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EFFECTIVENESS OF COGNITIVE CONFLICT STRATEGY FOR THE LATERAL SCIENCE THINKING ABILITY AT ELEMENTARY LEVEL

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ABSTRACT

The challenges of lateral thinking in science need to provide adequate opportunities to make observations, experiments, and investigations of the problems related to scientific reasoning. This research aimed to analyze the effectiveness of cognitive conflict strategy to assess the improvement between students exposed to cognitive conflict strategy and those exposed to traditional methods of teaching science. This experimental study has a group pretest and a post-test research design. A pretest is used to check students' prior knowledge about science, and the post-test is used to analyze the change in thinking after the intervention of the cognitive conflict strategy. A total of 94 pupils from Section A of the eighth grade were used in the study. They were split into control and experimental groups; 47 students in the control group were subjected to the traditional approach, and 47 students in the experimental group were treated to the cognitive conflict strategy. The scores of the students exposed to cognitive conflict strategies were compared to those exposed to traditional methods by comparing both groups' pre-and post-test results, experimental and control. Paired sample t-test was used to interpret the data for analysis. The results in the experimental group are more significant than the control group. The mean score of the post-test post-test (M=22.3) is significantly higher than the mean value of the pretest (M=13.73). There is an interaction between learning types and prior science knowledge of students. Thus, lateral thinking questions can minimize students' difficulties in completing the science difficulties. Cognitive conflict strategy helps the students cope with difficulties and enhance their lateral science ability.

KEYWORDS: Cognitive Conflict Strategy, Lateral Scientific Ability, Effectiveness, Bloom Taxonomy, Learning

1. INTRODUCTION

The cognitive conflict approach is an interactive, inspiring, interesting, and demanding learning method. It encourages students to actively participate in the thought process while allowing them to develop initiative, creativity, and freedom in areas relevant to their talent, interest, and abilities evolution of the mind and intellect (Susilawati et al., 2019). While not all constructivists agree on how learning is achieved, they all agree that learners actively construct their knowledge. One of the most obvious implications of this concept is that when kids try to learn in school, they are not starting from scratch. Students' prior or base knowledge plays an important part in learning, according to Alexander (1996): "One's knowledge base is, in fact, scaffolding that supports the foundation of all future learning."

What previous knowledge do the students bring to the class, and what are their special features? Were there two crucial points to consider? How can teachers integrate their prior expertise with their new subject? Were there any queries specifically about the concept of change? To understand more about students' perceptions, thoughts, and beliefs about theories and how teachers might apply this prior or foundational knowledge to the new subject being learned in the school.

First, the researcher briefly overviews the literature on theoretical transformation and cognitive conflict as a strategy for promoting it. Second, the impact of adopting cognitive conflict as a teaching strategy to develop students' lateral scientific thinking capacity was investigated.

Most theories that have attempted to explain conceptual change have emphasized the role of cognitive conflict as a key requirement for conceptual change. According to Piaget (1975), cognitive conflict is a step in the equilibrium process. He distinguished between adapted and non-adapted responses to data that was contradictory. Unaware of the conflict, people need to respond more adequately. Posner et al. (1982) suggested that the stage of conflict caused by frustration with current thoughts is the first step in conceptual transformation. Students should recognize that they, therefore, need ideas of modifying their present thoughts or conceptions to some extent throughout this

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dissatisfaction period. A certain level of there appears to be a necessary, but not satisfactory, situation for conceptual change in both a weak and fundamental sense (Vosniadou, 1994). To change something, an individual must first recognize that they must alter something and be eager to do it.

Thagard (1992) examined certain abstract scientific revolutions and presented a theory of conceptual transformation to explain how they came about. In several of these scientific revolutions, he maintained, anomalous evidence had a crucial role in the conceptual transformation that each revolution brought about. Bereiter (1993) presented a classification system for people's reactions to conflicting or unusual data. Chinn and Brewer (1993) identified seven response forms to anomalous data: ignore, reject, exclude, postpone, reinterpret, peripheral change, and theory shift. A popular technique for facilitating conceptual transformation is based on a theoretical conflict strategy. (Chan, Burtis & Bereiter (1997). The typical cognitive conflict paradigm is to (a) determine a student's current level of knowledge and (b) expose them to conflicting information often provided in the form of texts. Some studies have had negative results from the implications of cognitive conflict strategy, but some studies also show positive effects. Even when faced with conflicting facts, students often cannot create significant conflicts or feel dissatisfied with their previous ideas (Chan et al. (1997 some positive consequences (Dreyfus et al., 1990).

