



AN ANALYSIS OF IMPACT OF EXPERIENTIAL LEARNING IN CHEMISTRY ON THE ACADEMIC PERFORMANCE OF SENIOR SECONDARY SCHOOL STUDENTS

Prashant Thote and Gowri S.
Gyanodaya Vidya Mandir.

ABSTRACT

The objective of the present study is to build activity based 5Model for electrochemistry and to investigate effect of 5E constructive approach on students' performance. The quasi-experiment design was employed to personal study. Total 55 students from Senior Secondary School participated in the study. The research question and one hypothesis are formulated to guide the study. The Chemistry Achievement Test (CAT) tool is used to collect data. A reliability coefficient of equivalence 0.88 and coefficient stability 0.84 is obtained by using Pearson Product Moment Correlation. Result of the study reveals that student taught by using 5E Model of electrochemistry has higher mean score as compared to students exposed to traditional chalk and talk method. Hence it is recommended that teacher should construct instructional model in teaching Chemistry. Students should also be involved in active process of learning such as minds-on, hands-on and discoveries so that students can discover and generate knowledge themselves and will become independent problem solvers.

KEYWORDS: Chemistry, Model, Effectiveness, Students and Understanding .

INTRODUCTION

The 21st century is the century of knowledge based economy. Education will be focusing on the think, work, live and master tool to work. Education must nurture among students problem solving, think creatively and meta-cognition. The science literacy is important in our modern society. Science literacy is the ability to understand the social and natural phenomena around us. It develops the ability to make best decision scientifically, so that we may live more productively, healthier, better and comfortable. The science literacy is necessary for everyone because the progress of a nation's retreat is determined by the quality of human power that has literacy in science.

The learning cycle 5E model is student centered model. It consists of stages of activities organized to master the concept in joyful way. The engage, explore, explain, elaborate and evaluate. The advantages of learning cycle 5E models are to motivate students to be more effective and enhance curiosity and experiential learning activity learning. It also provides an opportunity to think, search, explain and find the application of conceptual understanding. The learning cycle 5E model will foster scientific literacy. The

knowing scientific questions - may be improved at the elicit and the engage stage; identification of evidences needed in scientific investigation- may be improved in explore, draw, evaluate, conclusion and communication. The assessment of accuracy of answer may foster evaluation stage and conceptual understanding of scientific connection is elaborated and extended sate.

The 5E learning cycle model is effective in science. It fosters students learning outcome and science process skills. It actively involves students in learning process, gave a positive impression and



reduces misconception. Experiential learning activity of 5E learning cycle involves students in active learning process by assimilation, organization and accommodation of the cognitive structure. The clear conceptual understanding will increase the knowledge, skill and attitude of students.

The experiential learning 5E learning cycle mode emphasize on control, production and expansion of knowledge. The present model emphasize greatly on the importance of elucidation of understanding, perception of students and the development and transfer of concepts, foster growth and thinking.

REVIEW OF LITERATURE:

Carallo and Labich (2001) states that the cyclic learning model is an approach that is consistent with nature of exploring and analytical teaching. In learning cycle model students simply actively participate that excited them. In order of active participation in learning, they continue to gain experience.

L.Mathew (2009) the discovery of learning approach in leading structuralization theories such as Piaget, Bandura and Vygotsky emphasis that students must creatively involve in constructive building of knowledge.

Akkar (2005) the cycle 5E model based activities arises students' attention, interest, curiosity and eagerness for the assignments.

Balbal (2010) cyclic 5E model consist of steps such as engaging, understanding, explore, explain, extent, generalized and evaluate.

In this study experiential learning cycle - 5E model was incorporated in different conceptual change in methods such as hands on activities, animation and conceptual change texts.

Animation:

It provides various opportunities in class-room educating environment as described by many pictures and figures in scenario. The uses of animation preferred by teachers are:

1. To make phenomena concrete.
2. To make abstract concepts.
3. Foster individual learning.
4. To foster active students participation in learning process.

Conceptual change text:

The conceptual teaching methodology is used to assist students to eliminate misconception, alternate concepts and enhances conceptual understanding. It is economic, time efficient and easy application. Work-sheets are used dominantly. It is class-task organizer. It may foster positive attitude towards chemistry curriculum. Hence work-sheet in the present study is used as time –efficient and as task organizer.

