



## Unraveling Pedagogical Beliefs and Practices of Chemistry Teachers at Secondary Level

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### ABSTRACT

This paper investigated the pedagogical beliefs and teaching practices of chemistry teachers at secondary level in Khyber Pakhtunkhwa. The samples of the study were 400 chemistry teachers from target population of three districts from zone 2. Data were collected through a self-developed questionnaire followed by semi structured interview and were analyzed through statistical tools i.e. mean, standard deviation, t test, ANOVA and qualitative data through qualitative data analysis techniques. Pedagogical beliefs questionnaire was used to measure teachers beliefs about their teaching practices. Finding of the study revealed that teachers have varied pedagogical beliefs i.e. positivist as well constructivist and those pedagogical beliefs in return influences how teachers teach. Finding of the study revealed that private sector teachers possess positivist teaching conceptions while public school teachers hold constructivist and critical pedagogy. It was therefore recommended for teachers, teacher educators and curriculum developer to diagnose and unravel teaching practices and the application of critical pedagogy are desired, encourage mediation to reshape those positivist teaching practices.

**KEY WORDS:** pedagogy, Pedagogical Belief, Positivist and constructivist teaching conceptions, constructivism.

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### INTRODUCTION

Teachers the change agent for their students; their level of belief can change their pedagogical paradigm for the best interest of student's academic achievement and teacher education (Malmberg, 2009). Teachers extract student's potentialities once they acquired sophisticated beliefs and constructivist teaching practices. Teacher's belief is the crucial parameters in improving teaching learning process. Teacher's belief is the significant factors that stimulate change process in learners as well as the inculcation of teaching strategies to be used in classroom (Caleon, 2018). Chemistry teachers needs to adopt teaching practices harmonious with content knowledge in order to make students problem solving, conceptual and capable of doing individual assignments, asking questions and mutual student-student and teacher discussion. Chemistry teachers needs to: Focus on student understanding, not syllabus coverage, Promote useful and relevant learning, Emphasize scientific literacy for all learners, Knowing and applying science knowledge, Constructing new understanding of chemistry knowledge and Reflecting on science knowledge (Nikolova & Stefanova, 2012).

#### Pedagogical Belief and Practices

The word "pedagogy" is extracted from Greek letter "pedagogia" in which "Pai" mean "child" while ago mean "I lead", so pedagogy is the art of how to lead a learner. Pedagogy is the driving force that motivates chemistry teachers to adopt teaching practices harmonious with the nature of knowledge i.e. content knowledge (Levy Nahum, 2010). Pedagogy helps teachers to understand student's priorities, needs and interest of individual learners' and how to deal and establish cooperative environment inside classroom. Pedagogy helps to transform student's theoretical knowledge into their real world lives (Brookfield, 2017). Each concept possesses their own specific knowledge so teachers need to have a beliefs' that direct and guide them to use the kind instructional pedagogy relevant to the nature of knowledge (Bryk & Gomez, 2015). Constructivism is a teaching learning conception in contrast to the more teacher centered approach of instruction i.e. the positivist or traditional approach of teaching. Traditional teaching learning has been considered to be a "mimetic" activity that focus on student's repetitions of what

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the teachers has taught (Richards & Rodgers, 2014). Teachers should realize that teaching is not to transfer some sort of information into the students or its just parroting the teacher's knowledge. Teachers should make students busy in the learning activities by applying teaching practice in order to stimulate their positive behavior towards chemistry (Tobin, 2012). Teachers' belief determines their teaching conception, their liking and disliking for a certain way of teaching in terms of methods and classroom environment. As a result it's the epistemology that bridges the gap between theory and practice (Naraian, Schlessinger, 2018).

### Research Questions

1. What are common pedagogical practices of chemistry teachers at secondary level?
2. How do chemistry teachers beliefs influence the way they teach?
3. How pedagogical practices differ across sectors?

## METHODOLOGY

The study was both quantitative and qualitative in nature for which a mix method research design was employed. This study was conducted in Khyber Pakhtunkhwa. Populations of the study constituted both public and private high and higher secondary schools of Zone 2 in Khyber Pakhtunkhwa. All chemistry teachers of (9<sup>th</sup>& 10<sup>th</sup>) were included in the population of the study. Among zone 2 a sample of 400 chemistry teachers were selected with 5% confidence level. The selection of schools was based on convenience while teachers were randomly selected.

