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Evaluating intellectual quality in Biology teaching and its impact on students learning at secondary level

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Abstract

This research was carried out to evaluate intellectual quality in Biology teaching and its impact on students learning at secondary level. The objectives of study were (i) to find the element of logical thinking, (ii) to explore about the element of in-depth knowledge, (iii) to find about the element of conceptual understanding (iv) to find the elements of substantive conversation, (v) to explore about the element of problematic knowledge and curriculum. The research was conductedwith 04 biology teachers in the city of Rawalpindi, Pakistan, by using qualitative methods. Data were collected through questionnaire, classroom observations and in-depth interviews. The collected data was analyzed through thematic analysis. The trust worthiness, reliability and validity of the research were checked through triangulation, member checking and auditing. The essence of the study was determined through common points in theme. Finally, the conclusion and recommendations were drawn. The research was beneficial for biology teachers to improve the quality of teaching for motivating students learning. The study concluded that the participant teachers who were teaching in Government sector were professionally well qualified, trained and experienced as compared to private sector teachers. All the participant teachers gave highest ranking to the aspect of intellectual quality and its elements like logical thinking, in-depth knowledge, conceptual understanding, substantive conversation and problematic knowledge and curriculum.

Keywords: Intellectual quality, teaching, Biology, Students learning, Secondary level, logical thinking, in-depth knowledge, conceptual understanding, substantive conversation, problematic knowledge and curriculum

Introduction

Education is a vehicle of social, economic and cultural change that shapes destinies and earns a nations' place in history. As we advance toward the future, our entire society is changing in a changing global context. Major institutions, including government, Industry and finance are seeking ways to restructure that will increase their flexibility and effectiveness in this climate of change. Education is often pointed to as the key sector of our society that can prepare us for this new world and ensure our success. Better educated and more highly skilled people are more likely to be in work, earn more and contribute more productively to our economy and society. Knowledge and skills provide individuals with their surest route into work and prosperity; helping eradicate the causes of poverty and division in society (Department of Education and Skill, 2001) developing these areas of knowledge and skills present major challenges for the teaching profession and to the content of teaching. It demands fundamental rethinking of traditional conceptions ofknowledge, its transmission', and delivery' by teachers and 'acquisition' by students. It raises questions about the quality of teaching, students' learning and motivation to learn.

In Pakistan, the most serious challenge facing education system today is how to improve the quality of teaching and learning that prepares the next generation with the

qualities of a life-long learner, and to build up students' ability and self-assurance to function as independent learners in the new information world. The Pakistan National Education Policy (NEP) published in 1998 expressed that in Pakistan, the efficiency and competency of teachers is a major problem. It stated that teaching is a specialized profession that requires an understanding of the philosophy of education, theories of learning, child psychology, teaching methodologies and evaluation techniques

Pakistan is facing different educational problems which hinder in the way of quality education like lack of uniformity, education without direction, outdated curricula, lack of professional development of teachers, lack of quality teachers, alarming dropouts, system of examination, poor supervisory standards, lack of resources, political instability, policy implementation, low budgetary allocation for education and last but not the least is corruption. All these issues are pointed out in different studies like (Ahmad et al., 2014; Ali, Sultana, Shaheen, Thalho, & Ibrahim, 2022; Kaloi, Maitlo, Solangi, & Mughal, 2021; Kirk, 2007; Noh, 2021; Rehman & Khan, 2011; Shahzad, 2019; Zaki, 1989).

This study investigated elements of the quality of teaching and learning in the subject of biology at secondary schools in Pakistan. There is currently little research into improving the quality of teaching and learning practices in Pakistan. Most studies give emphasis to the duration of the teacher training program and improvement of curriculum and instructional material, but no one appears to have addressed pedagogical practices and student motivation related to teachers' use of these in an individual class for enhancing student learning outcomes (Siddiqui, 1997; Khawaja,2002). To improve the quality of Education the Pakistan Institute of Quality Control (PIQC) has stated that due to the fast-changing global economy, rapid growth and expansion in information and communication technologies, there is a strong need to restructure the education system with innovation in teaching approaches to prepare students for success in this new economy (PIQC, 2004). In this situation this study might be helpful to provide so teaching strategies which improve the quality of teaching, students' learning and motivating students to learn.

Objectives of the study

The objectives of study were (i) to find the element of logical thinking, (ii) to explore about the element of in-depth knowledge, (iii) to find about the element of conceptual understanding (iv) to find the elements of substantive conversation, (v) to explore about the element of problematic knowledge and curriculum.

Research Methodology

In the study Queensland School Reforms Longitudinal Study (QSRLS) of Productive Pedagogies was used as a frame to investigate the issue of improvement of quality teaching to enhance students learning outcomes. The research was conducted with 04 biology teachers (02 females, 02 males) in the city of Rawalpindi, Pakistan, by using qualitative research methods. Data were collected through questionnaire, classroom observations and in-depth interviews. The collected data was analyzed and then conclusion and recommendations were made. The research will be beneficial for biology teachers to improve the quality of teaching for motivating students learning.

Literature Review

This review focuses on literature related to pedagogies and skills that improve teaching-learning practices and motivational aspects of students' learning. It examines classroom practices that support quality teaching and learning and that are helpful to improve and enhance students' learning, in middle school classes. In review the state of teaching and learning in Pakistani schools, particularly secondary schools teaching and learning in the subject of Biology was elaborated.