1.1. SIGNIFICANCE OF THE STUDY

This study assessed students' current scientific knowledge and the conceptual change in their thinking after exposure to a cognitive conflict method during their learning. The researcher checks this by establishing pre and post-tests while teaching through cognitive conflict strategy. This study was innovative in enhancing the students' lateral science skills. Many of the world's most pressing problems require new ways of thinking and responding. There are different ways of thinking. A person can use any cognition to adapt to the environment and society; however, when confronted with rapidly changing trends, strong competition, and the desire to perform miracles. Cognitive conflict provides a deliberate method and systematic process that leads to innovative thinking. Agha and Lulu (2009) agreed that using a cognitive conflict technique to teach science is effective. Using cognitive conflict as a teaching approach generates a stimulating and engaging learning environment. Students' scientific thinking skills, critical thinking skills, and creativity are all aided by cognitive conflict.

1.2. OBJECTIVES STUDY

The study has leading objectives as follows:

- Assess the present level of students' lateral science ability at the elementary level using a pretest based on cognitive conflict strategy.
- Investigate the lateral science ability of the students at the elementary level by using a post-test based on cognitive conflict strategy.
- Compare the effectiveness of the intervention based on cognitive conflict strategy before and after intervention implementation for the lateral science ability.

1.3. DELIMITATIONS

This study was delimited to only District Okara elementary students because it is an experimental study that was only exposed to a sample of 94 students to check their lateral science thinking ability when teaching through cognitive conflict strategy.

2. REVIEW OF LITERATURE

Cognitive conflict is a well-known and significant aspect of the conceptual transformation process and can be effectively used as a teaching-learning approach to help students learn new concepts and promote their intellectual growth of the students (Mufti et al., 2018)

A circumstance in which a learner is faced with a discrepancy between their existing cognitive aspects (such as thoughts, judgments, and beliefs) is known as cognitive conflict information or an idea) and knowledge and behavior (Waxer & Morton, 2012). According to some experts, teachers' professional expertise in teaching and learning techniques and tactics must be broadened and deepened to facilitate students' conceptual understanding (O'Brien & Iannone, 2018). The researchers also stressed the need for more research on how teachers tailor their teaching methods to suit their student's needs and how teachers could use a range of teaching approaches to ensure that students learn to have students' active participation in the learning process (Murphy & Parkman, 2019).

Cognitive conflict is a well-known contributor, even though there are still debates about its beneficial and negative consequences on research and conceptual transformation in learning science. This is a reliable method in the teaching of science. When one's beliefs, attitudes, or behaviors contradict one another, it is called cognitive conflict. Cognitive conflict strategy is a component of psychological abstract transformation theory (Kang & Lawrence, 2010) (Gyoungho & Jaesool, 2003). This method works effectively for both correcting a misconception and increasing performance. The conflict teaching strategy is utilized to aid learners in recreating their knowledge. Students' faith in their previous ideas is destabilized by contradictory experiences, such as conflicting events, according to a cognitive conflict approach. According to the cognitive dissonance strategy, contradictory cognitions motivate the mind to acquire or generate new concepts or beliefs (Lee et al., 2005).

Cognitive conflict techniques effectively address learner conceptual change and establish a greater science balance Yu-Fen Yang (2010). Cognitive conflict stimuli assist the absorption process to become more effective and

significant in the intellectual formation of learners. The core principle of cognitive conflict approaches is that thinking is not just a passive data consumer. Students can improve their lateral thinking skills by solving challenges in science. When students are exposed to a circumstance that contradicts their cognitive structure, the cognitive conflict strategy is viewed as a learning method that might satisfy their need to work hard and improve their thinking abilities. Different cognitive structures will eventually create a shift in thinking, allowing students to learn new material or comprehend new concepts (Lee, 2003).

