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Effect of Problem-based Learning Approach on Achievement in Science among IX Graders

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Abstract

The present study is an attempt to find the effect of Problem-based learning on Achievement of science among ninth grade students. The sample of 200 students for the study is selected from the ninth class students of Government senior secondary schools of Gurdaspur, Punjab, India. For the study experimental method of research is used. A self constructed and standardized Achievement test of science was used to collect the data.The study revealed that there is significant difference in the achievement in science of experimental and control groups. Achievement in Science of experimental groups (mean=20.68) is significantly better than that of control group (mean=11.73).

Key-words: Problem-based learning, achievement in science, senior secondary schools, experimental group and control group.

Introduction

Education is critical for reaching one's full potential, building a just and equitable community, and propelling national progress. With the rapidly changing employment environment and global ecosystem, children must not only learn but also learn how to learn. To make education more immersive, comprehensive, integrated, inquiry-driven, discovery-oriented, learner-centered, discussion-based, adaptable, and pleasurable, pedagogy must evolve (NEP, 2020). As not all learning occurs in the same way, learning as a process has different types and involves different methods. Unfortunately, no best learning theory fits all students, and the road ahead in determining precisely what educators should do remains hazy (Weegar&Pacis, 2012).According to research, students learn more effectively when they collaborate with their classmates to solve open-ended, complex, and problematic activities. Such activities take time, but they can be extremely rewarding when students reach their learning objectives (Allen, Duch& Groh, 1996; Gallagher &Stepien, 1996). In science education, problem-based learning is an effective pedagogical method for increasing learning. The PBL teaching style involves presenting students with real-world issues that they can research and learn about in order to help them develop their critical thinking skills and learn how to learn(Suwono& Wibowo, 2018).

Problem-based learning approach

Problem-based learning emerged as a higher education approach at McMaster University's Faculty of Health Sciences in Canada and has since spread around the world. It all started with the education of medical students. Its development and application are widely attributed to Barrows, a physician and neuropsychologist. (Knoll, 1992). Problem-based learning is an instructional method that focuses on the learner by having students solve ill-structured problems (Barrows, 2000; Torp & Sage, 2002; Hmelo-Silver, 2004). Students collaborate in groups to determine what they need to learn to solve a problem. They engage in self-directed learning before applying their new knowledge to the problem and reflecting

on what they learned as well as the effectiveness of the strategies used. Rather than simply imparting knowledge, the teacher facilitates the learning process.

The problem-based learning method in science lessons helps students gain skills and learn scientific procedures such as observation, measurement, communication, estimation, data acquisition, variable trace, hypothesising, experiment planning and execution, model building, and so on. By taking responsibility in Problem-based Learning classes, students gradually gain independence from their course teachers and, as a result, become independent learners throughout their education (Dahlgren & Berg, 2001; Kaptan& Korkmaz, 2001).

Process of Problem-based learning approach

Studies that have attempted to define and explain the process of problem-based learning (Barrows & Tamblyn, 1980; Schmidt, 1983; Hmelo-Silver, 2004; Hung, Jonassen, & Liu, 2007; Schmidt, Rotgans, & Yew (2011) typically identify five characteristics that collectively distinguish problem-based learning from other experiential learning techniques. (1) begin with the problem, (2) require student-directed learning throughout the process, (3) reflect on problem solving and learning, (4) small group collaboration, and (5) facilitation to guide learning. These characteristics must be combined for an effective problem-based learning design.Tan (2002) provided a typical problem-based learning process scheme that included the following steps: (i) encountering the problem,(ii) learning issues and problem analysis,(iii) reporting on the information discovered,(iv) presentation and reflection of solution,(v) integration, overview, and evaluation.

Academic Achievement

In general, a student's achievement is usually associated with the marks, awards, and grades he or she receives in academics and other extracurricular activities at school. Academic achievement is defined as progress towards the goal of acquiring educational skills, materials, and knowledge, which typically spans a variety of disciplines. It refers to academic achievement rather than general knowledge acquisition in non-academic settings (Bolt, 2011). It refers to achievement in intellectual domains taught in schools, colleges, and universities (Spinath, 2012). Ahmad (2008) defined achievement as the level of success or accomplishment in a given area, as measured by a test score. Academic achievement, according to the online Wallace (2014), is a measure of knowledge gained through formal education that is typically indicated by test scores, grade point average, and degree.

Achievement in Science

According to Kumar (2010), scientific achievement can be defined as knowledge gained or skills developed as a result of studying Science as a subject. Achievement in Science refers to all of the behavioural changes that occur in people as a result of various types of scientific learning experiences, both theoretical and practical. Science achievement refers to the degree or level of success or proficiency attained in a specific area of science. In general, it refers to the science subject's grade (Bala, 2019). It is an evaluation of a learner's knowledge or skills gained in a science class, typically indicated by grade points.

The operational definition of achievement is what a student is expected to know, understand, or be able to demonstrate at the end of the experimental treatment. A variety of cognitive and non-cognitive

factors influence academic achievement. The mean scores obtained by the students in the investigator's achievement test in Science were used to indicate achievement here.

