Impact of Experiential Learning Programme on Student's Science Self-efficacy

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Abstract

The rationale of this research was to explore the effect of experiential learning programme and traditional teaching on self-efficacy in the subject of science. The sample consisted of 90 students from Class IX. The sample selection was done on the basis of academic scores obtained by students in the subject of science in Class VIII. The study was experimental in nature. Students were randomly and equally segregated into experimental and control group respectively. Self constructed Science Self-efficacy Scale was executed before and after the experiment. Reliability of the Science Self-efficacy Scale was measured by Cronbach Alpha and split half method which was found to be 0.86 and 0.76 respectively. The control group was taught by traditional teaching and experimental group was taught by experiential learning programme. The experiential learning programme was developed on the basis of four step stages of Kolb's model. The intervention programme was performed for sixty days. The obtained data was analysed by employing't' test. The major findings of the study confirmed that experiential learning model is more effective for enhancing self-efficacy of students in the subject of science. The students were handling equipments and doing experiments by themselves. So, directly or indirectly it is helpful in enhancing the self-confidence of students. The research has its applications for in-service or pre-service teachers, parents, policy makers of curriculum framework and students of secondary schools.

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Introduction

Experiential learning helps us to know various ways of learning. It is a process of learning through which knowledge is enhanced, by learning various skills in real world, by hands on activities. The term "Experiential Learning" has been used by different theorists in different ways, like Dewey labels it by the name of "learning by doing" (Dewey and Dewey, 1915), whereas Wolfe and Byrne (1975) used "Experienced based learning" for it.

"Association to Advance Collegiate Schools of Business (AACSB) Task Force"(1975) considered the process of learning as "applied experiential learning", which includes learning from the existent world and its application in local interactive environment.

Experiential learning is a blend of skill, practice, observation, cognition and behaviour. In the mid-nineteenth century, there was a progression in experiential learning theory from formal and theoretical instructional methodology to experience or activity based information. In the early years of twentieth century, different out of school experiences were launched in class-room environment.

Montessori (1917) is the founding mother of experiential education. Montessori's method of learning involves two phases: in the first phase the child gets motivated to learn in a new learning environment, and in the second phase, the child works with the surrounding situations using available material daily, day after day, or at regular intervals (Smith and Knapp, 2011). In Montessori's, model teachers systematise the environment by making it more appropriate for children. The children learn in such appropriate conditions that encourage them towards self-creation and group learning. The free environment (Smith and Knapp, 2011) leads to overall development of a child's sensory and motor abilities.

Lewin (quoted by Kolb 1984) emphasised on action research and laboratory training. Learning is an integrated concept. It follows the sequence of concrete experiences, observation, reflection leading to abstract concept formation and generalisation. Thereafter, these concepts are tested in novel situations.

Dewey gave importance to the concept of "learning by doing" and co-operative learning. Dewey's theory (Miettinen, 2000) explains that diverse form of learning helps in changing the position and needs of concrete experiences into purposeful and focused actions. Dewey in his book (Experience and Education, 1938) explains that knowledge can be generated by performing the roles rather than by merely learning something. This leads to the restoration of learning experiences and individual learn practically.

Piaget (Kraft, 1990) worked on the developmental phases of cognitive growth and development and lay emphasis on active learning and concrete experiences. The theory suggested that children learn best from concrete experiences to develop new objective knowledge. There are four interrelated factors, namely maturity, skill of handling concrete objects and social relations with other children and equilibrium, which collectively help in organising the mental structure of an individual. Piaget outlined different stages of growth and development: starting from 0–2 years as sensor motor stage; 2 to 4 years as extorting concepts from experience; 4 to 7 years of instinctive idea; 7 to 11 years of concrete operational stage; and 11 to 15 years of abstract operational stage.

Rogers (1959) classified learning into two categories: cognitive and experiential learning. The cognitive part is focused with merely memorising the facts while the latter is basically applied knowledge that comes from doing their own. Rogers asserted that experiential learning is possible if common conditions like learners' own personal involvement in doing activity, their self initiated determined behaviour, self evaluation and learning spirit works.

