

The Effect of Integrative Pedagogy on Academic Achievements of Chemistry Students

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Abstract

The study in hand aimed to determine the effects of integrative pedagogy over the academic performance of secondary school students in the subject of Chemistry. The study was conducted in an experimental framework following the Solomon Four Group Design. A total sample of 120 students of 10th class was randomly taken from 4 private sector Secondary Schools of Khyber Pakhtunkhwa, Pakistan. The sample was divided into 4 groups, each having 30 students. Giving a randomized treatment to the groups, two groups were taken as experimental while two were taken as controlled. One experimental and one controlled group were pre-tested for Chemistry subject performance through objective achievement tests, while others were not pre-tested. Both experimental groups were taught through integrative pedagogy while the controlled groups were taught through the traditional method for three months. After regular monthly post-testing, the triplicate data revealed an 11-point average increase in the academic performance of chemistry students in both the experimental groups in comparison to the controlled groups.

Keywords: Integrative Pedagogy, Achievements in Chemistry, Science Pedagogy, Integrative Learning in Chemistry, Correlates of Achievements in Chemistry

Introduction

According to the Oxford English Dictionary, Integration is the process of combination, amalgamation, mixing up or joining two or more things, concepts, events, or processes. It is the collection of ideas or activities. Klein, (2005) defines integrative approaches as the umbrella term whereby it connects theory with practice, knowledge with actions, arts with science, experiences with thoughts, and simplicity with advancement. He further states that the term integration was introduced in 1855 by Herbert Spencer in his book on Principles of Psychology. Later the same term was used by William James in 1896.

Li, (2012) defines pedagogy as the theory and practice of learning, whereby a teacher facilitates a learner in understanding the concepts. He also states that it is the science of teaching, whereby a prescribed methodology is followed by the teacher for imparting knowledge to the learner. The term Pede, technically refers to a child or Kid, whereby pedagogy in this context means the science of teaching kids.

Atwoo and Steed (2004) defined chemistry as the branch of science dealing with the study of matter, its composition, and properties. They further state that chemistry has been divided into some sub-branches including analytical chemistry, which specifically deals with qualitative and quantitative analysis of matter, environmental chemistry, dealing with the chemicals found in the environment and their interaction with environmental processing, organic chemistry, dealing with the study of the compounds of Carbon and Hydrogen along with their derivatives. Inorganic chemistry is a branch of chemistry that studies chemicals other than hydrocarbons and their derivatives. Similarly, physical chemistry is the branch of chemistry that deals with the study of matter, energy, and their mutual interactions. Some other sub-branches of chemistry are also there including biochemistry, fuel chemistry, soil chemistry, applied and industrial chemistry etc.

Students of chemistry normally fail or give lower academics on concept-based achievement tests if they are taught through traditional methods of teaching, whereby the teachers rely only on

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lectures and there is given no demonstration or practical applications. In contrast following integrative measures of chemistry teaching are important for concept making and better academic achievements. Studies on male and female students of chemistry in experimental framework gave a significant increase in concept-based tests (Bunce & Gabel, 2002)

The school students generally consider chemistry as a tough subject and the fact is hidden in its teaching. When chemistry is taught in a cooperative learning environment, the results are in general increased. A study of Bowen (2000) revealed an increase of percentile rank from 50th to 14th, when the cooperative learning approach was utilized.

Objectives of the Study

The study was designed to achieve the following objectives:

1. To determine the effect of integrative pedagogy over the academic achievements of chemistry students at the secondary level.
2. To compare the academic achievements of chemistry students taught through traditional and integrative methods at the secondary school level
3. To suggest measures for improving the academic achievements of secondary school students in science subjects.

Limitation and Delimitation

The study was limited to the effect of integrative pedagogy on secondary school students for their academic performance in the subject of chemistry only. The study was further delimited to the private secondary schools for boys at district Peshawar, Khyber Pakhtunkhwa.

Statement of Problem

It is generally believed that chemistry is a complicated subject and most of the concepts are vague for students at the secondary level. Most teachers follow the lecture method in teaching chemistry and besides, the practice is conducted as per the prescribed syllabus. The current study focused on the introduction of integrative pedagogy in teaching chemistry, whereby the following aspects were integrated:

- Theory and concepts with their application in daily life
- Team teaching and lecture-demonstration
- Seminars and questioning
- Problem-solving approaches and projects
- Assignments and allocation of knowledge resources
- Oral and written examinations every month

Review of Related Literature

Ciccorico (1970) introduced the concept of integrative learning by combining the role of schools with community engagement and proposed the idea of application of curriculum in social interactions, in terms of natural relations.

Wei, (2004) introduces the concept of integrative pedagogy in teaching English language, He conducted a study over students' achievements in the subject of English and developed a framework for teaching English following a combination of the Grammar Translation Method with Communicative Language Teaching Method. The results when compared with students being taught through a single approach were found with a big difference in performance.

While analyzing the engineering pedagogy in terms of students' outcomes and skills gained, Donna, (2012) found that merging Science, Technology, Engineering, and Mathematics with their field applications in pedagogy, the student's results are always satisfactory. The pedagogy of engineering should incorporate the integration of theory and practice anyway.

In his study on the paradigm of integrating theory and practice in teacher education, Korthagen (2010) claimed that there have been paid little attention to the integration of teachers' behavior with their cognition. An empirical research conducted over the given issue provided a satisfactory result over students' achievements.

Study of Dyck and Kleysen (2001) over the implication of integrative pedagogy revealed that there is a significant positive influence on managerial uplift. When students of management sciences were analyzed for understanding of managerial concepts through integrative pedagogy, the results found desirable.