The objective of the present study is developed on experiential learning activity based on 5E learning cycle with application of computer animation, work-sheet, hands on activity and conceptual change text for eliminations, misconceptions and alternative concepts of “electrochemistry cell” among senior secondary school students.

Method:

The present study is to develop experiential learning activities based on 5E learning cycle. It is basically laboratory activities. The activity focused misconceptions are:

1. Placement and positive or negative charge of Anode and Cathode.
2. The direction of flow of electrons.
3. The direction of ions flow on the salt bridge.
4. Writing cell reactions.
5. Anode and cathode electrodes masses.

The science processing skills based activity plan to eradicate and eliminate alternative concepts and misconception. A draft of experiential activity based on 5E learning cycle with computer animation, work sheet, conceptual change text and hands on activity was prepared to eliminate alternative concepts, misconception and improving science process skills. The expert advice was taken to improve effectiveness and efficiency of activities. The pilot study was conducted to investigate the impact of experiential learning activities. Researcher participated in interviewing and observing how students reacted. Worksheet was examined.

Pilot Study:

The study was conducted on 24 students of grade 12 in the academic year 2018-2019. Seven groups were formed. The worksheet based on experiential learning based 5E learning cycle with different conceptual change methods were handed over to each student. The pilot study took 120 minutes.

Learning design:

The experiential learning activities based on 5E learning cycle presents how to embed this conceptual change mentioned within 5E learning cycle in worksheets.

Engagement (10 Minutes)

Teacher asked the students question in the initial stage of worksheet to increase students' awareness of electrochemistry cell concept and activates students' ideas (pre-existing) and attending towards concepts. Teachers instructed learners to design an experiment, find variables, frame the hypothesis on electrochemical cell. The students are asked to write their answers in the worksheet provided. Teacher endows with perfect learning class-room discussion and do not provide any clue to the related question or answer about these questions. It is presented in the engagement phase of worksheet.

Fig: 1 Worksheet part:

I am Lulqi Galvani. 1791- After observing a dead frog's legs contracted when nerves in the frog's legs was cut with Scalpel. I observed the organizational principle of cell.

Questions:

1. What is your opinion about the relation between Galvanic cell and dead frog leg?
2. How the cells in mobile phones, laptops, remote controls produced required energy to operate them?

Students, you will find answer after completion of the following activities. You are requested, to take direction into consideration. Please answer the following questions.

Design experiential learning: Experiment about the chemical energy to electrical energy using the following material.

Material: conducting wire, beaker, cables (with alligator clips), glass cotton, u-tube, CU – metal electrode, Zn-metal electrode, voltmeter, 0.5m Copper Nitrate $Cu(NO_3)_2$, 0.5 m Zinc Sulphate ($ZnSO_4$), saturated kcl solution.

You are requested to fill the following spaces based on your design experiment:
Write experiment hypothesis
Hypothesis
Variables of Experiment
Dependent Variables
Independent Variables
Controlled Variables

Stage 2: Exploration (30 Minutes)

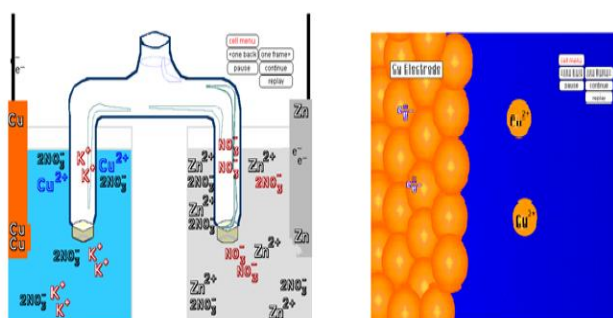
The teachers provide students an opportunity to work in group and to communicate with each other to design experiential learning laboratory based experiment. Teacher enables the experimental set up to be set. The students stage the potential difference value in galvanic cell, set up and observation.

