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Development of Creativity among Elementary Level Students of Low Socio-Economic Background through Guided Inquiry: An Empirical Evidence from Islamabad Pakistan

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Abstract: *Major aim was to determine the effect of guided inquiry on fluency and originality of ideas in creative thinking. The study was quasi-experimental. "Convenience" sampling technique was used. The sample size was 60. The experiment was performed in an elementary school in Islamabad. The scoring rubrics were used to analyze creative thinking in terms of fluency and originality. The scores of tests of the experimental group and control group were compared by t-test. There was a significant difference in the performance of the control group and the experimental group. Guided inquiry is recommended for the teaching of creativity in terms of originality and fluency.*

Key Words: Creative Thinking, Fluency of Ideas in Creative Thinking, Originality of Ideas in Creative Thinking, Low Socio-economic background Science Classroom, Guided Inquiry, Elementary Level

Introduction

Creative thinking resolves problems, communicates efficiently, and acquires leadership which is vital to coping with the challenges of modern society (Seyihoglu & Kartal, 2010). So, in this regard, just knowledge is not enough thing. Rather, the capacity to think and learn, team up, and communicate is important. Zubaidah, Fuad, Mahanal & Suarsini (2017) reported Moon (2008) that one of the 21st-century skills is creative thinking skill which students should be trained. To address and meet the complicated challenges of the modern world, trained professionals in creative thinking, independent learning, problem-solving, team-building, including other higher-order abilities are required. Hadzigeorgiou (2012) stated that the foundation of science is based on creative thinking skills. Hence, education, especially science education, requires calling attention to these skills, including creative thinking, which is an important skill of this century isso that students can meet the challenges of a modern and changing world.

Around the world, scientific research has been a pillar of essential education modification, but in Pakistan situation is not good. National Education Policy 1998, Pakistan said that there are 145,960 primary and 24,590 Elementary schools in the public sector. Unfortunately, none of them are according to the international standards both by way learning skills and teaching strategies. The outdated methodology is being used by teachers who do not match with ground realities (Rashid & Mukhtar, 2012). Teachers are failing to nurture analytical and logical thinking abilities among students (Ali, 2011). Keeping in mind some effort is being made by Pakistan Science Foundation to inculcate twenty-first-century skills among students, but these efforts are started only at the primary and elementary level. So, keeping in mind this whole scenario this study is performed to see the effect of Guided Inquiry-based teaching on the creative thinking of students at the Elementary level.

Creative thinking is the bringing of new ideas which are valuable through various means (Boden, 2001). Scientific education is based on scientific investigation, and it is an important method of learning. Creativity is the production of novel products (Mumford, 2003). Creative thinking is related to the novelty of ideas and their implementation to make something new from existing ones (Greeenstein, 2012). Baker & Rudd (2001) considered creative thinking skills very important for the students. As a result of reform at the national level in science classes, science teachers are now using research-based teaching (Wang, 2010). Therefore, the researchers are doing research in the implementation of scientific

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investigation in classes with the uniqueness of the situation in various grades.

Throughout this study, "creative thinking" means, for pupils, that operationally defined ability is calculated in different subjects and on different instruments through paper and pencil tests and are scored accordingly. The worth of this stability is evidenced through many studies which are reviewed and reported in this study. Guided Inquiry is not like a single activity rather is a process that engages students in continuous adaptation and production of their personal knowledge under the given context. Now a day's, scientists are using scientific Guided Inquiry as a tool in many practices.

Some studies have given the relationship between teaching practices and scientific research; some studies carefully provide interaction between teacher and students in a class of the investigation. In addition, few studies observed in the characteristics of the class of the survey at different levels. Agreed to the importance and emphasis of research, this study has examined the effect of the Guided Inquiry on the class of investigation on creative thinking. A fundamental objective of science that teaches the work of reform has been to deal with students in a precise way the epistemological aspects of science. This objective provided the basis for significant attention in these last times devoted to research and the natural world of science coaching (Ford&Wargo,2007).