Heikkinen et al. (2011) found that integrating the theoretical knowledge with practicum in teaching is beneficial for students understanding and high academic input. The study focused on the concepts of curricula with behavioral aspects of students in terms of their self-regulation and applied aspects of the subject knowledge, where the results were found with an increased output.

The integration of theoretical knowledge, practical or applied knowledge, self-regulatory knowledge, and Socio-cultural knowledge of teachers is feasible and can have positive outcomes (Tynjälä, et al., 2016).

Methodology

This experimental study was conducted in the framework of Solomon Four Group Design (Solomon, 1949), whereby the diagrammatic representation of the given study is given as follows:

E₁	O₁	X	O₂
C₁	O₃	-	O₄
C₂	-	-	O₅
E₂	-	X	O₆

Table 1. The Solomon four Group Experimental Design

The Design given in table 1. is clearly showing Two Experimental Groups (E₁ & E₂) and Two controlled Groups (C₁ & C₂). The Pre-test observations are marked for E₁ and C₁ only, represented as O₁ and O₃ while the Post-tests are given for all the Experimental and Controlled groups, represented as O₂, O₄, O₅, and O₆. X being the treatment of Experimental groups.

Population

The population of this study included all the male and female secondary school students at Private Schools of district Peshawar, Khyber Pakhtunkhwa, being enrolled in the session 2018-2019.

Sample and Sampling Technique

To achieve the objectives of the study, a total of 04 Private secondary schools of District Peshawar were randomly selected, following a convenient sampling technique. For this purpose, an informed consent form was sent to the principals of 9 Private Secondary schools, highlighting the objectives of the study and the ethical consideration to be followed. A positive response was received from 06 Schools, out of which the accessible 04 were selected as sample. Of each school, 30 students of Class 10th were taken randomly.

Data Generation Tools

The study was executed following two major tools of data collection:

Pre-test

One pre-test tool having 104 items was used for randomization, based on achievement test items in the subject of chemistry at grade 10th level.

Post-test

The post-tests were divided into 03 sub-tests based on achievement test items in the subject of chemistry at the 10th-grade level.

Piloting

Both the tests were initially pilot tested through some 10 students of Islamia Collegiate School Peshawar. The data of pilot-tested students was omitted in the actual study.

Validity and Reliability of Tools

The tools were checked thoroughly by experts of Chemistry subjects for item analyses, difficulty levels, and uniformity. For reliability of tools, Cronbach Alpha statistics were applied, receiving an average value of 0.89 for the Pre-test and 0.81 for the Post-test.

Treatment

The controlled groups were subjected to teaching Chemistry in routine, without intervention by the researcher, while the experimental groups were taught using integrative approaches in chemistry subject. Both the experimental groups were treated equally for three months by the trained teachers of chemistry for integrative learning. All the groups were subjected to post-tests on monthly basis for data collection.

Data and its Analyses

The pre-test and post-test data are given here in tabular form for both pre-test and post-tests. The data were analyzed through percentages and averages for deriving inferences.

Pre-Test

S.No	Observation	Group	% Score	Average Score %
1	O ₁	Experimental	70.3	73.9
2	O ₃	Controlled	77.5	

Table 2. Students Achievement Percent Average Score in Chemistry

The data in table 2. Is given for pre-testing of one experimental and on controlled group (E₁ and C₁) with observations O₁ and O₃ shows that the percent score of the Experimental group was 70.3 and that of the controlled group was 77.5. the average score of both the groups was 73.9 percent, collectively.

Post-Test

S.No	Group	Observation	1 st Monthly	2 nd Monthly	3 rd Monthly	Average %age	Grand Average	Difference
1	E ₁	O ₂	74	92	89	85.3	84.9	11
2	E ₂	O ₆	91	80	83	84.6		
3	C ₁	O ₄	67	79	82	76		
4	C ₂	O ₅	74	77	70	73.7	74.8	

Table 3. Post-Test Percent Average Score of Chemistry Students

Shown in table 3, the average score of experimental groups E₁, represented as O₂ was 85.3 percent and the average score of Experimental Group E₂ was 84.6 percent. Marked as O₆. Similarly, the controlled group C₁ showing its observed Score O₄ was 76 percent average and C₂ in observation O₅ showed an average percent score of 73.7.

The collective averages of percent scores of both the experimental groups was 84.9 (nearly 85) and the collective average percent score of both the controlled groups was 74.8. A total difference of 11 points was recorded between the experimental and controlled groups average percent score.

Discussion

Based on the data collected and analyzed for the effect of integrative pedagogy on the achievements of chemistry students, it was found that there does exist a difference between the conceptual understanding of students being taught via traditional methods of teaching (using lecture method or demonstration) as compared to students which are subjected to integrative approaches of learning in the subject of chemistry. The same was proved true by the research findings of Bowen (2000) and Bunce and Gabel (2002).

Similarly, an increase in the average score of students was recorded by Tynjälä, et al. (2016).

Suggestions and Recommendations

The study found a significant increase in the average percentage score of students of secondary level for the subject of chemistry, it is therefore recommended that:

1. Secondary level students may be subjected to the inclusion of integrative approaches in teaching their subjects, specifically science.
2. The teachers may be provided proper trainings for implementing the integrative approaches in their teaching at the secondary level.
3. The administrative authorities may highlight the integrative pedagogical approaches in curriculum framing and implantation for its effective outcomes.
4. Schools heads may provide means of integrative learning for teachers and students along with the traditional approaches of teaching-learning processes in their respective schools, along with checks and balances for improvement.

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