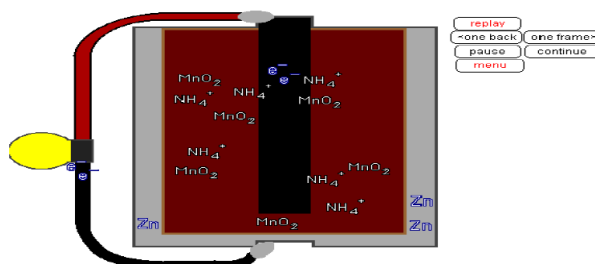
The students are asked to fill the gap in the worksheet. The students are also asked to explain: why the values were read differently?, What are the essential condition for setup of galvanic cell? The exploration stage gives an opportunity to learn science processing skills such as observation, measuring, data recording, classification, graphing, data analysis, data interpretation, conclusion, inference and experimenting.

Explanation :(40 Minutes)

The conceptual change text is handed over to students, students read the conceptual change text, discuss misconception, alternative concepts and change them with correct once. Teacher explains the scientific concepts related to electrochemical cell like anode, cathode, salt bridge function, conversion from chemical energy into electrical energy, electro motive force(EMF), cell potential, galvanic cell. The both animation and conceptual change text can be used to explain how the electrical energy was generated from chemical energy.

Fig-2: Sample of animation



Sample screen of animation:**Elaboration: (20 Minutes)**

In this stage three questions are asked to the students and the answers are received. The students are asked to watch computer animation, to know the working principle of dry cell commonly used in daily life. When dentist is filling tooth, galvanic cell is formed in patient mouth. Gold and silver are used as cement by dentist. The probes or steel forceps make up of battery cells when interacted with cement. The metal probe acts as an electrode and electrode is cement. The secretions of saliva are a medium of solution. The pain caused due to generation of electric is small quantity. The explanation given in this stage provide basis to students to answer the question in engagement /entry/ first step, in addition to this, it emphasizes on what and how the concepts mentioned in the laboratory or school appeared in daily life.

Evaluation: (20 Minutes)

The last part of worksheet contains questions based on how to transfer newly constructed knowledge. Branched diagnostic tree is used for conceptual understanding of electrochemical cell. Teachers assess the conceptual understanding of students' abilities and extended knowledge.

Sample Questions:

1. What is overall reaction?
2. What is half-cell reaction occur at anode and cathode electrode?
3. Draw the battery scheme and so torch.

Objective of the study:

1. The objective of the study is to compare the relative effectiveness of 5E learning cycle on Student's achievement in electrochemistry in senior secondary school.
2. To study is there are any difference in academic achievement of students taught by using traditional lecture methods and 5E learning cycle.

Research question:

What is the difference in academic performance of students who are taught electrochemistry by 5E learning cycle and who are taught by traditional chalk and talk method?

Hypothesis:

Ho1: There is no significant difference between mean score of students taught electrochemistry by using 5E learning cycle method and students taught by traditional chalk and talk method.

Method:

Research design : Learning cycle 5E based on experiential learning was adopted for the present study. In present paper purposive sample technique is used. pre-test, post-test controlled designed is used as independent variable and students achievement as dependent variable.

Sample:

Purposive sample technique is used. Total 80 students participated in the study. The 40 students are in Experimental group and 40 are in Control group.

Tool:

The Chemistry Achievement Test (CAT) is developed by the researcher, consisting 40 multiple choice questions. The tool is standardized objective questions adopted from past paper of All India Senior Secondary Certificate Examination. The tool is subjected to analysis of items analytical, differences index, discrimination index, effectiveness of distractors to verify psychometric feature of each item. A reliability coefficient is 0.88 and stability coefficient is 0.84 using person product moment method of construction.

Treatment:

The electrochemistry unit is selected for the study due to the abstract concept. Experimental group taught by using experiential learning based 5E learning cycle and in traditional chalk and talk methods.