### Data collection instrument and analysis

A self-administered questionnaire was developed for collection of data from chemistry teachers followed by semi structure interview. The questionnaire had two domains i.e. positivist or traditional conception and constructivist or student centered. The questionnaire was comprised of closed ended questions with five liker's scale options. Questionnaire was tested in pilot study at 10 schools. The reliability was measured through Cronbach alpha test for which alpha coefficient value 0.9 was obtained. According to (Amin, 2005), validity is the extent of instruments that measures what it intends to measure. Data collecting instruments were developed under the close guidance and supervision of research experts to ensure content validity. The collected data from teachers were analyzed by using (SPSS, version 16.0). For analysis of data mean, standard deviation, t test, ANOVA and correlation were used and tables were prepared for illustration. The data were interpreted and discussed accordingly

### Analysis

**Table 1 Sector wise Comparison of Teachers Beliefs**

Domain	Sector	Mean total	Standard Deviation	T	Df	Sig
Teachers Beliefs	Public	79.75	6.657	7.111	448	0.000
	Private	75.18	6.651			

Table 1 portrays the Sector wise comparison regarding teacher's level of beliefs. The overall mean value of public school teachers is 79.75 higher than private school teachers 75.18 about all the components of teachers beliefs i.e. Knowledge simplicity, Knowledge certainty, Innate ability of knowledge, Learning quickness and Source of knowledge. Similarly standard deviation value of public school teachers is 6.657 higher than private school teachers 6.651. Likewise t value shows that this difference is significant.

**Table 2 Sector wise Constructivist Conceptions of Teaching**

Domain	Sector	Mean	Standard Deviation	T	Df	Sig
Constructivist Conceptions	Public	30.44	3.679	5.641	448	0.000
	Private	28.43	3.719			

Table 2 portrays the Sector wise comparison regarding teacher's constructivist conceptions of teaching. The overall mean value of public school teachers (male and female) is 30.44 higher than private school teachers (male and female) 28.43 about all the components of teacher's constructivist conceptions of

teaching. Similarly standard deviation value of private school teachers is 3.719 higher than public school teachers 3.679.

**Table 3 Sector wise Traditional Conceptions of Teaching**

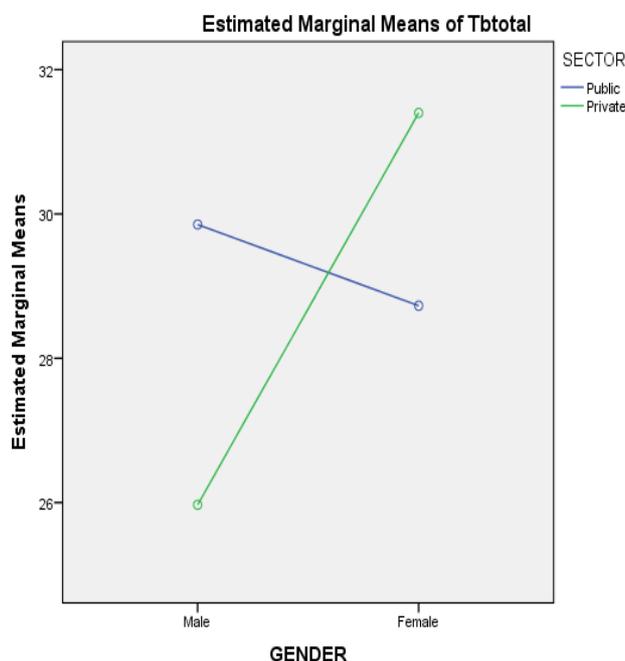
Domain	Sector	Mean	Standard Deviation	T	Df	Sig
Traditional conceptions	Public	28.34	3.820	2.534	448	.012
	Private	29.30	4.882			

Table 3 portrays the Sector wise comparison regarding teacher’s traditional conceptions of teaching. The overall mean value of private school teachers (male and female) is 29.30 higher than public school teachers (male and female) 28.34 about all the components of teacher’s traditional conceptions of teaching. Similarly standard deviation value of private school teachers is 4.882 higher than public school teachers 3.820

**Interaction Effect for Sector and Gender wise comparison for pedagogical practices**

To determine the interaction effect between gender (male, female) and school sector (public, private) two teaching approaches of pedagogical practices i.e. constructivist and traditional conceptions of teaching were entered in the multivariate analysis as dependent variables and gender and sector as independent variables. Results of this analysis are given in the figure 1 which shows that there is significant interaction effect between gender and sector for traditional conception of teaching. Results of analysis show that teacher’s beliefs regarding traditional teaching of different gender in different school sectors was different. The possible interaction between gender and school sector was investigated with the help of interaction graphs given. In gender wise comparison regarding traditional teaching “female teachers” both public and private has more traditional level beliefs of teaching having means value more than 30 than “male teachers” both public and private teachers with means value of less than 28.