Quality of Teaching and Learning in Pakistan

Improving the quality of teaching and learning in Pakistani schools is a national priority. The Pakistan National Education Policy (NEP) (1998-2010) stresses that the success of the education system will largely depend on the quality of teaching and learning (Govt. of Pakistan, 1998). For the improvement of both teaching and learning areas the government has made several attempts in teacher training in recent years (Iftikhar, 2003). However, despite the considerable investment of human and material resources, many of these projects (mostly teacher training projects) have failed to have the anticipated impact on improving the quality of teaching and learning in Pakistani schools. Iftikhar (2003) points out that the reason for this failure is that teachers feel more comfortable with a traditional "chalk and talk method" that "delivers information in a pre-digestible format" (Iftikhar, 2003).

The New Education Policy' document published in 1970 also expressed alarm at the high dropout rates of school children. In that document revision of curricula and texts was called for and emphasis given on the need for improved facilities, better supervision and new ways of recruiting teachers. Since 1960, all government Five Year Plans have called for qualitative improvements in school education programs. These programs sometimes stress improving the quality of the school environment with the recruitmentand training of learning coordinators to improve the supervision of instruction; at other times they emphasize the creation of resource centres to provide more support for classroom teachers, the development of an integrated curriculum that reduces the number of separate subjects and text books for teaching modules with activities for teaching lesson concepts, and teaching kits containing instrumental aids for classroom use to reduce the high dropout rate. But none of these has proved completely successful, nor has their implementation been smooth (Govt. of Pakistan, 1998). The teaching method that ismostly practiced in the public institutions of Pakistan is teacher-centred in which the teacher is considered the sole source of knowledge and presents the lesson in the lecture / recitation mode. Teachers determine the standard content and methods and provide factsor knowledge from books. Skills are acquired by drill and rote memorization not by activities or through direct experiences of students (Siddiqui, 1997).

There is no integrated system in which one step leads to the next, to enable a student to develop a truly sound base for the discipline in which the student is interested. Teachers usually talk and write on the board for half the lesson. Rust et al. (1990) found that in middle year classes in Pakistan in about 70% of the classes, the majority of student notebooks observed reflected verbatim copying from the teachers' notes. Subjects are seen as compartmentalized and not connected. The teachers rarely relate the content of their lessons to students' personal lives and students' participation in class is limited andrestricted (Rust et al., 1990).

Features of Quality Teaching

Quality in teaching means "fitness for purpose" (Teaching Times Online News Service, 2004). It means selecting of the most appropriate methods of teaching for a particular quality teaching means creating and maintaining an effective learning purpose. Environment by the teacher within a framework provided by the school and the national education and curriculum polices (Teaching Times News, 2004). In an effective learning environment, the teacher performs those teaching practices, which leads to thorough and lasting acquisition of the knowledge, skills and values the students have to acquire (Felder and Brent, 1999). Summarizing the work of an international number of researchers the main features of quality teaching are considered as:

- Drawing objectives of the lesson and achieving in lesson' by focusing attention on these aims.

- Flexibility in the lesson content that meet the needs of individual students.
- Support of teacher to the students that they are treating individually, and direct helps 'at risk' students.
- Creation of supportive learning environment in which complex learning activities extend and challenge their thinking in a broad range of capabilities. They work in group and take responsibilities for their own learning.
- Designing lesson that encourage them to be actively involved in learning and help to develop understanding of concepts and ideas.
- Assessing students' performance by engaging them in discussion, written assessments, group work and provide feedback with suggestions to improve their work.

Students engagement in experimental learning in which they are working on realistic problems and acquire wide range of capabilities like problem solving skills,acquisition, assimilation or creation of new knowledge and understanding personal development, goal setting and self-assessment (RMIT, 2002; Teaching Times News, 2004).

Learning is a cognitive process of acquiring skills or knowledge (Bourke, Bulluss, Chamberlin, England, Mc Phec, 1994). Quality learning means active participation by students in learning by sharing ideas, asking questions, consulting references and resources of information and taking challenging tasks (Bourke et al., 1994). According to the Bourke et al. (1994), the major features of quality learning relate to purposeful learning activities with well-defined goals that are related directly to intended outcomes. Active involvement of students in planning and development of their own learning, which directed them to their self-reliance and independence. Motivating students by creating learning environment that are cantered on challenging issues / problems / themes that havecontemporary meaning and interest for students (Bourke et al., 1994).

Costello (1996) states that to enhance students learning outcomes it is necessary that students take responsibility for their own learning in class and develop strategies for learning, collaboration and communication

Pedagogy of Quality Teaching and Learning

Pedagogy means the art and science of teaching, including teaching strategies that raise students' achievement, or the principles and methods of instruction (Harvey, 1970). Pedagogy refers to the interaction that occurs between students and teachers in teaching-arising Situations. It also includes theories about teaching, learning and environment that inform teaching practice (Chamberlain, 2001). Pedagogy refers to the nature of knowledge and learning specifically how knowledge is produced and reproduced, transformed and experienced, in situations created by students and teachers. It includes what is taught, how it is taught, and how it is learned and reflected in the classroom. Various traditions of pedagogy including critical pedagogy, radical pedagogy, authentic pedagogy and productive Pedagogy. Given the nature of this research thesis, the present study will focus on ideas related to authentic and productive pedagogy and their relationship to quality teaching and learning.