Cognitive conflict strategy is an interactive, inspiring, interesting, and demanding learning method. It encourages pupils to actively participate in the thought process while allowing them to develop their initiative. Their skill, interest, and psychological and cognitive development influence their innovation and independence (Susilawti et al., 2017). Cognitive conflict has been a common teaching approach in science education research since the 1980s. Many scholars believe that cognitive conflict has a significant/positive impact on conceptual evolution (Lee & 2013). However, some unresolved questions remain about cognitive conflict's impact (Hewson et al., 1998). Cognitive conflict is viewed as a teaching strategy that aims to assist pupils in overcoming pre-existing misunderstandings and perceptual (Bell & Purdy, 1985)

When students are presented with a circumstance that contradicts their cognitive structure, the cognitive conflict technique is considered a learning method that can satisfy their desire to work hard and maximize their thinking abilities. The tension caused by differing cognitive structures will eventually result in a shift in understanding, allowing students to learn new information or understanding (Lee et al., 2003). Cognitive conflict strategy is an interactive, inspiring, interesting, and demanding learning method. It encourages pupils to actively participate in the thought process while also allowing them to build their initiative. This fact also suggests that learning is closely linked to problem-solving (Susilawti et al., 2017).

According to Piaget, assimilation and accommodation integrate the cognitive structure into the environment (Watson, 2002; Sutawijaya &D Ahlan, 2010; as cited in Dahlan, 2012). If assimilation and accommodation do not conflict, the cognitive structure is in balance. When someone is in a state of disequilibrium, on the other hand, he will seek a new equilibrium with his environment. To provide a clearer orientation, Piaget defined cognitive conflict into three levels: low, medium, and high. A low level happens during accommodation and assimilation when someone is in a state of equilibrium with no conflict.

"Cognitive conflict has never been fully characterized," Damon and Killen (1982) wrote. There currently needs to be literature that describes the definition in full. It is also difficult to discover a dictionary definition of cognitive conflict. In a book devoted solely to conflict, there is no definition in the chapter on cognitive conflict. To explain cognitive conflict, scholars employed a variety of concepts in addition to cognitive conflict circumstances. Several phrases have similar meanings to cognitive conflict for each of the researchers:

Cognitive dissonance (Murray et al., 1977), cognitive gap (Furth, 1981), conceptual conflict (Johnson & Johnson, 1979), discrepancy (Zimmerman &Blom, 1983), disequilibrium (Damon & Killen, 1982), internal conflict (Bodrakova, 1988), paradoxes (Movshovitz-Hadar & Hadass, 1990), psychic conflict (Chntor, 1983), socio-cognitive conflict (Bearison et al., 1986).

Each researcher chose one or two terms based on how similar or unlike the meanings of those words are. Smedslund (1961), for example, utilized the term equilibration, coined by Piaget (1985). Festinger's cognitive dissonance and Heider's balance mechanisms may be related to equilibration.

3. RESEARCH METHODOLOGY

The nature of the research was a true experimental study, One-group Pretest-posttest Research. The researcher employed a control group design. The pretest was used to assess students' prior knowledge, and the post-test was used to assess students' current knowledge after applying the treatment of cognitive conflict strategy and to check the effectiveness of cognitive conflict strategy in enhancing students' lateral science ability.

The researcher utilized statistical calculations to calculate the score differences between the experimental and control groups' pretest and post-test after collecting data, pretest, and post-test from the experimental and control groups. Data analysis is crucial for the researcher when examining data to discover a solution to a statistical computation. The research aims to use data from the pretest and post-test to react to the problem statement, post-test. The researchers used SPSS IBM's paired sample t-test to analyze the data.

The data of 94 respondents were analyzed on the Statistical Package of Social Sciences (SPSS). The present study was carried out in two phases. Both descriptive and inferential statistical procedure was used to test the hypothesis and fulfill the aims and objectives of the study. We will apply statistical tests like Correlation and paired t-tests to test these.

4. RESULTS AND DISCUSSIONS

Participant data was compared to determine the effects of independent variable on dependent variable. To calculate the research statistics, the researcher used the Statistical Package for Social Sciences (SPSS 20.0) to examine the data obtained by the participants. Descriptive statistics were used to obtain the percentages, averages, and standard deviations.