Science Self-efficacy

Bandura (1977) proposed the idea of self-efficacy in his theory of Cognitive Behavioural Change. (Okcin and Gerceklioglu, 2013) which includes social learning and self-efficacy components collectively. It is one's own belief in capability of arranging and carrying out any task with the required action for a forthcoming situation.

School students need to recognise their own self-efficacy to get success in science subject. Therefore, science self-efficacy is students own beliefs regarding their level and making them proficient in performing specific assignments and finding solutions of specific problems related to science. Studies have revealed that students' level of science self-efficacy is affected by the plan or method they prefer to follow (Taasoobshirazi and Glynn 2009), their involvement in class-room during Science learning (Lau and Roeser 2002) and their achievement in Science (Chen and Pajares 2010; Merchant, Goetz, Keeney-Kennicutt, Kwok Cifuentes, and Davis, 2012; Zusho Pintrich and Coppola. 2003). A strong self-efficacy belief is linked with a healthy and victorious socially assimilated environment (Ozen, Ozen and Sonmez Tiryaki. 2014). Bandura (1994) asserts that there are four aspects which enhance the self-efficacy of learners: i) Mastery experience, related to previous experiences that helps the students to deal with new situations. The winning act of student enhances their self-efficacy beliefs, whereas their failed attempts diminish their self-efficacy beliefs, ii) Social modeling, a student's surveillance towards friends or classmates. Achievement of friends or classmates in any task increases their self-efficacy, while watching their failure decreases their self efficacy belief. Therefore, friends' or classmates' self efficacy belief also affects students' state of self-efficacy. iii) Social persuasion, when people are convinced and praised by others regarding their capabilities, it is helpful in attaining mastery and appreciation (Litt, 1988; Schunk, 1989). iv) Physiological and emotional response in a class environment, it affects self-efficacy of a child, if a child feels happy and comfortable in classroom environment, it leads to the enrichment of self-efficacy belief and vice-versa.

Experiential learning vs science Self-efficacy

Science self-efficacy is affected by experiences, assignments and circumstances that an individual receives throughout their life. If an individual is stressed and nervous, and doubts their skills, it may lead to development of negative self-efficacy. However, if the person is self-confident, it leads to joy, excitement and develops a positive self-efficacy. The studies of science self-efficacy implies students' belief in handling difficult science tasks, assignments, activities, solving any scientific problems, field visits and handling science projects (Bandura, 1997; Britner and Pajares, 2006). Besides it, different kinds of experience based activities contribute in raising the level of science self-efficacy among students.

There are some research studies which showed that first hand concrete experiences, laboratories or other activity oriented strategies are capable of cultivating self-efficacy in science subject. Margolis and McCabe (2006) recommended a variety of experiential or concrete experiences, having different practical approaches for teachers for their classrooms to promote self-efficacy of students. These activities include giving difficult and challenging tasks to the students, so that they can make fruitful efforts in finding the right solution to the problem. Teachers must teach in a precise and convenient way which may include assigning a complex task, breaking it into simple and sequential steps and also explaining the way to trace their progress in each given task. Educational material or teaching aids used during teaching-learning process is also helpful in confining the focus of the learner and also provide encouragement to teachers which contribute towards enhancing the level of self-efficacy. Various instructional approaches like, question and answers, application of electronic media, collaborative learning, and assignments related to conceptual problems were certainly interrelated with students' perceived resource of self-efficacy in Physics (Fencl and Scheel, 2005).

Hypothesised "Kolb's Model of Experiential Learning"

Experiential learning is an innovative way of learning, whereby, creating knowledge and transforming experiences (Kolb, 1984). Experiential learning theory defines "learning as a process and involves transaction between social knowledge and personal knowledge" (Kolb and Kolb, 2009).