Emergence of the Problem

Numerous studies have been conducted on these aspects all over the world now. The studies conducted by Orhan and Tandogan (2007); Araz and Sungur (2007); Charif (2010); Üce and Ates (2016); Zakariya, Ibrahim, and Adisa (2016); Awan, Hussain, and Anwar (2017); Merritt, Lee, Rillero, and Kinach (2017); Thakur (2017); Umanailo (2019); Fidan and Tunsel (2019); Bara and Xhomara (2020); Kaur (2021); and Funa and Prudente (2021) reveal significant positive effect of problem- based learning on achievement in science. Hodges (2010), Crowley (2015), and Khobragade, Abas, and Khobragade (2016), on the other hand, find no significant effect of problem-based learning on science achievement.

Though much work has been done on the problem-based learning approach all over the world, few studies on the problem-based learning approach in India have been reported like Thakur (2017) and Kaur (2021), it is very clear that much work has not been done in India on the problem-based learning approach and particularly in Punjab, India, only one study has been reported on Government School students and that too with different variables. As a result, the proposed study is fully justified.

Objective

To compare the Achievement in Science of the groups taught through the problem-based learning approach and conventional teaching.

Hypothesis

There will be no significant difference between Achievement in Science of the groups taught through problem-based learning approach and conventional teaching.

Method

Experimental method of research with randomized groups pre-test and post-test design was used.

Sample

The current study's target population was senior secondary school students in Gurdaspur, Punjab, India, who were in ninth grade. A sample of 200 students from the IX class was chosen from two Government Schools in Gurdaspur, Punjab, India.

Procedure

The experimental and control groups were matched based on their achievement in science pre-test. In both schools, the experimental group was taught using a problem-based learning approach for approximately 30 working days, while the control group was taught using a lecture and demonstration method. This phase consisted of post-testing, i.e., a post-test of achievement in Science was given to both groups after the experiment, i.e., after 30 working days of teaching.

The science textbook served as the primary source for developing lesson plans based on the problem-based learning instructional strategy in order to achieve the study's objectives. The investigator chose six chapters from the Punjab School Education Board's Class IX science text book and created an achievement test and instructional material for problem-based learning based on the topics covered in these chapters.

Tools

Achievement test in Science

The investigator created and standardized a science achievement test based on selected topics from the Punjab School Education Board's ninth-grade textbook. The investigator created a 45-item multiple-choice achievement test for the selected ninth-grade science topics. Following a thorough item analysis, the final version of the test contained 45 items. The test-retest reliability after a 20-day gap was found to be 0.83. The content validity was determined by creating a blueprint of the test items that included the weightage assigned to the objectives and discussing it with a panel of experts. The time limit for the test was set at 65 minutes.

Result

Matching of Groups: The t-ratio is a statistical test that is used to compare the means of two groups. To compare the achievement in Science of the groups taught through the problem-based learning approach and conventional teaching t-ratio was calculated and the values are given in table 1 below:

Table 1: Matching of Experimental and Control Groups on the basis of Achievement in Science (pre-test)

Groups	N	Mean	Standard Deviation	t-ratio
Experimental Group	100	10.52	2.86	0.52 (NS)
Control Group	100	10.33	2.33	

**NS means non-significant*

Table 1shows that the values of mean for achievement in science (pre-test) for experimental and control groups are 10.52 and 10.33 respectively. The t-ratio is 0.52, which is non-significant ($p>0.05$). It indicates that experimental and control groups are matched on the basis of achievement in science (pre-test). As both the groups are homogeneous (Koul, 2011) it fulfills the condition of experimental research.

Effect of Problem Based Learning on Achievement in Science: The t-ratio was calculated to compare the achievement in science of the groups taught using the problem-based learning approach and conventional teaching, and the values are shown in table 2 below:

Table 2: Significance of Difference in Achievement in Science (Gain Score) of the Groups Taught Through Problem-based learning Approach and Conventional Teaching

Groups	N	Mean	Standard Deviation	t-ratio
Experimental Group	100	20.68	5.19	13.12*
Control Group	100	11.73	4.35	

**Significant at 0.01 level of significance*

According to Table 2, the mean values for Achievement in Science (Gain score) for the experimental and control groups are 20.68 and 11.73, respectively. The t-ratio is 13.127, which is statistically significant ($p<0.01$). It shows that there is a significant difference in scientific achievement between the experimental and control groups. The experimental groups' science achievement (mean=20.68) is

significantly higher than the control group's (mean=11.73).Hypothesis:'There will be no significant difference between achievement in Science of the groups taught through problem-based learning approach and conventional teaching,'is thus rejected.

The group taught through problem-based learning approach has significantly better achievement in science as compared to group taught through traditional approach. This finding is well supported by the studies conducted by Orhan and Tandogan (2007); Araz and Sungur (2007); Charif (2010); Üce and İsmail (2016); Zakariya et al. (2016); Awan et al. (2017); Merritt et al. (2017); Thakur (2017); Fidan and Tunsel (2019); Umanailo (2019) Bara and Xhomara (2020); Kaur (2021);Funa and Prudente (2021).The development of critical thinking, problem-solving, and communication skills can all be facilitated by problem-based learning, which is much superior than traditional approaches in this regard. Also, it can offer chances for group projects, locating and analysing research materials, and lifelong learning (Duch, Groh, & Allen, 2001).

Implications: The current study's findings demonstrated that the problem-based learning approach improves student achievement, so it is recommended that every science teacher use this approach when teaching for better science achievement. Instead of a hierarchical collection of topics, the subject matter content and abilities to be learned are organized around problems. The problem stimulates learning, which is then applied to the problem (Jonassen & Hung, 2008). It is suggested that teachers frame open-ended and poorly structured problems that are motivating and engage students' interests, as well as provide students with opportunities to solve the problem from multiple perspectives.

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