subjects Effects

Source	*Df*	*F*	Sig.
Gender	1	488.385	.000
Qualification	2	11.787	.000
Experience	3	1.415	.239
Gender * Experience	2	81.960	.000
Experience * Qualification	4	22.399	.000
Gender * Qualification	2	4.114	.018
Error	225		

The second hypothesis stated that there is no impact of teachers' qualification on their classroom practices. Subjects related to teaching qualification were divided into three groups (qualification of; BSc, BS/MSc, MS/M. Phil.). A two-way ANOVA was applied to test this hypothesis. The effect of teachers' qualification on their classroom practices was statistically significant as F (2, 225) = 11.787, p = 0.000 (Table 2). So, the null hypothesis i.e. $H_0$2: There is no impact of teachers' qualification on their classroom practices, was not accepted. As there was statistically significant difference between teachers' classroom practices with respect to their qualification, hence, Post Hoc tucky test was applied.

Table 4.3

Results of Post Hoc Tucky Test

(I) qualification	(J) qualification	Mean Difference (I-J)	Sig.
BSc	BS/MSc	-4.79	.000
	MS/MPhil	3.82	.004
BS/MSc	BSc	4.79	.000
	MS/MPhil	8.61	.000
MS/MPhil	BSc	-3.82	.004
	BS/MSc	-8.61	.000

Results in Table 4.3 showed that there were statistical differences present in all the groups related to teachers' qualification. This implied that the teachers with different qualifications i.e. BSc, BS/MSc, MS/M. Phil. used strategies that were different from each other. Table 3 also found that the minimum mean difference i.e. 3.82 found between practices used by the teachers with the qualification of BSc and MS/M. Phil, while, this mean difference reached to 4.79 in case of the teachers with the qualification of BSc and BS/MSc. It was also found that the teachers with the qualification of BS/M. Sc. and MS/M. Phil. showed maximum mean difference i.e. 8.61.

Third hypothesis stated that there is no impact of teachers' experience on their classroom practices. Subjects related to teachers' experience were divided into four groups (experience of; less than 1 year, 2 to 5 years, 6 to 9 years and above 10 years). A two-way ANOVA was applied to test this hypothesis. The effect of teachers' experience on their classroom practices was not statistically significant, F (3, 225) = 1.415, p = .239 (Table 2). So, the null hypothesis i.e. $H_0$3: There is no impact of teachers' experience on their practices, was accepted.
Fourth hypothesis stated that there is no interaction effect of teachers' gender and qualification on their classroom practices. A two-way ANOVA was applied to test this hypothesis. The interaction effect of teachers' gender and qualification on their classroom practices was statistically significant, F (2, 225) = 4.114, p = .018 (Table 2). So, the null hypothesis i.e. $H_0$4: There is no interaction effect of teachers' gender and qualification on their classroom practices was not accepted.

Fifth hypothesis stated that there is no interaction effect of teachers' gender and experience on their classroom practices. A two-way ANOVA was applied to test this hypothesis. The interaction effect of teachers' gender and experience on their classroom practices was statistically significant, F (2, 225) = 81.960, p = .000 (Table 2). So, the null hypothesis i.e. $H_0$5: There is no interaction effect of teachers' gender and experience on their classroom practices was not accepted.

Sixth hypothesis stated that there is no interaction effect of teachers' qualification and experience on their classroom practices. A two-way ANOVA was applied to test this hypothesis. The interaction effect of teachers' qualification and experience on their classroom practices was statistically significant, F (4, 225) = 22.399, p = .000 (Table 2). So, the null hypothesis i.e. $H_0$6: There is no interaction effect of teachers' qualification and experience on their classroom practices was not accepted.

5. Conclusion

The findings of the study concluded that the null hypothesis i.e. there is no significant difference between pedagogical practices of male and female teachers was rejected as there was a significant difference between practices of male and female teachers. Moreover, male teachers were statistically using more practices than female teachers. The results of the study also concluded that the null hypothesis i.e. there is no impact of teachers' qualification on their classroom practices was rejected as there was statistically significant difference between teachers' qualification with respect to their classroom practices. Post-hoc comparison using Tukey HSD also showed that the teachers with the qualification of BS/M. Sc. and MS/M. Phil. showed maximum mean difference. The results of the study also concluded that the null hypotheses i.e. there is no

interaction effect of teachers' gender and qualification on their classroom practices; there is no interaction effect of teachers' gender and experience on their classroom practices and there is no interaction effects of teachers' qualification and experience on their classroom practices were rejected. While the null hypothesis $H_0$3: There is no impact of teachers' experience on their classroom practices was accepted.