Authentic Pedagogy and Elements of Quality Teaching

Authentic pedagogy is an "umbrella" concept used for the enhancement of meaningful learning. This concept was developed by Fred Newmann and his associates at the University of Wisconsin, Madison. The major purpose of Newmann et al.'s study was to increase self-regulating intellectual thinking in all students and to engage students in goal- oriented classroom learning activities by providing deep knowledge within across the

subjects and school. The use of authentic pedagogies refers to the way in Central Regional Educational Laboratory, 2000). The conceptual understanding is developed by engaging the students in meaningful classroom conversations by giving them real challenges and extending their ideas.

Lingard, Ladwig, & Luke, (1998) stated that Newmann et al's research of authentic Pedagogy presented a valuable account of how teaching practice might be improved translate into practical models of pedagogy. One research group that has worked on the development of such a practical model that is theoretically developed, comprehensive and multi-dimensional. And practically applicable, is the Queensland Study of Productive Pedagogy (QSRLS). The QSRLS pays simultaneous attention to already existing aspects of classroom practices and draws teachers' attention to what really matters in helping students to learn (Gore and Ladwig, 2003). The QSRLS productive pedagogy is different from other pedagogical approaches because it pays attention to many essential aspects of classroom teaching instead of focusing on just one aspect of teaching (Gore et al., 2003). The Queensland Study of Productive Pedagogy (QSRLS) The QSRLS extended the ground-breaking work of Newmann et al. (1996). It identified twenty elements of teachingthat lead to enhanced student learning outcomes. These twenty elements of teaching are classified into four broad teaching dimensions. These dimensions are:

- Intellectual Quality,
- Relevance,
- Supportive Classroom Environment, and
- Recognition of Difference.

Research from the QSRLS study suggested that some of these teaching elements are better suited to teaching certain skills and fields of knowledge than are others while some elements are better suited to certain student backgrounds, learning styles and abilities (QSRLS, 2001).

Intellectual Quality

Newmann's studies on quality teaching and studies of authentic teaching-learning activities (Newmann et al., 2001), show that students' success in the present-day world requires not only basic knowledge and skills but also the capacity to engage in more complex intellectual activity. Students who engage in intellectually stimulating work learn more than repeated drills aimed at disconnected knowledge and skills. Many research studies in the recent past, along with the Queensland's study of Productive Pedagogy, indicate that students exposed to intellectual challenges are more engaged in their schoolwork than students exposed to more conventional schoolwork (see for example, Avery, 1999; Kane et al., 1995; Newmann & Associates, 1996; QSRLS, 2001). These research studies emphasize the need for Intellectual Quality because their findings showed that it is instrumental in motivating students to learn and perform academically well. The six elements that comprise this dimension are: 1) higher order thinking, 2) deep knowledge, 3) deep understanding, 4) substantive conversation, 5) knowledge as problematic, and 6) use of meta language. The element of higher order thinking gives emphasis to students' reconstruction of new knowledge with the usage of information and ideas. Constructing knowledge and understanding is a social, interactive process (Driver etal., 1994). Students learn from each other by sharing their ideas and points of view, asking questions, and building on their shared methods and ideas. There are five elements in this dimension:

1) social support,
2) academic engagement,
3) self-regulation,
4) students control in determining their learning activities, and

5) Explicit criteria for high quality performance in learning.

Related Researches

Elkhidir N. (2020) conducted a research titled "Effective Teaching Strategies in Biological Education: Present and Future Prospects". The objective of the study was to explore the diversity of teaching strategies in biological education and expected results on acquisition of knowledge and fulfilment of learning outcomes in an attempt to identify which strategies work best with biology students. Three databases and search engines were used: Scopus, Google Scholars and Web of Science. The study concluded that the teachingof biological sciences was experiencing evident transformations towards student-centered learning. As educational goals were being modernized in biology at present times. The more simulations and problem-based learning became part of the teaching strategy, the teaching of biology becomes more learner-centered to enhance learners' critical thinking on complex biological processes.

Olimpo and Esparza (2020) stated review of literature titled "Active learning and Conceptual Understanding in Biology". Evidence within the science, technology, engineering, and mathematics disciplines demonstrates that engagement in the learning process was pivotal for students' development of conceptual understanding in their respective field of study. Achieving such engagement depends largely on the extent to which faculty incorporate active-learning strategies into their curricula in a purposeful manner. Specifically, active-learning strategies should be aligned to explicit student learning objectives and forms of assessment in order to assist students in acquiring deep understanding of the content. In this chapter, we first define active learning and provide several examples of common active-learning strategies. They discussed the relationship between active learning and students' development of conceptual understanding in the biological sciences, with particular attention given to factors that have the potential to mediate that relationship. They concluded by offering recommendations for how faculty might assess conceptual understanding in their own classrooms as well as the efficacy of active-learning strategies more broadly.

Haudhri; Gong; Heller and Yamada (2019) stated in their review in the book titled "Explicating the Logic of Biology to Support Critical Thinking".. Mathematicallogic and philosophical ontology can play an important role in improving biology education by teaching critical thinking. We propose to explicitly identify universally true statements in biology textbooks so that there is clear understanding of the applicability conditions for each piece of knowledge. We further propose that each biology concept should be defined using an Aristotelian definition. We show how these enhancements enable critical thinking and could be made part of pedagogical practice using an intelligenttextbook.