Each other the process of skills and knowledge on the nature of science are contained in the investigation. Process skills involved the formulation of research activities and collection and examination of the data. Both philosophical and communal aspects are parts of perception and knowledge about the nature of science. To investigate the natural world scientists conveniently used process skills and arrangements (Breslyn & McGinnis 2012).

Creative thinking is to think about problems in a novel or a new way (Oxford Advanced Learner's Dictionary, 2013). Shaheen (2011) quoted that creative thinking means the association of bright new ideas, facts and pertinent thoughts. Expression of oneself in a unique and novel way is creative thinking (Abraham 2016). Creative products are distinctive and innovative and not are imitations. This type of thinking is precious and is of use to society. Daud, Omar, Osman, and Turim (2012) quoted Normee (2001) that creative thinking is the process in which basic thinking ideas are utilized to create new ones. However, despite every single one of the troubles, the character of unique creative thinking in integration and useful personal and interpersonal adaptation looks like extra significant than for a long time. Different indicators of creative thinking were reported by some experts. Treffinger, Selby & Young (2002) reported five indicators which are (a) fluency, (b)flexibility(c) originality(d) elaboration(e) metaphorical thinking.

Yusnaeni ,Corebima, Susilo & Zubidah(2017) reported that in order to develop creative thinking skills among students, a specific learning condition is required, which involves a learning experience teaching through Guided Inquiry is actually the utilization of means for gain of knowledge by students. It includes the skills development of the investigation, as (1) capacity to recognize and define a problem, (2) to make an assumption, (3) to the experimental plan, (4) to collect and analyze data, and (5) to infer data and in meaningful conclusions. Science as Guided Inquiry is not simply a collection of facts that it's rather a method obtained through facts. In this study, researcher covered activities of scientific research to reveal the characteristics of creativity.

Statement of Research Problem

The idea of this study was perceived while working with school education department of Pakistan where system involves rote memorization and textbook content knowledge reproduction. Our present system of education mostly relies on cramming. Much emphasis is given to the attainment of better grades and marks. Both teachers and parents of students have great focus on achievement of high marks. Our examination system also encourages just rote learning. Moreover, the focus is on the enrollment of new students and their retention. This is the potential problem that just to provide knowledge to the students is not enough to meet the challenges of this century. The basic purpose of education is changing all over the world. It is being shifted towards the attainment of abilities and skills which are also called twenty-first century skills including creative thinking and creativity. These skills and knowledge are essential to make progress for developing countries like Pakistan. In this regard, the researchers had planned to do research on the effect of Guided Inquiry-based science teaching on the creative thinking of students.

Objectives of the Research

This research was conducted to achieve following objectives:

i. Determine an effect of guided inquiry-based teaching on creative science thinking of elementary school students of the marginalized area of society.

ii. Determine an effect of guided inquiry-based teaching on fluency of ideas among elementary school students of the marginalized area of the society.

iii. Determine an effect of guided inquiry-based teaching on originality of ideas among elementary school students of marginalized areas of the society.

Research Hypotheses

Following hypotheses of research were tested:

1. **H_0:** There is no significant difference between creative thinking of students who were exposed to the guided inquiry-based method of teaching and taught by the traditional method.

   H1: There is an insignificant difference between creative thinking of students who were exposed to the guided inquiry-based method of teaching and taught by the traditional method.

2. **H_0:** There is no significant difference between fluency of ideas in students' creative thinking who were exposed to the guided inquiry-based method of teaching and taught by the traditional method.
3. *H1:* There is a significant difference between fluency of ideas in students' creative thinking who were exposed to the guided inquiry-based method of teaching and taught by the traditional method.
4. **H_0:** There is no significant difference between originality of ideas in students' creative thinking who were exposed to the guided inquiry-based method of teaching and taught by the traditional method.
5. *H1:* There is a significant difference between originality of ideas in students' creative thinking who were exposed to the guided inquiry-based method of teaching and taught by traditional method.