6. Recommendations

It was recommended that all the teachers with different qualifications might be trained by the latest pedagogical practices and techniques for the classrooms. Special training material might be developed for the purpose to remove the differences between their practices. Male and female teachers might also be encouraged to use practices in the classrooms equally, so that the statistical difference between them might be removed.

References

Anjum, A. (2002). *Problem faced by Secondary School Teachers at Kamra Cant. (*Thesis: Master in Education) Islamabad: International Islamic University.

Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., Klusmann, U., Krauss, S., Neubrand, M. &. Tsai, Y.M. (2009). Teachers' mathematical knowledge: Cognitive activation in the classroom, and student progress. *American Educational Research Journal*, 47, pp. 133-180.

Brownlee, J., Boulton-Lewis, G., & Purdie, N. (2002). Core beliefs about knowing and peripheral beliefs about learning: Developing an holistic conceptualization of epistemological beliefs. *Australian Journal of Educational and Development Psychology*, *2*, 1-16.

Cooper, T. (2002). *Why students retention fails to assure quality.* Paper presented at the HERDSA Conference, Edith Cowan University, WA.

Crawford, B. A. (2000). Embracing the essence of inquiry: New roles for science teachers. *Journal of Research in Science Teaching*, *37(9)*, 916-937.

Creemers, B. P. M. & Kyriakides, L. (2008). *The Dynamics of Educational Effectiveness: A Contribution to Policy. Practice and Theory in Contemporary Schools*. London/New York: Routledge.

Darling-Hammond, L. (1997). *Doing what matters most: Investing in quality*

teaching. New York: National Commission on Teaching and America's Future.

Darling-Hammond, L. (1999). *Solving the dilemmas of teacher supply, demand, and standards: How we can ensure a competent, caring, and qualified teacher for every child*. New York: National Commission on Teaching and America's future.

Faize, F. A. & Dahar, M. A. (2011). Effect of Mother's Level of Education on Secondary Grade Science Students in Pakistan. *Research Journal of International Studies, 19,* 13-19.

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Researcher*, *38*, 47-65

Feldman, A. (2000). Decision making in the practical domain: A model of practical conceptual change. *Science Education*, *84(5)*, 606-623.

Johnson, K. (2004). The role of field paleontology on teachers' attitudes toward inquiry science. *NOVAtions Journal*, 2004(2f). Retrieved 12/10/2015 from http://novationsjournal.org/content/article.pl?sid=04/05/04/0024254&mode=thread &t...

Keys, P. M. (2005). Are teachers walking the walk or just talking the talk in science education? *Teachers and Teaching: theory and practice*, *11(5)*, 499-516.

Klieme, E., Pauli, C. & Reusser, K. (2009). Quality of geometry instruction and its short- term impact on students' understanding of the Pythagorean Theorem. *Learning and Instruction, 19*, 527-537.

Mundhe, K. L. & Herkal, S. C. (2013). Life Long Learning: Progression from pedagogy to Andragogy then to Heutagogy. *Scholarly Research Journal for Interdisciplinary Studies (SRJIS).*

National Commission on Mathematics and Science Teaching (NCMST, 2000). *Before it's too late*. Jessup, MD: Education Publications Centre, U.S Department of Education.

National Research Council (1996). *National science education standards*. Washington, DC: National Academic Press.

National Research Council (1997). *Improving schooling for language-minority children: A research agenda*. Washington, DC: National Academy Press.

Orr, B. (1999). Pre-service Teachers Perceived Success of Classroom Management Strategies. *Journal of Family and Consumer Sciences Education*, *17*(1).

Reeves, T. (2002). *Mass education and quality.* Paper presented at the HERDSA Conference: Keynote address: Edith Cowan University, Perth.

Shaheen, F. (2003). *A Study of the Problems of the Overcrowded Schools at Secondary Level in District Attock*. (Thesis: Master in Education), Department of Education, Islamabad: International Islamic University.

Van Driel, J. H., Beijaard, D. & Verloop, N. (2001). Professional development and reform in science education: The role of teachers' practical knowledge. *Journal of Research in Science Teaching*, *38(2)*, 105-122.

Vant Hooft, M. (2005). The effect of the "Ohio school going solar" project on student perceptions of the quality of learning in middle school science. *Journal of Research in Technology Education, 37(3)*, 221-244.