**Fig .1 interaction effect between gender and sector**



**Themes Extraction from Teachers’ Pedagogical Practices**

“The qualitative strand included ten participants systematically and purposefully selected from the results of the quantitative strand”. All participants requested to keep their particulars i.e. school address, etc

confidential due to strict Pashtun customs constraints. Upon a thematic analysis, four themes emerged from the data, and the themes are used as a framework for organizing the findings.

The themes include:

1. Chemistry teachers were used to different teaching approaches i.e. learners and teacher centered
2. Elements of teaching practices fostering student's engagement
3. Factors affecting teacher's instructional practices
4. Teaching learning outcome, memorization or problem solving

**Theme 1: Chemistry Teachers were used to different Teaching Approaches i.e. Learners and Teacher Centered.**

The respondents mentioned the contemporary teaching methods i.e. learners-oriented along with teachers accustomed to teacher centered teaching. Mr. Asif replied that at the start of my teaching career for me, teaching was lecture method. Another respondent Mr. Imad replied that I was accustomed with teacher centered teaching and for students it was just like parroting the teacher's knowledge. Mr. Asif described some students hand on activities to work on "homologous series" organic chemistry concept with a little bit of direct lecture where students feel difficulty. A respondent "Miss Sarwat adopted a similar teaching style by stating that her class include about 15-20 minutes of direct instruction as classroom is amalgamation of individual differences and to teach according to students pace".

**Theme 2: Elements of teaching practices fostering student's engagement**

Teachers knowledge, enthusiasm, emotional attachment, intrinsic motivation, multimedia, laboratory equipments, less load on teachers, syllabuses based on research, proper teacher trainings, less pressure of annual syllabus completion, class discipline, Lesson planning, friendly classroom environment, Classroom activities, avoiding administrative interference, smooth parental involvements, availability of physical resources, teacher ability how to teach. Free and trustful environment, collaborative work between student and teacher, school support, are the elements that foster problem solving and critical traits in students shared by the participants.

**Theme 3: Factors affecting teacher's instructional practices**

Participants teachers manifest that teachers subject knowledge, Some fixed and negative beliefs, emotional attachment, lack of intrinsic motivation, lack of multimedia, laboratory equipments, overcrowded classes, workload on teachers, no proper teacher trainings, pressure of annual syllabus completion and students' result, poverty and laboring students, huge classrooms strength, students assessment problems, respective environment, encouragement of teachers by heads, overloaded working schedule are the factors that affect teachers instructional practices.

**Theme 4: Teaching learning outcome, memorization or problem solving**

Teacher's interview reveals their classroom outcome as problem solving and critical thinking because through these aspects, students are able to solve problem by their own and can make cognitive decisions, but some concept need memorization like symbols, periodic table elements names learning by heart. Teachers explained of using Problem solving but there is some ghost language concept which needs memorization.

## DISCUSSION

Teachers' responses about pedagogical practices were divided in two sub-categories and presented in table 1-3. The theme of data collection was similar as adopted in schummer, to ensure that the proper features of all the sub categories of teachers' beliefs and practices and were assessed in the studies. The mean score (total) of teachers beliefs in public sector chemistry teachers were 79.75 reveals high level and sophisticated beliefs than public chemistry teachers with a mean score (total) of 75.18. Results of analysis shows that both public and private chemistry teachers possess varied beliefs regarding, all sub categories of beliefs and practices. Mean score for public chemistry teacher strive hard to teach as compare to private to tackle chemistry teaching as simple and easy. The overall mean value of public school teachers is 30.44 higher than private school teachers 28.43 about all the components of teacher's constructivist conceptions of teaching shows that public teachers adopt student centered teaching which transform critical and problem solving thinking The overall mean value of private school teacher is 29.30 higher than public school teachers 28.34 about all the components of teacher's traditional conceptions of teaching which promote rote learning and low order thinking skills. The possible interaction effect for gender was investigated with the help of interaction graphs. In sector wise comparison regarding pedagogical practices

private has more traditional level and didactic beliefs of teaching transforming dualistic and low level thinking skills. Public school teachers were of the view that each student has their own learning behaviour so teacher had to deal that particular student according his/her cognitive competencies. Majority of public chemistry teachers exercise student centered teaching approaches. Private chemistry teachers adopted mix of both teacher and student centered teaching approaches. Teachers pointed out that it is difficult to deal with the large number of students as we have in our classrooms. Sometime teacher cannot even give a minute to a single student all because of the huge number of students in class.