Learning is a cyclic process which involves four stages (Kolb, 1984). Here, learners first go through the concrete personal experience; secondly, observe and reflect on that experience; thirdly, generate abstract concepts and generalisations and fourth, test these in new situations. Kolb's model of experiential learning is given in Figure 1.

efficacy. In experiential learning programme, independent concrete experiences with appropriate freedom are given to students. Co-operative learning, feedback and positive environment are also provided to students which thereby enhance their Science self-efficacy. The performance of students must be compared with their past experiences. Such kinds of timely evaluation and feedback affect

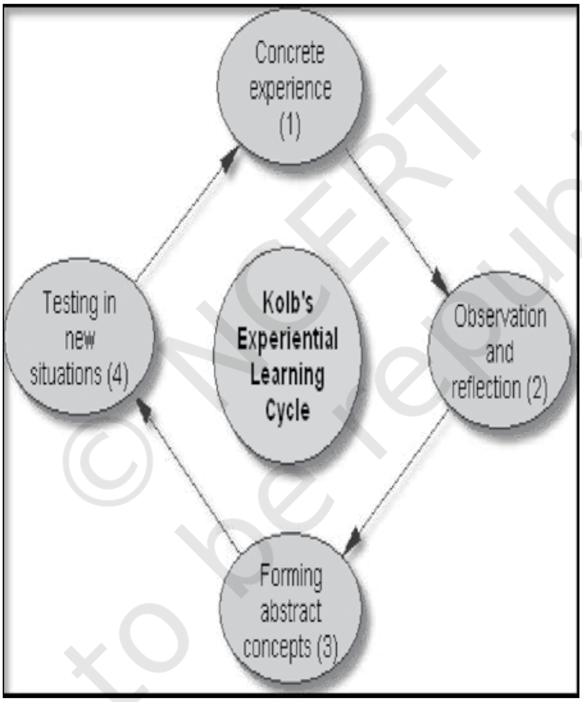

Figure: 1 Kolb's model of experiential learning

Rationale

The rationale of the study was to discover experience based instructional strategies that help students in developing Science self-the performance of the students (Schunk and Pajares, 2002), and that they are able to explore the environment freely and get results. The rationale of the study was to employ experiential learning model given by Kolb and identify its effect on students' science self efficacy.

Methodology

Sample

Ninety students of class IX, from senior secondary schools in Sonepat, Haryana, were selected for the study. Students were selected randomly and divided equally into experiment (N=45), and control group (N=45). Experimental group and Control group was taught with Kolb's model of experiential learning and conventional methods respectively.

Tools used

After reviewing literature, it was found that standardised tool was available only for measuring general self-efficacy of students but no such tool was available for measuring Science self-efficacy. Therefore, Science self-efficacy scale was developed for Class IX in the subject of science. Finally, five elements were selected in the scale. These elements were self-confidence, self-regulation, Science self-concept, perceived science-efficacy and outcome expectancy. It was prepared to assess the self-efficacy of 14–17 years students, particularly in Science subject. The scale included 55 items and the items were categorised into above given five elements. The literature review related to self-efficacy and Science self-efficacy was used for developing the scale. In the initial phase, items related to various elements of Science self-efficacy phase were framed. The opinions regarding Science self-efficacy scale were framed on five point Likert Scale. The scale was executed on three hundred students of ninth standard. After administrating the preliminary draft of scale, the process of item analysis and item discrimination was done and finally, 41 items were retained for the final scale.

The reliability of the scale was measured by Cronbach's alpha and split-half method. The value of Cronbach alpha of this scale was 0.86 and for split-half method it was 0.76. Validity of Science self-efficacy scale was determined by establishing content, face and construct validity.

Procedure

A pre-test of forty one items developed to judge the self-efficacy among students of Class IX in the subject of science was done. The chapters included in experiential learning programme were Matter in our Surroundings; Is Matter around us Pure? Motion, Laws of Motion; Work and Energy; Cell— fundamental unit of life and Why do we fall ill? (Syllabus of Science of Class IX prescribed by Haryana Board of School Education). After pre-test, Instructional material (60 lesson plans) based on the above chapters in experimental group was taught by blending various activities of experiential learning programme like learning through examples, observations, brainstorming, projects model building, laboratory activities, simulations, asking learners to use real problems, discussions, homework assignments, animation and video clips, cooperative learning, student debates, class game, etc., which was followed by four stages of Kolb's model of experiential learning. The control group was taught by conventional method of teaching. After the completion of experimental activity, both groups were again tested through science self-efficacy scale as post-test.

