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Elevating Chemistry Education: An Experimental investigation on the Impact of Activity-Based Teaching on Secondary Students Learning Outcomes

Riazuddin Ahmad[a*], Sumaira Kanwal[b], Safdar Hussain[c], Sabira Bibi[d]

[a]Elementary & Secondary Education Department Khyber Pakhtunkhwa. [b]M.Phil Scholar, Allama Iqbal Open University Islamabad. [c,d]University of Chitral.

[*]**Email:** riazchem02@gmail.com

***Abstract*:** Students face difficulty in understanding the concepts of chemistry at secondary level and in modern classroom setting teacher's also face it difficult to achieve the students learning outcomes mentioned in the national curriculum. This experimental study aimed at finding out the effectiveness of activity based teaching in the achievement of students learning outcomes in the subject of chemistry at secondary level. Control and experimental group were separated on the basis of mixed abilities and the targeted students learning outcomes were taught to experimental group through activity based teaching method while the control group was taught through traditional teaching method. A well-structured and validated test was designed on targeted students learning outcomes and was administered on both the groups. Data was analyzed using mean, slandered deviation and t-test. The analyzed data shows that activity based teaching method is more effective than traditional teaching methods in achieving the students learning outcomes in the subject of chemistry at secondary level.

Key words: Activity based teaching, Traditional teaching methods, Students learning outcomes

1. Introduction

Teaching is a dynamic, well-structured and methodical presentation of information, concepts, skills and procedures to students with the goal of maximizing learning opportunities. The fundamental criterion for a successful teaching /learning process is the selection of the best instructional tactics (Hussain, Anwer, & Majoka, 2011). Teaching method are means that reflect the success of the learning process and ability of teachers. Learning is more effective when it is more sensitive to the needs of the learners, so there a need to combine a different skill to convey knowledge and ideas (Vinko &Delaney, 2020). Teaching and learning are inseparable in education, which aims to equip students with essential knowledge and skills for employment and societal contribution. Teachers play a crucial role in delivering accurate information and setting standards. They need to be knowledgeable and convey their subjects creatively and neutrally, fostering positive ideas and critical thinking in students (Anwer, 2019). Teaching of science at secondary level produces rationale thinking, attitudes and skills in the students, which brings about financial success in the humanity as these thinking, attitudes and skills are transformed into action in the field of medicine, agriculture, livestock, forestry, wildlife and different industries. Science education at secondary level is, therefore, the early step towards the development of a country (Ahmad, 2021).

Effective Utilization of skills, practical knowledge and competencies are the criteria which determine nation's slandered in present era (Ozturk, 2001). Statistics shows there is a direct relation between education and economic

growth in developing countries (Rehman 2013). Improved quantity and quality of education with the provision of standard facilities is the motto of Government. Literacy rate has been increased 10% in last two decades (Abbas & Foreman, 2008). In Pakistan the education system is shifting from the focus of In put to focus on Out put (outcome based education). Globally it has been accepted that students learning outcome based education has developed the concept of practical knowledge and applied skills with theoretical knowledge (Asim, 2021).

The majority of students in traditional classroom have poor learning ability. They are only allowed to copy what's written on the board and are incapable of doing anything else through thought, examination and inquiry. As a result of this limited intellectual capabilities learner loose interest in learning. Activity-based teaching (ABT) is a method used by teacher to emphasize the importance of involving students in activities. Activity -based teaching is a way used by a teacher to stress his or her teaching methodology through activities, in which the students are fully engaged and learn well. It is the process by which the child is successfully incorporated in rational and physical interest (Noreen & Rana , 2019). This study is focused on the effect of activity based teaching on the students learning outcomes in the subject of chemistry at secondary level in northern part of Pakistan

1.1 Objectives

The main objective of the study was:

To evaluate the effect of activity based teaching over traditional method of teaching in achievement of students learning outcomes (SLOs) in the subject of chemistry at secondary level.

2. Literature Review

Learning outcomes for students are defined as written statements describing the achievements a successful student is expected to reach by the conclusion of a program module, course unit, or qualification (Adams, 2004). Student learning outcomes are statements indicating the expected knowledge, understanding, and/or skills that a learner should demonstrate upon completing a learning process (Mahajan, 2017). Students learning outcomes represent the benchmarks for achievement within an educational course or program. They provide a precise understanding of what participants can expect to gain by enrolling in a specific program, be it a short course or a degree program. It is essential to establish and document these outcomes prior to the course commencement to ensure thorough planning and assessment alignment. By clearly defining students' learning outcomes, educators can effectively design the teaching approach, learning activities, and assessment criteria necessary for the successful delivery and completion of the course or program (Brooks & Dobbins, 2017).

According to Darari & Firdaus (2020) activity based learning is an environment in which learners actively participates in learning process rather than just passively listening. Active learning method is differed from traditional method in that:

(a) The active role and participation of students in the classroom.

(b) The cooperation of students in the learning environment.