Significance of the Study

This study aims to provide support to the policymakers of the education system of Pakistan in order to provide them a method that is effective in enhancement of creative thinking, i.e., inquiry method. This study would also be helpful for those teachers who wants modification in their methodology to enhance creative thinking among students through the inquiry method. In the present changing global scenario where creative thinking is an important skill, this study would be helpful for the students to produce creative thinking among them. The results of this study would be useful to those students who want to arouse curiosity among them due to which they should take much interest in learning of science subjects. The findings of this study help them to retain their interests and resulted in a better understanding of concepts. They could get the benefit to solve their problems in science through creative thinking. Creative thinking helps them to continue their scientific training, so scientific knowledge should form the basis for producing a valuable product, rather than simply collecting knowledge. This study helps toward encouraging students to make new inventions/ innovations. The results of the study are beneficial to high school science students who can think creatively and can deal with difficult problems to find new solutions and ideas. The results of the study offer guidelines for teachers to improve their methodology. Teachers can regard creative thinking as an important skill instead of taking it as an ordinary understanding or skill. They could use Inquiry-based science teaching after having guidance from the results of this study. They may get directions to apply other teaching methods to evaluate the effectiveness of creative thinking skills at various levels of education in Pakistan. The results of the study provide guidelines to the state/ government to make new and effective policies. Government can use the results of this study for the development of a new curriculum. In-service and pre-service science teachers training institutes can use the results of this study in terms of training of the science teachers.

Theoretical Background

Creative thinking is the formation of new fundamental rudiments which help to meet particular requirements or are valuable in some other way. If the combining elements are more jointly distant, then the process will be more creative. One of the most frequent methods to define creativity operationally is all the way through the presentation and performance on the Alternate Uses or divergent thinking tests (Goff, 2002). These experiments also aim to assess people's capability to create a familiar object or novel creative solutions over a limited period of time in laboratory situations (although the characteristics of the tests and instructions may be different. Contestants are usually tasked with being creative and are set to 2-3 minutes to generate creative ideas through fluency (the figure of responses applied within selected time) also originality or responsiveness (i.e., participants' responses to or from responses in the test sample).

There is ample agreement that creativity is the basis for providing scientific interference and solutions for inventions that are essential to economic growth. The enhancement of creativity among students is one of the important goals of modern education (Yang, Lee, Hong, and Lin, 2016). Guided Inquiry or research-based education is, in fact, an education system which is the combination of students' inquisitiveness and scientific technique to boost progress of creative thinking abilities with the learning of science. Guided Inquiry-based method for science takes an analytical advance for instruction and learning, and learners have the opportunity to the exploration of the problem, find sustainable resolutions, create comments, pose queries, test ideas and imitate in an innovative and creative way, and apply their ideas. Therefore, Guided Inquiry-based science requires students to learn by doing so.

They themselves evaluate their understandings in the light of obtainable facts. This approach of teaching involves recognition of important problems by the teachers, then they present it to the students, and students try to find out the answer of such problems on the basis of evidence. Hansen & Buczynsk (2013) quoted Chang and Mao (1999) those students that are taught by Guided Inquiry-based method show better achievement and constructive attitude towards science.

In this method, the curiosity of the students is provoked by asking scientific questions, then they learn to prioritize the evidence and evaluation of results on this evidence and communicate and give explanations for their findings. In short, it requires the use of facts, judgment, and the mind to develop explanations about the naturally existing world (Abell *et.al.* 2004, p.258). Creative Science Thinking; Creativity is something different from the preservation of great artists, musical groups, designers and innovative thinkers. Creative thinking incorporates a stress-free, open, lighthearted approach and is less planned, controlled and conventional as compared to critical thinking. Therefore, it is somewhat risky as there is the chance of mistakes. There is needed to be ready to deal with significant hazards, perplexity, and mess. Skills related to Creative thinking are about attitude, self-assurance as well about ability and endowment. The cognitive functions of creativity (in other words, different and convincing thinking, i.e., convergent and divergent thinking) could be built-up through planned programs (Leritz, Mumford & Scott, 2004). On the basis of insights obtained from the above-mentioned literature, it was discovered that it is feasible to design theory-based intervention for the development of creative thinking performance and analyze its effectiveness.