Alrubaie, Majwall, and Jawad (2019) studied on "The Effect of Teaching on the Skills of Logical Thinking in the Achievement of Student's Achievement in Biology". The aim of the research was to identify the effect of logical thinking skills on the achievement of the fifth grade biology students. To achieve the goal, the researchers put the zero hypothesis which states: There is no statistically significant difference at the level of (0.05) between the averages scores of the female students of the experimental group will be guided by the logical thinking skills .The average number of female students of the control group will study according to the usual method in the biology test. In order for the researchers to apply, the experiment was applied in the second half of the academic year (2018-2019). If the sample consisted of (82) fifth grade female students of Al-Baqir High

School for Girls. And random image were divided into two groups of 36 students per group. The two groups were equivalent in the following variables: age, decision scale, testing the previous information of the new material, and in light of the behavioral objectives and the relative importance of the content, (40) paragraph of multiple choice, and the researcher has achieved the specifications of the cytometric test, the experiment continued to apply for (8) weeks.

Thomas et al. (2017) study was conducted on "Teaching Biology in the Field: Importance, Challenges, and Solutions". Learning that occurs in a field setting is a powerful experience that promotes the development of new generations of creative scientists, enhances environmental literacy, and in stills social responsibility in our citizens. Institutional challenges to field studies include decreasing financial resources and increasing regulatory concerns. These are coupled with changing student interests; in particular the growing misconception that field study is not relevant to many biological careers. Collectively, these factors contribute to a significant decline in field-study opportunities for students and lack of pedagogical guidance for instructors interested in conducting field courses. Nature and culture are inextricably linked, and we all benefit from including diverse backgrounds and perspectives in field experiences. We suggest expanding the definition of "the field" to include human-influenced ecosystems, as well asmore conventional natural habitats. More than ever, the world needs the passion, insight, and wisdom that come from field studies.

Research Methodology

Research Design
The study was qualitative in nature.

Sample
In qualitative research the selection of a sample is purposeful and small. Criterion sampling technique was used in this study. In present study 4 science teachers teaching biology at Govt Girls high school Johar Memorial Rawalpindi, Govt Girls High School Gangal Gulzar e Quaid and Govt Boys High School Gangal Gulzar e Quaid were selected as a sample of study.

Tools of data collection
Observation manual: An observation manual was developed to observe each participating teachers. For observing each participating teacher's classroom practice the researcher completed observation manual herself.
Questionnaire: A questionnaire was developed to collect the demographic information of teachers.
Semi-structured interview: A semi structured interview was developed that covered five elements of intellectual quality.

Procedure of the study
In the first month, demographic information of the participants were collected the researcher herself visited the sample schools and participants to develop relationshipamong them to complete the study.

In the second and third months, classroom observations and interview of the participant teachers and students were conducted. Grade IX & X classes were observed during scheduled biology classes. While sitting in the classrooms rough notes were made of what was happening in class. This included the things the teacher was saying and

doing, and students' responses both in terms of whole class interactions and actions ofthe individual students sitting close to researcher. The researcher also noted when teachers were using elements of teaching, they had ranked most highly on their questionnaire.

The staff interview schedule was designed to obtain each teacher's views on teaching practices and students' outcomes based on each of the 5 selected elements. The interview schedule and observational schedule accompanied by a brief explanation that was provided to participants at least one day in advance of their interviews. During each interview, researcher took detailed notes. Each interview averaged approximately one and a half hours in duration. The data was collected through questionnaire, in depth interview and observations. The goal of qualitative study was to comprehend the significance of experiences of the participants. This type of research on the other hand enables us to know how to create their words to assign meaning to their experiences.

The researcher observed each lesson using the classroom Observational Schedule as described previously. In observation the researcher coded each of the 5 elements observed on a 5-point Likert scale with the indicators used: Very Frequently, Frequently, Infrequently, Very infrequently and Not Evident in class. The researcher also completed descriptive notes to document evidence of observation. To know more about the nature of teaching and learning in the subject of biology in these classes, their attitudes towards learning and the changes in classroom practices they wanted to enhance their motivation to learn Biology and improve their academic performance. The data was analyzed by using thematic analysis with inductive coding. Different researches have used and stated this method of data analysis (Medelyan, 2019, Saldana, 2015, Creswell, 2012 and Naz, 2023).

Results

Table 1 Showing qualifications and experience of teachers

Code allotted	Name of teacher	Academic qualification	Professional qualification	Teaching Exp. (years)	Institution
A	Shahzana Nisar	M.Sc. (Statistics)	Nil	08	Sir Syed School & College, Rawalpindi
B	Attiq-ur-Rehman	M.Phil (Chemistry)	M.Ed.	12	GBHS, Gangal, Rawalpindi
C	Aqeel Ahmed	B.Sc. & M.A. (Pak Study)	B.Ed.	12	GBHS, Gangal, Rawalpindi
D	Ms. Shagufta Naseem	M.Sc. (Biology)	M.Ed.	28	GGHS, Gangal, Rawalpindi

Table 1 shows that Teacher-A (Shahzana Nisar) is teacher of biology at Sir Syed Science School & College for Girls, Dhoke Syedan Rawalpindi in Pakistan. She teaches this subject of biology at secondary level. She has been teaching in this school for 8 years. She is M.Sc. (Statistics) and have no professional degree. She has not taken any training courseand workshop.