These foundational components form the heart of ABL, designed to foster a supportive classroom atmosphere. ABL serves as the bedrock for cultivating both creative and critical thinking abilities. It provides a rich educational setting where students can actively generate ideas through interactive engagement, potentially involving hands-on manipulation of materials, gamified learning, or direct experimentation with physical objects (Noreen and Rana 2019). There are many ways that teachers can implement within the class to make sure that students gain the targeted skills and knowledge which predicted to organize person for real world. One among the simplest sort of these ways is activity-based learning.(Albadi & David, 2019). A study by Alabi (2014) found that activity-based learning strategies are more effective in improving students' achievements in chemistry than traditional learning strategies. However, research has shown that activity-based learning strategies can be used to encourage the learning of individual basic science concepts regardless of gender. Khan, Muhammad , Ahmed, Saeed, & Khan, (2012) concluded that there is positive impact of activity-based learning on the cognitive development of students in the secondary classes. Activity based teaching methods are more effective in developing higher order thinking in students than lower order thinking.(Mishra & Yadav, 2013)concluded that the activity approach causes students more interest and attitude to the material being studied compared to the traditional method of teaching. Activity based teaching technique is very useful in improving thinking skills of students and reducing or preventing the misunderstanding of ideas that can occur when teacher always use to teach by traditional methods. The finding of the study shows that students enjoy learning with hand-on, mind-on learning strategies. It also shows that more challenging roles help

develop thinking skills (Valdez & Lomoljo, 2015).

Chemistry teachers use a variety of teaching methods and techniques while teaching chemistry that contribute to the study and understanding of various topics of chemistry. Recent trend towards students centered learning encourage teachers to use teaching methods and technique that are compatible with this approach. Students are actively involved in learning and the role of teacher primarily to facilitate students centered teaching. There are many teaching methods and techniques including lectures, question and answer session and role plays. One of these teaching methods is educational games like card activity. The finding of the study shows that by using such activity-based teaching methods the student can easily and deeply understand various topics of chemistry, The study of complex formulas of compounds and symbols of elements by students in depth and continuous, and card activities contribute positively to increasing students' positive attitude, interest in the topic and improve students' interaction (Duvarci, 2010).

2.1 Hypothesis

H_{01}: There is no significance difference between traditional method of teaching and activity based teaching in the achievement of students learning outcomes (SLOs) in the subject of chemistry at secondary level.

3. Research Methodology

3.1 Experimental Study

Teachers teaching chemistry face challenges regarding active participation of learners. During the teaching of chemistry it is of high importance to keep in mind chemistry as body of knowledge, a way of investigation and a way of thinking, without which the expected learning outcomes of the learners can't be achieved. As per literature demonstration, assignment, projects, activities and other methods should be stressed to involve learners, so that all the three components can be achieved. The researcher tried being a chemistry teacher adopt activity based teaching method and investigate its effectiveness in the subject of chemistry under classroom environment.

3.2 Research Design

The study follows experimental design in which the sampled students were divided into two groups' i.e experimental group and control group. With experimental group activity based teaching method was used during teaching period of selected students learning outcomes while the control group was taught the same students learning outcomes through traditional method. A well structured test was developed on the taught students learning outcomes, which was validated by the subject experts and their opinion and suggestions were incorporated. The test was administered on both the groups and the results were analyzed.

3.3 Sampling and Sample Size

For the experimentation a boy's secondary school was selected by the permission of higher authorities. In the sampled school there was two sections of grade 9^{th} which were mixed to make a homogeneous class and the divided into two section to make experimental and control group. The experimental group was named as EA and control group was named as EB. The number of students in each group was 25.

3.4 Experimentation

The experimentation was start with the targeted students learning outcomes at the time when the course actually reached on the same students learning outcomes to ensure that the students have enough background knowledge on the targeted students learning outcomes. Activities were designed for the EA group and they were taught through activity based method while the EB group was taught through traditional methods. Formative assessment was done with the both groups during teaching process. The selected students learning outcomes were completed in 13 days with the same group. After completing the task the developed test was administered. Same test was administered on the experimental and control group. The test comprised of ten multiple choice questions and five short questions. The short questions were marked on the basis of developed rubrics. The scores of both experimental and control group were collected and tabulated for statistical analysis.

3.5 Data Analysis

The collected data of both experimental group and control was analyzed by calculating the mean, SD and applying t-test.

4. Results

The following table shows the results of collected data:

Group	Number of students	Mean	Slandered Deviation	T-test Score	p- value
Experimental group	25	21.3	1.97	5.20	0.0001
Control Group	25	18.3	2.1		

The table shows that the mean score of students in experimental group is high than the mean score of control group which signifies the effectiveness of activity based teaching method over traditional teaching method.

4.1 T- Test

T- Test was applied to analyze the following null hypothesis:

H_{01}: There is no significance difference between traditional method of teaching and activity based teaching in the achievement of students learning outcomes (SLOs) in the subject of chemistry at secondary level.

The p-value as per statistical analysis is 0.0001 which is considered to be statistically significant and the observed value of t-score is 5.20 which is higher, therefore the stated null hypothesis is rejected. Hence, there is a statistically significant difference between activity based teaching method and traditional teaching method in achievement of students learning outcomes in the subject of chemistry at secondary level.

4.2 Discussion

The study's results indicate that an activity-based teaching method enhances student's learning in chemistry more effectively than the traditional teaching methods. Evidence from the study shows that this method can improve student achievement. Given the importance of achievement of students learning outcomes, chemistry teachers are encouraged to adopt activity-based teaching to boost their performance. Students taught using this method achieved higher scores compared to those taught through traditional lectures. Therefore, implementing this method in secondary schools could likely improve performance in chemistry. The features of the activity-based method suggest it can be readily integrated into the current school system. However, it should be noted that developing the necessary materials requires significant time, and creating learning objectives, formative tests, and corrective activities places a substantial burden on teachers.

5. Conclusion

Based on the finding of current study we can conclude that activity based teaching at secondary level in the subject of chemistry can enhance the achievement of students learning outcomes as compared to traditional methods of teachings because in activity based setting students can actively generate ideas through interactive engagement and activity based teaching strategies and more effective in improving students achievements in chemistry than traditional learning strategies.

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