In recent times by means of the Torrance Tests of Creative Thinking, Chandrasegaran & Yoon's (2015) study discovered that by applying Guided Inquiry-based learning methodology in a lab program of study of science appreciably enhanced the creative thinking of students. The productive outcomes of their research on common creative thinking skills have motivated the researcher to explore more closely how creative scientific thinking could be built-up. Adding up, Kind and Kind (2007) suggested additional studies on the development of explicit features of tests of creative thinking, and training resources were required for enhanced understanding. Guided Inquiry-based teaching is one of the learning methods which can endow with a dynamic and authentic scientific procedure to build up the abilities of creative thinking.

Thus, the following study investigates the usefulness of a measure focusing on promoting creative scientific thinking, scientific research, and Guided Inquiry capacity by incorporating the aforesaid cognitive, motivating and group approach to science education i.e. Guided Inquiry-based science teaching. In the context of science education, we must take into account that teachers are not much concerned about the development of creativity and use of the Guided Inquiry method in the classroom and there is a lack of studies in this field too especially in the case of primary schools it is obvious from the literature review in Pakistan.

Literature Review

Higher-order thinking skills are improved by Guided Inquiry-based learning like critical thinking intellectual and rational growth. Blanchard, Southerland, Osborne & Sampson (2010) claimed that higher-order thinking skills of students improved through the Guided Inquiry method also retention of knowledge improved through this method. According to Samih Mahmoud and Saleh (2010) creativity be the appreciation, execution and novelty of thinking. In later years, Trivedi and Bhargava (2010) conducted an Elementary study on the main school (ages 15 to 17) students of the city of Jodhpur to study the correlation between academic success and creativity to measure the level of creativity. Creativity tests (Passi test of creativity) were administered to subjects. Results of the previous review have been taken as school student success. The results revealed differences between the sexes on creativity based on the combination of high and low achiever. Correlation between academic success and creativity; the impact of the equality of the sexes was,

however, less creative as compared to educational outcomes. (Samiullah, 2018)

For encouragement of creative thinking, active learning strategies are more effective as compared to traditional teaching. Student's acquirements of Creative thinking learning skills, long-lasting retention of knowledge, cooperative work, and liability of their own learning, self-sufficiency are fostered by the pedagogical techniques which are based on Guided Inquiry, communication, problems solving in a flexible environment. Akintunde, Ogunsanya and Olatoye (2010) studied a relationship along with the creativity of students, there and academic achievement in provisions of CGPA scores. They found a negative correlation between creativity and CGPA gain. Hence, the superior the creativity of the students, the poorer the CGPA score. In an environment where individuals are from different domains and fields working together communicate their ideas and share their knowledge. Their interaction and potentially positive and productive conflicts can boost Creative thinking. (Samiullah, 2019)

Cubukcu & Eksioglu (2009) emergence, advancement and permanence of creative thinking differ from individual to individual field-specific and field general. Nuangchalerm (2009) stated that Guided Inquiry-based learning activities are helpful to promote students in terms of both cognitive and analytical thinking. Heller (2007) reported that convergent thinking is a component of creative thinking. Guided Inquiry-based teaching is a representation of a broad-spectrum investigative process. In which scientists use imitate real investigations through which students attain different skills to utilize their knowledge and get solutions to difficult problems. (Savery2006).Runco (2006) reported a conclusion that divergent thinking is related to the knowledge of certain tasks, especially when the tasks cover a field. For example, a horticulturist would probably score well on a test of divergent thinking if all tasks related to plants. But the study also shows that experiential bias can be avoided by tests of divergent thinking of crafts where tasks represent unknown areas. Sternberg (2006) explored that creativity in education is the future need of the national economy. (Samiullah, 2020)