Table 1: T- test mean comparison of Chemistry Achievement Test of experimental group and control group

Group	N	Mean	SD	df	t cal	t	p-value	Decision
Control	40	28.28	9.84	78	1.51	1.95	0.1229	Accepted
Experimental	40	24.59	9.91					

Table 2: Mean score of students taught electrochemistry:

Group	N	Pre-test (m)	Post- test (m ₁)	Mean Difference
Control	40	28.33	56.00	27.62
Experimental	40	24.59	67.39	42.30
Diff		4.21	11.39	15.12

Table 3: t-test mean score of students taught electrochemistry:

Groups	N	Mean	SD	DF	t-cal	t-cor	Decision
Control	40	56	9.3	78	-3.82	2.001	Rejected
Experimental	40	67.39	12.4				

RESULT:

The analysis of data of hypothesis and research question is shown in Table-1. In pre-test data analysis of experimental group and control group, result shown in table-1 reveals that there is no significant difference between per-test mean score of experimental group and control group. It shows that both groups are equivalence.

Research questions are different in Chemistry Achievement Test of students who are taught electrochemistry by using experiential learning based 5E learning cycle and traditional chalk and talk method.

Result shown in table -2 shows that there is a significant improvement in the academic achievement of experimental group students. The mean score of experimental group is 24.59 (pre-test) and 67.39 (post-test) with mean difference 42.30. The mean score of control group is 28.33 (pre-test) and 56.00 (post-test) with difference 27.67. It reveals that experimental group has higher mean difference (42.30) compared to control group (27.67). Table-2 shows that mean difference of 15.12 is in favour of experimental group.

Hypothesis:

There is no significant difference between mean score of students taught electrochemistry by using experiential learning based 5E learning cycle approach and traditional chalk and talk method.

Result in Table 3 shows that the t-value (3.82) is greater than critical value (2.00) and $P < 0.05$. Hence null hypothesis is rejected. It shows that there is a significant difference between mean of experiential and control group.

Discussion:

Result of the study reveals that experiential based 5E learning cycle constructive approach perform better than traditional chalk and talk method. To test hypothesis result shows that the difference in Chemistry Achievement Test (CAT) of students are significant at 0.05 level of significance. The students of experimental group perform better than 5E learning cycle because teacher took time to elicit the students' previous knowledge to ascertain their conceptual understanding. This tool fosters the conceptual understanding in experimental group. In experimental group students actively participate in new concept in such activities that foster motivation, interest, curiosity and attention towards the concept. On the other hand students were mere passive learners and do not participate in any hands-on activity.

Result of the present study is in line with Madu (2004) Onwidowki (2001) and Kjunu (2014). In the experiential based 5E learning cycle approach is hinged in democratic class-room situation, where students actively participate in learning and teachers are not dispensers of knowledge, they are facilitator, guide, friend and philosopher. Teacher creates positive environment in class-rooms. Students' active role in hands on activities opposes teacher didactic approach.

Educational Implications:

1. As the result of the study reveals that experiential learning based on 5E learning cycle is effective over traditional teaching approach. Hence teacher must learn and acquire skills to apply this model in classroom.
2. Students must have access and approach to resource such as books, libraries, equipments, apparatus; students actively construct knowledge, reflect on and think critically. The students' active participation on minds-on, hands-on and discovery. This approach is child-centered. Students gain knowledge, acquire skills, find solutions, create, produce themselves.
3. School should provide adequate infrastructure, material for laboratory so that learners may integrate with equipment, apparatus, and ability to explore and construct knowledge of their own.

CONCLUSION:

Experimental learning based 5E learning model amalgamation with different conceptual change methods is illustrated here. The laboratory based activity is effective to improve students' motivation and analysis active participation in learning process. The improvement is seen in conceptual understanding and science processing skills.

REFERENCES:

1. PrashantThote, The Effect of the availability and Utilization of Laboratory Apparatus in the Teaching Chemistry to Senior Secondary School Students, Central India Science Park.
2. PrashantThote, An Investigation of availability and Utilizations of Resources in Chemistry Laboratory on Academic Achievement of Senior Secondary School Student, Indian stream Research Journal.
3. PrashantThote, A study of performance of senior secondary school students in Practical Chemistry: Gender Analysis Indian Stream Research Journal.
4. PrashantThote, A Study of factors affecting attitude of students towards Chemistry Practical's, Journal of Research Extension and Development.

5. Prashant Thote The conceptual of Hindrance Rotation in Conformational Analysis in organic Chemistry, International Journal for Research and Development.