Teacher-B (Attiq-ur-Rehman) (Pseudonym) is teacher of biology at Government Boys High School, Gangal, Gulzar-e-Quaid, Rawalpindi in Pakistan. He teaches this subject of biology at secondary level. He has been teaching in this school for 12 years. He is highly qualified and has M. Phil. Chemistry degree. He is professionally M.Ed. He has taken many training courses and workshops.

Teacher-C (Aqeel Ahmed) is teacher of biology at Government Boys High School, Gangal, Gulzar-e-Quaid, Rawalpindi in Pakistan. He teaches this subject of biology at secondary level. He has been teaching in this school for 12 years. He is highly qualified and has B.Sc. and M.A. Pak Studies degrees. He is professionally B.Ed. He has taken many training courses and workshops.
Teacher-D (Mrs. Shagufta Naseem) is a science teacher at Government Girls High School, Gangal, Gulzar-e-Quaid, Rawalpindi in Pakistan. She teaches the subject of biology at secondary level. She has been teaching in this school for 28 years. She has M.Sc. (Biology) degree. She is professionally M.Ed. She has taken many training courses and workshops.

Table 2: Observations of teachers in the classroom regarding elements of logical thinking

In the classroom teacher	**Observations of Participant Teachers**			
	A	B	C	D
New knowledge and information during all the lessons	2	2	2	2
Engaging students to develop learning Competencies	3	1	2	2
Asking questions to provide critical reasoning	1	2	1	2
Provide factual information from the textbook	1	3	2	2
Reading and explaining the textbook content word by word	4	3	2	2
Dictating or writing notes on the black board	3	3	3	2

Very frequently=1, frequently=2, infrequently=3, very infrequently=4, Not evident=5

Table 2 indicates that Teachers A,B,C&D gave new knowledge and information during all the lesson frequently except teacher D who gave it very infrequently Teacher B engaged students to develop learning very frequently, teacher C frequently and teacher Avery frequently. Teachers B,D asked questions to provide critical thinking frequently while teacher A&C very infrequently. Teacher A provided factual position from the text book very frequently, teacher C&D frequently, teacher B infrequently while teacher A very infrequently.

Table 3: Observations of teachers in the classroom regarding elements of in-depth knowledge

In the classroom teacher	**Observations of Participant Teachers**			
	A	B	C	D
Present detailed factual knowledge and information on all the Content of the lesson	1	1	1	1
Present knowledge by focusing attention on the central idea of the topic all the contents of the lesson are discussed	2	1	1	2
The content of the lesson is connected With the main idea	1	2	1	2
Lesson develops deep insight and knowledge	2	2	2	1
Provide an argument on important contents of the lesson	2	3	3	2

Very frequently=1, frequently=2, infrequently=3, very infrequently=4, Not evident=5

Table 3 teachers A,B,C&D presented by detailed factual knowledge and information on all the content of lesson by 'frequently'. Teachers B,C presented knowledge by focussing attention on the central idea of the topic of all the contents of the lesson were discussed 'very frequently', Teacher-A&E frequently, Teacher A&C connected the content of the lesson with main idea 'very frequently', teacher B&D frequently. Teachers A,B,C in their lesson developed deep insight and knowledge frequently, teacher D very frequently. Teacher B, C provided an argument on important content of the lesson infrequently, teacher A,D frequently.

Table 4: Observations of teachers in the classroom regarding elements of conceptual understanding

In the classroom teacher	Observations of Participant Teachers			
	A	B	C	D
Almost all students clearly understand the lesson,	3	2	2	5
Almost all students can conceptualize the idea behind The words	3	2	2	5
Almost all student demonstrate their understanding of the given knowledge	4	2	2	3
Almost all student can solve their academic exercise /problem	2	2	3	3
Almost all students raise questions or arguments or provide answers to the Questions	2	1	1	3
Almost all student share their understanding with others	1	1	2	5

Very frequently=1, frequently=2, infrequently=3, very infrequently=4, Not evident=5

Table 4 shows that almost all students of teacher A clearly understand the lesson very frequently, teacher B,C students frequently wile teacher A&D students infrequently and not evident respectively, teacher B,C frequently, teacher students infrequently. Almost all students of teacher B,C, demonstrated their understanding of the given knowledge frequently teacher D students infrequently while teacher A students very infrequently. Almost all students A,B solved their academic problem, frequently, teacher C,D students infrequently. Almost all the students of teachers B,C raise questions or arguments or provided answer to the questions very frequently, teachers, A&F students frequently and teacher D students infrequently. Almost all students of teachers A,B, showed their understanding with others very frequently, teacher C students infrequently and teacher D students not evident.