Lee & Theraariault (2013) is of the view the role of working memory in creative thinking procedures is very important. Academic and nonacademic experiences of student both can change divergent thinking ability. Gibson (2005) found that creative thinking ability and creative personality are partially related to each other. The view of Craft (2005) is that in the late 1990screativity in education has been globally viewed significant in conduct never supposed before. Preckelaet al. (2005) narrated that fluency, flexibility, and originality enhanced considerably along with ability to assess creative ideas. Karkockiene (2006) revealed divergent thinking is improved by well-structured classroom. Teacher should be creative for this purpose. (Samiullah, 2018)

According to Pewnim, Ketpichainarong, Panijpan, & Ruenwongsa(2011) Guided Inquiry method is very helpful in learning of some specific skills. Coulter (2004) comprehensive policy statement can build a creative learning in physics. Cheng (2004) explored that the relation between originality and appropriateness is difficult to demonstrate. Scott, Leritz, & Mumford, (2004) bring into being the meta-analysis of 70 studies; cognitive framework should be used as base for successful interventions. Educational procedures put pressure on the problem recognition, thought creation also theoretical blend that leads to success in studies. (Scott *et al.*, 2004, p. 382).Russo (2009) also exposed changeability between performance of students of medium and high-IQ and skills of creative thinking in his longitudinal study. Another study by Coulter (2004) was conducted to assess the effects of three classroom sessions (formal, informal and intermediate) on the creative output of the students of the college. Ninety students have been tested using Sternberg and Lubart creativity assessment test before and after participation in a teaching session. No significant changes have been found between classes average creativity of scores after the experimental session. In the intermediate class, there was a significant reduction of the scores before and after the session; however, in the other two classes, formal and informal, there was no significant change. A well-structured class environment brings a statistically significant and unique contribution to gains in divergent thinking above previous levels at the entrance of students in critical thinking. This finding applies to out-of-class environment as well and therefore supports the theoretical speculation for a long time that experiences academic and non-academic students jointly influence change in the capabilities of divergent thinking (Preckela*et al.*, 2005). Meador (2003) reported a positive effect of a model based on Guided Inquiry method on creative thinking of students in science.

According to Runco, Illies and Reiter Palmon (2003) there is a negative association among reserved conduct, divergent and convergent thinking. Lloyd and Howe (2003) positively relation between solitary active play and divergent thinking. Runco and Charles showed that originality was a more reliable predictor of creativity than appropriateness. In

another similar study, the authors remarked —Although applicant that things creative theories are both original and proper meaning, it is difficult to demonstrate the originality and relevance are themselves relatedll (Runco, Illies and Reiter - Palmon, 2003). In a study, Lloyd and Howe (2003) examined the positive relationship between multiple forms of solitary games and convergent and divergent thinking.

Chinn & Malhotra (2002) affirmed that novice scientists' affluent concepts in which they build up investigative skills through Guided Inquiry. Aroura and Kour (2014) explored a positive relationship between scientific creativity and school environment at Elementary level. Devi (2002) found that disciplinary practices and creativity are positively correlated.Hu and Adey (2002) put forward a scientific creativity model according to which Creative thinking in science consists of an amalgamation of creative procedure, attributes of the creative individual and ensuing products. Andrea Vincent, Brian, Decker & Michael (2002) divergent thinking have distinctive sound effects on creative problem solving.Jia, Hu, Cai,Wang,Li, Runco, & Chen, (2017) stated that flexibility and originality scores were high through Guided Inquiry method. Runco & Charles (2000) said that divergent thinking is a component of creativity. The rationale of creative thinking is to stimulate inquisitiveness and give your support to difference of opinion. Creative thinking is basically a method of making something creative, innovative, novel and original. Some skills like flexibility, novelty, associative thinking, smoothness, and imagery are also required for it.