Results

The effectiveness of experiential learning programme and conventional method of teaching on students' Science self-efficacy has been analysed. Initially, the students' science self-efficacy scale in both groups was tested and compared. The mean and standard deviation of pre-testing phase and post-testing score of students in both groups were computed and tested for significance of difference by using 't' value. The results obtained are shown in Table 1.

It is clear from Table 1 that the experimental group obtained 138.17 and 16.09 as mean and standard deviation scores respectively, whereas these figures for the control group were 134.68 and 17.96. The mean score of students falling in experimental group was slightly enhanced than those in control group. On the other hand, the obtained 't' value of both groups were found to be 0.97 which is not significant at 0.05 level. It means the students of both groups have same level with reference to their science self-efficacy before the experimental intervention.

Further, it was also revealed from Table 1 that the obtained post-test value for the experimental group was 151.51 ± 15.16 as mean and standard deviation scores respectively, whereas these figures for the control group were 141.06 ± 15.36. The mean score of students falling in experimental group was enhanced as compared to that of control group. On the other hand, the obtained 't' value of both

Table 1
Mean scores of Experimental and Control Group on Science Self-Efficacy during Pre-testing and Post-testing Phase

Variable	Phase	Group	N	Mean	SD	't' Value	Significance Level
Science Self-Efficacy	Pre-testing	Experimental Group	45	138.17	16.09	0.97*	*Non-significant at 0.05
		Control Group	45	134.68	17.96		
	Post-testing	Experimental Group	45	151.51	15.16	3.24**	**Significant at 0.01
		Control Group	45	141.06	15.36		

groups were found to be 3.24 which is significant at 0.01 level. It means the students of experimental group attained higher order self-efficacy in science than control group, after the experimental intervention.

The graphical description of mean scores of two groups on Science self-efficacy during the pre-testing and post-testing stage is given in Figure 2.

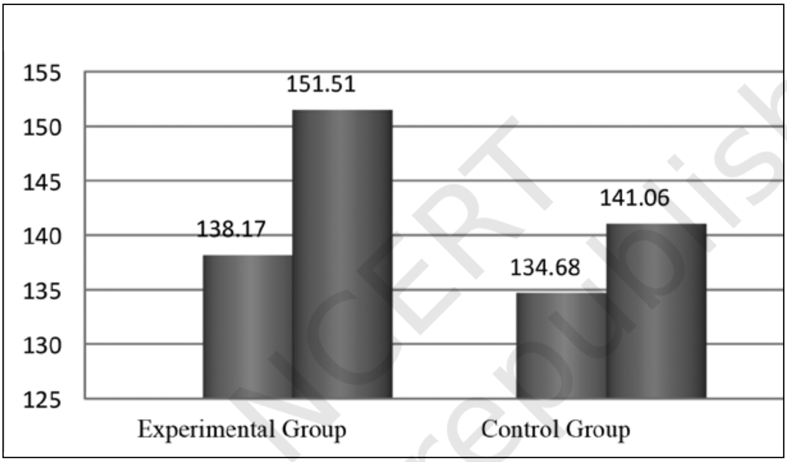

Figure 2 : Mean Scores of Experimental and Contral Group of Science self-efficacy during Pre-testing and Post-testing phase

Pre-testing and Post-testing Phase

It is clear from Figure 2 that there is improvement in both groups in post-testing scores than pre-testing scores. Figure 2 further explored that the improvement is highly visible in Science self-efficacy of experimental group as compared to that of control group.

Comparison of Gain Science Self-efficacy Scores in Experimental Group and Control Group

The mean and standard deviation of the gained science self-efficacy scores of the two groups were calculated. The 't' value was computed, tested and significance level found is illustrated in Table 2.

Table 2
Mean Gain scores of Experimental Group and Control Group on Science Self-efficacy scores

Variable	Group	N	Mean	SD	't' Value
Science Self-Efficacy	Experimental Group	45	13.33	14.64	2.13*
	Control Group	45	6.42	16.07	

**Significant at 0.05 level*

Table 2 illustrates that the 't' value for experimental and control group was 2.13 which is significant at 0.05 level. In the context of mean gain scores, it was found that the mean gain scores of experimental group and control groups were 13.33 and 6.42 respectively, and this gain difference in mean scores of experimental group is two times greater at 6.91. It means that science self-efficacy of experimental group has shown significant improvement after their exposure to experiential learning programme than that of control group. Hence, it can be inferred that teaching through experiential learning programme has significant positive impact on Science self-efficacy.