Table 5: Observations of teachers in the classroom regarding elements of Substantive Conversation

In the classroom teacher	Observations of Participant Teachers			
	A	B	C	D
Almost all students Engage in intellectual talks	3	1	1	2
Almost all students provide critical reasoning on the subject matter	2	2	2	3
Almost all students their ideas with others in the form of Comments/ questions / extended statements/ students understanding through sharing of ideas / summarizing views of class participants / and test-based questions	1	2	3	3
Almost all important content areas are covered with conversation	2	2	2	2
Students are nominated for conversation	2	1	2	2

Conversation is only between teacher and Student	4	2	2	3

Very frequently=1, frequently=2, infrequently=3, very infrequently=4, Not evident=5

Table 5 shows that teachers B,C, engaged almost all the students in intellectual talk very frequently, teacher D frequently and teacher A infrequently. Teacher A,B,C students frequently and teacher D very infrequently. Almost all students of Teacher A shared their ideas with other in the form of comments/ questions/extended statements/student understanding through sharing of ideas/ summarizing views of class participants and test based questions very frequently. Teachers B&D students frequently and teacher C infrequently. All the teachers A,B,C,D covered almost all the important content areas with conversation. Teacher B,D nominated the students for conversation very frequently while teacher A,C&D frequently. Teacher B,C, conversation was only between teachers and students frequently, teacher D infrequently while teacher A very infrequently.

Table 6: Observations of teachers in the classroom regarding elements of Problematic knowledge and curriculum

In the classroom teacher	**Observations of Participant Teachers**			
	A	B	C	D
All knowledge is presented in Problematic way	2	3	2	2
Almost all student construct knowledge with their prior understanding	2	2	2	2
Almost all students solve the problem with the construction of new knowledge	1	1	1	2
Almost all content of the lesson is presented in problematic manner	3	2	2	2
Students construct knowledge in group activities	3	2	2	2
Information provided through brainstorming activities	4	1	1	2

Very frequently=1, frequently=2, infrequently=3, very infrequently=4, Not evident=5

Table 6 shows that teacher A,C,D presented all knowledge in problematic way frequently while teacher B infrequently. Almost all the students of teacher A,B,C constructed knowledge with their prior understanding frequently. Almost all students of teachersA,B,C solved the problem with construction of new knowledge very frequently, teacher D students frequently. Teacher B,C presented almost all content of lesson in problematic manner frequently while teacher A very infrequently. Students of teacher B,C,D constructed knowledge in group activities frequently while teacher A students infrequently. Teacher B,C provided information through brainstorming activities veryfrequently while teacher A very infrequently.

Analysis of In-Depth Interviews of Teachers

Interview Teacher-A (Shahzana Nisar)

Logical Thinking

1. Teacher-A developed the ability among students to build their own ideas by discussion after lecture.
2. She developed the critical and logical thinking among her students by giving examples.
3. According to teacher-A, deep search and knowledge are necessary competencies to be developed in the students for dawning realization.

In-depth knowledge

1. She presented new knowledge in the class by giving real life examples to build deep insight in students.
2. According to her, central idea of a lesson allows the students to think critically about the lesson.

Conceptual understanding

1. To help the students to understand the concepts of the lesson's contents by giving additional information about history or background of the lesson.
2. She cleared the concepts of students in her lesson by explaining thoroughly.
3. She discouraged the students from memorizing the lesson by asking questions that involve critical thinking.

Substantive conversation

1. According to her the relationship between teacher-student and student-student should be respectful and this relationship is developed by setting boundaries.
2. She said substantive conversation plays a very important role in teaching and learning because both can understand each other well.
3. She encouraged the students to share their understanding in the class by developing confidence in them.

Problematic knowledge and curriculum

1. According to her knowledge helps students to solve multiple problems at the same time.
2. She always gave exercises relevant to the topic that helped students understand better.

Thematic Analysis of Teacher-A

For presenting Teacher-A interview it is divided into five elements comprising of elements of quality related to intellectual quality that are logical thinking, in-depth knowledge, conceptual understanding, substantive conversation and problematic knowledge and curriculum.

Teacher-A said that for developing the element of logical thinking, she discussed after lectures and gave examples. She considered deep search and necessary competencies. Stating about the element of in-depth knowledge she gave real life examples. About central idea she said it allows the students to think critically. She said that she provided additional information about the history or background of the knowledge for conceptual understanding. She explained her lesson thoroughly. She asked the questions from students to discourage them from memorizing.

Regarding the element of substantive conversation she suggested that there should be a relation of respect between teacher and students. She said that substantive conversation played on important role in teaching and learning. She encouraged the students through developing confidence in them. Addressing the element of problematic knowledge and curriculum. She said that knowledge helped to solve multiple problems. She gave exercises relevant to the lesson.

Teacher-B Interview (Attiq-ur-Rehman)

Logical Thinking

1. I build this ability in the student by giving class assignment related to topic to students.
2. I develop critical and logical thinking in the student by asking questions/answers.
3. I think the learning competency of relating the knowledge with daily life is helpful for drawing realization.

In-Depth Knowledge

1. I present new knowledge by interconnecting it with previous knowledge.

2. I think central idea is important to motivate the students to achieve their goals.

Conceptual Understanding

1. I designs my lesson by presenting related models these can be helpful for students understanding.
2. I clear the concept of the student by practical examples.
3. I discouraged the students from memorizing by doing practical work in the class room.

Substantive conversation

1. I think the teacher should be facilitator between students and teacher there should be friendly relationship.
2. In my opinion substantive conversation helps in developing interest and removing the barriers of hesitation.
3. I encourage the student to share their understanding in the class by drill exercises.

Problematic Knowledge and Curriculum

1. I think, the knowledge as problem work develop critical and logical thinking.
2. I give daily routine type examples for solution of exercises.