## CONCLUSIONS

On the basis of findings of the study the following conclusions were drawn.

- ✓ It was concluded from tables 2 and 3 that two teaching approaches i.e. positivist (teacher centered) and constructivist (student centered) were identified in this study. Secondary Chemistry teachers were in complete accord that these two conceptions of teaching were the most significant and relevant to chemistry teacher's classroom practices at secondary level.
- ✓ It was concluded from table 2 that public male chemistry teachers possess constructivist conception of teaching about all the components of constructivist conceptions of teaching which shows the implementation of student centered teaching which transform critical and problem solving thinking
- ✓ It was concluded from table 3 about all the components of teacher's traditional mode of teaching that, majority of private teachers adopt teacher centered teaching which promote rote learning and low order thinking skills.
- ✓ In sector wise comparison interaction effect graph was plotted and it was deduced that majority of Private chemistry teachers has more traditional beliefs of teaching transforming dualistic and low level thinking skills.
- ✓ Majority of public school teachers opined regarding "depend on textbook knowledge or integration of own knowledge" that Text book has only words and images. Without integration of teacher's knowledge you can't even teach a word.
- ✓ It was concluded from interview analysis of Public chemistry teachers that every student has the ability to learn with different abilities. Students never come to school dumb but it's the school environment (teachers) that make him/her dumb. All students are smart all the time, and smallest students' achievement should be acknowledged. Constructivist teacher is one who can extract student's potentialities into real world.
- ✓ Factors affecting teacher's instructional practices are: Teacher subject command, enthusiasm, Some fixed and negative beliefs, emotional attachment, lack of intrinsic motivation, lack of multimedia, laboratory equipments, overcrowded classes, workload on teachers, no proper teacher trainings, bad administration, pressure of annual syllabus completion and students' result, poverty and laboring students, poor Academic and professional qualification , Lesson planning ,low academic strength of students to grasp the concept ,lack of lab equipments, class control when doing group work, Students' family background.

## Recommendations

On the basis of conclusion of the study, the following recommendations are presented

1. Two aspects of pedagogical conceptions i.e. positivist and constructivist were identified in this study. The identification of these aspects proposed for the curriculum bureau that specific focus may be given to include concepts harmonious to daily life activities in curriculum in order to ensure higher order thinking skills and higher achievement in chemistry.
2. Compared to private sector, public chemistry teachers (table 2) possess experienced beliefs about critical pedagogy and constructivist teaching so needs the attention of administration for more sophistication of teaching learning process. This can be done by provision of in-service training and refresher courses of existing teachers.
3. It was explored in this study (table 3) that teachers are reluctant to constructivist conceptions and stuck to positivist teacher oriented teaching. It is recommended for Curriculum bureau reformers to concentrate on the importance of epistemological beliefs and constructivist conception, so that a mutual harmony may be establish between the nature of knowledge and the relevant teaching approaches which satisfy student's concept and creative thinking.

4. It was examined that student's class size adversely affect teaching practices. It was difficult to deal with the large number of students per class as we have in our country. Sometime teacher cannot even give a minute to a single student all because of the huge number of students in class. Therefore it is recommended that, to impart quality education, students strength should be 25 per class (<http://classsizecountswa.com/about/>), similarly the number of teaching staff should be increased accordingly.
5. The goal of teaching learning process is to inculcate reasoning, critical, analytical and met cognitive skills in learners is rapidly increasing day by day. Therefore, it is strongly recommended that constructivist paradigm of teaching should be introduced into secondary chemistry class rooms on priority basis to make the teaching learning process more effective and launching constructivist-based inquiries in science education in order to inform chemistry teachers pedagogy.
6. Majority of Private chemistry teachers' depend on book as final authority of knowledge without integration of own knowledge, needed more recognitions towards sophistication of their beliefs. Therefore teacher trainers may keep in mind this fact while preparing teachers with stress on pedagogical knowledge related to this aspect to enhance conceptual understanding and students' achievement.

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