The graphical representation of mean gain scores of two groups on Science self-efficacy during the pre-testing and post-testing stage is given in Figure 3.

On the basis of the above results, hypothesis, "Experiential learning programme has a significant positive impact on Science self-efficacy of secondary school students", is accepted at 0.05 significance level.

Therefore, it is inferred that experimental and control group students significantly differ from each other in terms Science self-efficacy. The results are in favor of experiential learning programme. There is double improvement in gained scores of experimental group than control group. So, it can be concluded that teaching through experiential learning method has significant advantage over conventional teaching.

Discussion

The present research revealed that experiential learning activities in science are helpful in enhancing self-efficacy among students. The results of present research are supported

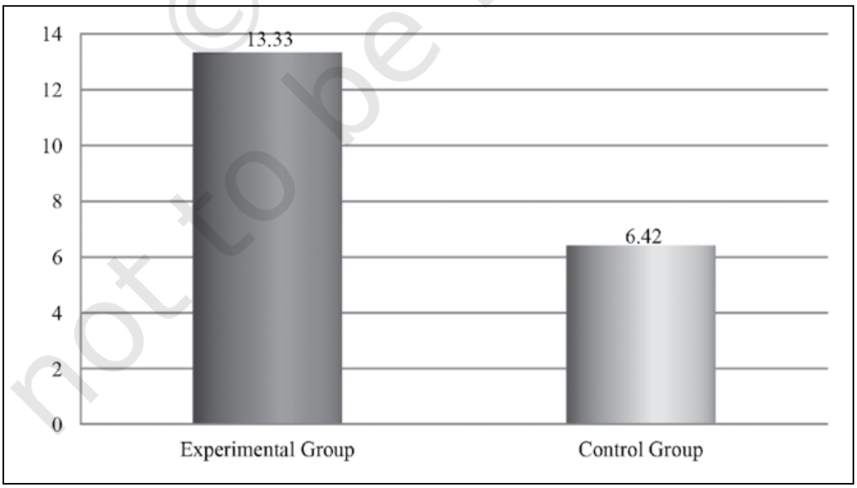

Figure 3: Mean Gain Scores of Science Self- Efficacy

by Cannon and Scharmann (1996) and Kiran and Sungur (2012). They explored that there is a close link between various teaching strategies and its impact on enhancement of science self- efficacy. Therefore, teaching through co-operative learning and collaborative science games is capable of enhancing science self-efficacy among students and teachers. The findings are congruent with Cheung (2014) who stated that various efficacy enhancing techniques like deep learning strategies directly affect the students' Science self-efficacy in Chemistry subject. Esters and Retallic (2013) argued that agricultural and work based experiential learning programme had a progressive impact in the enhancement of Science self-efficacy.

The results confirmed that experiential-learning programme has high impact than conventional class-room teaching in enhancing Science self-efficacy. The reason behind this may be the fact that content presented through experiential learning is highly motivational, as students are directly involved in the process. This leads to development of self-belief on various elements of Science self-efficacy, viz. self-confidence, self-regulation, self-concept, perceived science-efficacy and outcome expectation.

Conclusion

Introduction of experiential learning programme to experimental group has resulted in a positive change Science self-efficacy. The findings showed that there was visible variation in mean score of pre and post-testing of students in experimental group. Although, the enhancement in Science self-efficacy level is also noticed in conventional teaching method, but interestingly, there is double improvement in gained scores of students exposed to experiential learning. Hence, it can be concluded that teaching through experiential learning programme is effective in enhancing Science self-efficacy. The research studies revealed that students find difficulty in subjects like English, Science and Mathematics, so these subjects must be given due importance. But, for the all-round development of the students, all subjects should be given equal importance; and for every subject different types of experiential activities must be introduced in pre-service and in-service teacher training programmes.

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