Thematic Analysis (Interview) of Teacher-B

For presenting Teacher-B interview it is divided into five elements comprising of elements of quality related to intellectual quality that are logical thinking, in-depth knowledge, conceptual understanding, substantive conversation and problematic knowledge and curriculum.

Teacher-B said that for developing ability among students to build their own ideas logical thinking is created in the students critical and logical thinking are developed through their class assignment related to the topic of Teacher-B thinks daily life examples are necessary for student to draw realization Teacher-B says that he develops present the new knowledge after interconnecting with previous knowledge. Speaking about the importance of central ideas he says it is impotent to motive the student to achieve their goals. Regarding the conceptual understanding he says, “he design his lesson by presenting related models. He clears the concepts of the students with the help of practical examples. He discovers memorization of the knowledge by assigning practical work in the classroom.

Discussing the element of substantive conversation he says, “The teacher should be a facilitator for students whereas there should be friendly relationship between students and teacher. He says, “In teaching learning process substantive conversation develops interest and remove the behavour of hesitation” he thinks that problems work develops critical and logical thinking. He usually gives daily routines type examples as exercise for solution to students.

Interview of Teacher-C (Aqeel Ahmed)

Logical Thinking

1. There are many ways to build ideas among the students. I try to take some task and give some assignments.
2. By putting some question to students. I improve their logical thinking.
3. For realization I usually use to take their thinking and on the basis of these I take their questions.

In-depth Knowledge

1. By taking their questions about the new topic, then started on the explanation on these questions. I gave the students deep insight.
2. Central idea of the lesson is the main thing it is the most important I give much emphasis on the central idea. If the central idea is clear then it is easy to study and learn the whole lesson easily.

Conceptual Understanding

1. To understand the concepts of the lesson I designed my lesson with different diagrams and flow charts.
2. With diagrams and some time by practical work. I clear the students conceptual understanding.
3. By asking different questions I discourage the students to memorize the lesson.

Substantive Conversation

1. The relationship between the teacher and students and the between the student must be friendly. This relationship is developed in teacher by playing, different games with students.
2. It plays a key role in teaching and learning. The substantive conversation is very helpful in the learning.
3. by giving them chances to come on the board and I encourage the students deliver some ideas to their class fellows about the topic.

Problematic Knowledge and Curriculum

1. The knowledge as problem work in student learning is very helpful. If there is a problem there must be its solution.
2. I usually give them home tasks and take tests again and again.

Thematic Analysis (Interview) of Teacher-C

For presenting Teacher-C interview it is divided into five elements comprising of elements of quality related to intellectual quality that are logical thinking, in-depth knowledge, conceptual understanding, substantive conversation and problematic knowledge and curriculum.

Teacher–C said that developing the element of logical thinking he gave some tools and assignment to students he put big qustions for developing critical and logical thinking. For drawing realization, deep thinking was considered necessary. Stating about the elemnet of indepth knowledge he raised questions about the new topic and the explained these quesitons. About central ideas he said with its help the whole lesson became, easy. About the element of conceptual understanding he said that he designed his lesson with different diagrams and flow charts and sometimes through practical work. He asked differnetqustions to discourage the students from memorization. Regarding the element of substansive conversation, she developed friendly relationsihip with teachers and students by playing different games with students. This erelationship became helpful in teaching and learning. He gave students chance to come before the white board for delivering some ideas to their class fellows about the topic. Addresing the element of problematic knowledge and curriculum he thought that problem work was helpful in learning for searching the solution of the problem. He usually gave students home work task and tests again and again.

Interview Teacher-D (Shagufta Naseem)

Logical thinking

1. She said that she built ability among students by giving examples from daily life and experiences.
2. She developed critical and logical understanding in students by starting from previous knowledge and then coming to the new topic by relating both.
3. According to her, correct and deep knowledge of a topic is necessary to develop dawning realization.

In-depth knowledge

1. She presented new knowledge by coming from simple to complex to build deep insight in students.
2. According to her central idea of a lesson is very important.

Conceptual understanding

1. She designed her lesson by incorporating previous knowledge and examples from the surrounding so that the students can understand concepts.
2. She cleared the concepts of students by repeating the lesson.
3. She discouraged the students from memorizing the lesson by clearing their concepts.

Substantive conversation

1. According to her the teacher-student and student-student relationship should be cooperative and they should have mutual understanding.
2. She said that substantive conversation is the basic step for clearing the concepts of students.
3. She encouraged students to share their personal understanding in class by asking about their personal experiences.

Problematic knowledge and curriculum

1. According to her lack of knowledge becomes a problem for both teacher and student.
2. She gave exercises that forced the students to think critically.

Thematic Analysis (Interview) of Teacher-D

For presenting Teacher-D interview it is divided into five elements comprising of elements of quality related to intellectual quality that are logical thinking, in-depth knowledge, conceptual understanding, substantive conversation and problematic knowledge and curriculum.

Teacher-D said that for developing elements of logical thinking she built this ability among students by giving example of daily life experiences. She developed critical and lgical thinking in students by stating from previous knowledge and then to the new topic by relating both. According to her correct and deep knowledge of the topic was necessary to devleope the abiltiy of drawing realization. Stating about the element of in depth knowledge she said that she presented new knowledge by coming from simple to complex.According to her central idea of the lesson was very important. About the element of conceptual udnerstanding she said that she designed her lesson by incorporating problems knowledge and examples from the surroundings so that students could understand the concepts. She cleared the concepts of students by repeating the lesson. She discouragedthe students to memorize. Regarding the element of substansive conversation she developed understandable and cooperative reltionship between teacher and students substansive conservation provided a basic step to clear the concepts of the students. She encouraged students to share their personal understanding in the class by asking about their personal experiences. Addressing the element of problematic knowledge and curriulum shethought that lack of knowledge became a problem both for student and teachers. She gave exercises that focused the students to think critically.