Table 1: Comparison between the overall scores of pre-test and post-test

Variables	N	Mean	S.D	Df	t	Sig.
Pre-Test Marks	94	13.73	4.331	93	-7.314	.00
Post-Test Marks	*94*	*22.13*	*9.022*	-	-	-

*Significance level ***p≤ .05*

Table 1 indicates that the calculate significance value (.00) was smaller than the significance level (.05) in indicating a statistically significant difference between the pre-test and post-test scores. The post-test mean score (M=22.13) is greater than the pre-test mean score (M=13.73). The post-test S.D value (9.022) is higher than the pre-test number (4.331). The t value (-7.314) distinguishes between the pretest and the post-test. This pre and post-test difference occur because of the cognitive conflict strategy which helps the students to enhance their lateral thinking for science ability. By comparing the results of control and experimental groups, the effect of cognitive conflict strategy is much more effective in an experimental group rather than the control group.

Table 2: Comparison between pre-test knowledge level and post-test knowledge level

Variables	*N*	*Mean*	*S.D*	*Df*	*t*	*Sig.*
Pretest Knowledge Level	94	1.98	.622	93	-7.688	.00
Posttest knowledge level	94	2.91	1.064		-	-

*Significance level ***p≤ .05*

Table 2 indicates that the calculated significance value (.00) was smaller than the significance level (.05), indicating a statistically significant difference between the pre-test and post-test knowledge level score. The post-test knowledge level's mean score (M=2.91) is greater than the pre-test knowledge level's mean score (M=1.98). The post-test knowledge level's S.D value (1.064) is higher than the knowledge level's pre-test value (.622). The t value (-7.688) distinguishes between the pretest and the post-test. This pre and post-test difference occur because of the cognitive conflict strategy which helps the students to enhance their lateral thinking for science ability. By comparing the results of control and experimental groups, the effect of cognitive conflict strategy is much more effective in an experimental group rather than the control group.

Table 3: Comparison between per-test comprehension levels with post-test comprehension level

Variables	*N*	*Mean*	*S.D*	*Df*	*t*	*Sig.*
Pretest comprehension level	94	2.06	.993	93	-4.994	.00
Posttest comprehension level	94	2.91	1.991	-	-	-

*Significance level ***p≤ .05*

Table 3 Indicates that the calculated significance value (.00) was smaller than the significance level (.05), indicating a statistically significant difference between the pre-test and post-test comprehension level score. The post-test comprehension level (M=2.91) has a higher mean score than the pre-test knowledge level (M=2.06). The S.D value of the post-test comprehension level (1.991) is higher than the pre-test value (.993).The t value (-4.994) also differentiates between pretest and post-test. This pre and post-test difference occur because of the cognitive conflict strategy which helps the students to enhance their lateral thinking for science ability.

Table 4: Comparison between pre-test application-level score and pot test application-level scores

Variables	*N*	*Mean*	*S.D*	*Df*	*t*	*Sig.*
Pretest application level	94	2.27	.894	93	-4.421	.00
Posttest application level	94	2.98	1.057	-	-	-

*Significance level ***p≤ .05*

Table 4 indicates that the cal calculated significance value (.00) was less than the significance level (.05) which shows a statistically significant difference among the pre-test post-test application-level score. The mean score of the post-test application level (M=2.98) is higher than the pre-test application-level score (M=2.27). S.D value of post-test application level (1.057) is greater than the pre-test value application level (.894). The t value (-4.421) also differentiates between pretest and post-test. This pre and post-test difference occur because of the cognitive conflict strategy which helps the students to enhance their lateral thinking for science ability.

Table 5: Comparison between the pre-test synthesis level score with the post-test synthesis level score

Variables	*N*	*Mean*	*S.D*	*Df*	*t*	*Sig.*
Pretest analysis level	94	2.46	1.404	93	-5.819	.00
Posttest analysis level	94	4.21	2.184	-	-	-

*Significance level ***p≤ .05*

Table 5 Indicates that the calculated significance value (.00) was less than the significance level (.05) which shows a statistically significant difference among the pre-test post-test analysis level score. The mean score of the post-test analysis level (M=4.21) is higher than the pre-test analysis level score (M=2.46). S.D value of the post-test analysis level (2.184) is greater than the pre-test value analysis level 1.404). The t value (-5.819) also differentiates between pretest and post-test. This pre and post-test difference occur because of the cognitive conflict strategy which helps the students to enhance their lateral thinking for science ability.