Conclusions

Teacher-D had the highest degree in the subject of Biology which was M.Sc. and M.Phil respectively. Teachers B,C and E had professional qualification of M.Ed., B.Ed., B.Ed and M.Ed. respectively while teacher A had not any professional qualification. Teachers B,C&D had taken many training and workshops while teacher A had not attended any training and workshops session. Teachers A,B,C&D had teaching experiences of 8,12,28 and 07 years. Government teachers were professionally well qualified, trained and expressed as compared to private sector teachers.

Concerning to intellectual quality teachers A developed the element of physical thinkingby giving examples during lecture and discussion after the lectures, teachers-B,C by

giving assignments related to the topic and teacher D by giving examples from daily life and experiences with the help of previous knowledge.

Teacher-A considered the learning competency for drawing realization as deep search for knowledge, teachers B. daily life examples, Teacher-C through questionnaires, Teacher D through correct and deep knowledge of the topic. Teachers A developed in depth knowledge through presentation of new knowledge with help of real life examples, teachers B through intercoonnection of previous knowledge. Teacher B taking students qustions about the new topic to explain, teacher-D coming from simple to complex about the improtance of central idea of the lesson while teachers A,D consiered it very important, Teachers B used it to motivate the students to to retain their goal. Teacher C considered it to make easy to study and learn. About the element of conceptual understanding Teachers A desinged their lessons by giving information about history or background of lesson. Teachers B,C designed it by presenting related materials diagrams and flow charts while Teacher D presented it by incorporating previous knowledge and examples from the surrounding. Teachers A cleared the concept of student by it explainingclearly, Teachers B through practical examples. Teacher-C cleared the concept with diagrams and sometimes by practical work while teacerhs D by repeating the lesson as regard to discouraging the students to memorize the lesson Teachers A did not dicourage, Teachers B by assigning practical work in the class and teacher D by clearing their concepts.

In context of elements of 'substansive conversation' opining about necssary student-teacher relationship for teaching. Teachers A gave importance to respectful relation, Teachers B,C said teacher should be facilitator and the relationship should be frientlywhile teacher C said that teacher should develop friendly relationship by palying different games with students. Teachers A, B encouraged the students to share their understanding with the class by developing confidence to talk in front of whole class, teacher C by givingthem chances to come on the board for delivering ideas to their class fellows about the topic while teacher D by encouraging students to share their practical understanding in the class about their personal experience. Ansering about the element of problematic knowledge and curriculum. Teachers A&D thought knowledge as a problem work in student learning helped to solve multiples problems to Teachers B it developed critical and logical thinking teacher C considered it helpful to solve the problems type, teacher D considered lack of knowledge to solve the problem of daily life routine, teachers A,B gaveexercises relevent to the topic while teachers C&D gave exercises for solution about next day test.

As far as the aspect of supportive classroom environment was concerned Teachers A opined that there should be good connection between teacher and studnets. Teacher B opined that teacher should support the students as guider, motivator, controller etc.Teacher C expressed the teacher should provide all types of support to studnets while teacher D held that teacher support should play key role for studnets learning. Teachers A&D said that teacher might help the students to learn daily discussion of the previous topic and the class should be active to assess what other students had learnt their losses.

Teachers B opine that teacher can help the students in learning by encouraging and engaging them in their studies while teacher-C says that teacher can help by all means. Teacher-D expresses that teacher can help the student in learning through moral support and encouragement. Teachers A expressed that they encouraged the students to participate in learning by giving them interesting activities, teachers B by engaging them in their studies and Teacher D by giving challenging activities in the form of practical experiment to improve students outcome. Opining about working of student activities in learning

teachers A,B said that it developed interest in student, Teacher D said that these activities played very important role in learning.

The observation manual showed that there was fluctuation for using different elements from lecture to lecture and teacher to teacher.

Recommendations

On the basis of thematic analysis findings following recommendations are made for Biology teachers.

- Attend training and workshops arranged by teacher training institutes. For becoming professionally strong they may acquire the professional degrees like B.Ed. Bs.Ed, M.Ed. etc.
- Improve the learning of the students by presenting diagram with detailed explanation.
- Improve students' learning by using models or real plants if they are teaching about plants so that students can learn its use for practical life
- Conduct experiments, regularly related to the lesson taught. In this way student can be encouraged to improve their lesson. It is because Biology is a practical, activity based and applied subject.
- For improving the lesson teacher may incorporate daily life experiences of thestudents in the lesson for ensuring complete engagement of the students.
- Ensure the use of selected and most important elements of quality teaching and enhance students learning. For this purpose lesson planning can be helpful.

Implication for future Research

- The study was delimited to three schools four participants (biology teachers). It was a phenomenological study its conclusions cannot be generalized for larger population like other qualitative designs. This research may be further expanded to Intermediate level or college level that fulfils the criteria for phenomenological study in thescience as well as arts subjects.

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