Table 6: Comparison between the pre- test analysis level score with the post-test analysis level score

Variables	*N*	*Mean*	*S.D*	*Df*	*t*	*Sig.*
Pretest synthesis level	94	2.55	1.449	93	-5.873	.00
Posttest synthesis level	94	4.35	2.417			

*Significance level ***p≤ .05*

Table 6 Indicates that the calculated significance value (.00) was less than the significance level (.05) which shows a statistically significant difference among the pre-test post-test synthesis level score. The mean score of the post-test synthesis level (M=4.35) is higher than the pre-test synthesis level score (M=2.55). S.D value of the post-test synthesis level (2.417) is greater than the pre-test value synthesis level (1.449). The t value (-5.873) also differentiates between pretest and post-test. This pre and post-test difference occur because of the cognitive conflict strategy which helps the students to enhance their lateral thinking for science ability.

Table 7: Comparison between the pre-test evaluation level score with the post-test evaluation level score

Variables	*N*	*Mean*	*S.D*	*Df*	*t*	*Sig.*
Pretest evaluation level	94	2.45	1.250	93	-7.288	.00
Posttest evaluation level	94	4.64	2.743			

*Significance level ***p≤ .05*

Table 7 Indicates that the calculated significance value (.00) was less than the significance level (.05) which shows a statistically significant difference among the pre-test post-test evaluation level score. The mean score of the post-test evaluation level (M=4.64) is higher than the pre-test evaluation level score (M=2.45). S.D value of the post-test evaluation level (2.743) is greater than the pre-test value evaluation level (1.250). The t value (-7.288) also differentiates between pretest and post-test. This pre and post-test difference occur because of the cognitive conflict strategy which helps the students to enhance their lateral thinking for science ability.

5. CONCLUSION AND RECOMMENDATIONS

This cognitive conflict strategy for science learning and teaching is founded on Piaget's long history in science education, which has underlined the need for all students to comprehend essential disciplinary core ideas and scientific abilities that are part of the inquiry process.

Cognitive Conflict Strategy plays an important role in developing lateral thinking. In this study, the researcher followed the Cognitive Conflict Strategy domain's steps to develop elementary science students' lateral thinking skills. This research was implemented in GGHS No. 2 Havali Lakha in 8th grade. This study shows that there are no science students.

Due to the lack of subject teachers, the Cognitive Conflict Strategy needs to be followed in government schools. In this study, the teacher creates the intervention plan, lesson plan, and timetable for the class to follow the Cognitive Conflict Strategy domain levels (knowledge, comprehension, application, analysis, synthesis, and evaluation).

These Cognitive Conflict and strategy domain levels make students more confident in attempting any type of paper or test, such as MCQs (short and long questions). Most teachers do not use the activities to promote lateral thinking in science students, but in this study, teachers followed the Cognitive Conflict Strategy to develop lateral thinking skills.

The researcher has applied the Cognitive Conflict Strategy to studying science with elementary school students, which gives a more effective and valuable result. The cognitive conflict strategy has been the best tool for developing lateral thinking skills in elementary science.

By keeping in view the above discussion, the following recommendations were made:

- Using cognitive conflict strategy as a teaching approach enables students to develop lateral abilities in science.
- Produce innovative ideas for science learning and reasoning through cognitive conflict.
- The cognitive conflict, which represents a developing understanding of how to teach science best, represents a significant shift from traditional learning to lateral science ability taught in most schools and will force most science teachers to change their teaching methods.
- Teachers are important, but they work in collaboration. The schools, districts, and communities in which they operate, as well as the professional communities they belong, determine their potential to improve students' scientific comprehension and enhance their lateral thinking abilities.
- The following research examines how cognitive conflict affects students' thinking, emphasizing how the current educational system could be changed to support the continued development of teachers who respond to expectations raised by current changes in science Lessons.
- Plan and conduct research examining various approaches to assisting science teachers in their learning.

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