Jhonson(2010) reported a positive effect of a model based on Guided Inquiry method on creative thinking of students in science. Yager (2000) stated that the course of scientific awareness sees the program as inspiring that ought to be well-thought-out significant in the creation and development of a creative mind. He found that students ask more questions, think creatively and explore diverse aspects of an issue.

Method and Procedure

The method and procedure adopted in this study is mentioned herein below:

Design

This experimental study adopted "Quasi-Experimental" design and more precisely "The Pre-test, Post-test non-equivalent control group Design" was followed.

Sampling/Sample

Convenience sampling technique was adopted to select the sample of the study. The sample of study comprised students of class 9 studying in IMSG, Islamabad. The researchers did not disturb the timetable of respective school so a whole classes were selected for the purpose of this research. The sample size was 60.

Instrument

The data of this study was collected from achievement test scores by administering the same test as Pre-test and Post-test. Beside the basic cognition/knowledge area, the test also contains questions that assess the originality of the students' ideas. The reliability of the test was calculated as 0.88 and the test was validated by a group of specialists in Allama Iqbal Open University Islamabad.

Procedure

The intervention of lesson study was applied for eight weeks covering three lessons in a week. Total 24 lessons were delivered following the "guided inquiry" pattern. The success of the intervention was determined by comparing both groups on the basis of their performance in pre-test and post-test. The data were obtained in quantitative form (test scores of students).

Data Analyses

The t-test was executed for analysis of data through SPSS software. The data were analyzed in the tables ahead. The data were analyzed in the following ways:

- Overall comparison of experimental and control groups in creative thinking in science.
- Overall comparison of experimental and control groups in fluency attribute of creative thinking in science.
- Overall comparison of experimental and control groups in originality attribute of creative thinking in science.
- Task-wise comparison of experimental and control groups in creative thinking in science (originality of ideas).

Table 1. Comparison of Control and Experimental Groups before Start of Experiment

Group	Pre-Test Mean
Control group n=30	16.00
Experimental group n=30	16.20

Table 1 (on previous page) shows the comparison of pre-test mean scores of both the control and experimental groups in overall performance of creative thinking. It also shows that both groups were almost the same in creative thinking skill.

Table 2. Overall Comparison of Control and Experimental Groups

Group	Post-Test Mean	SD (Post- Test)	*df*	t-value	Sig (2-tailed)
Control group n=30	13.10	3.48			
Experimental group n=30	40.99	7.53	58	4.80	0.00***

Table 2 indicates that in creative thinking test, the control group has mean score of the control group was 13.10 in the post-test. The experimental group students a mean score of 40.99 in post-test. The t-value for the comparison of the control group and experimental group at *df* (58) is 4.80, which is less than ρ‹0.05 is significant. Therefore, it can be concluded that experimental group students performed better than controls in terms of overall creative thinking students.

Table 3. Overall Comparison Fluency Component of Control and Experimental Groups in Creative Thinking

Group	Attribute	Post-Test Mean	SD (Post-Test)	*df*	t-value	Sig (2-tailed)
Control (N=30)	Fluency	5.10	1.20	58	2.40	0.001
Experimental (N=30)	Fluency	12.20	3.50			

Table 3 indicates that in creative thinking test control group has mean score in fluency is 5.10 in post-test. In the same skills the experimental group has mean value of fluency and originality in post-test is 12.20. The t-value for comparison of the performance of control group and experimental group is 2.40 at *df* (58), ρ>0.001 is significant.

Table 4. Overall Comparison Originality Component of Control and Experimental Groups in Creative Thinking

Group	Attribute	Post-Test Mean	SD (Post-Test)	*Df*	t-value	Sig (2-tailed)
Control (n=30)	Originality	7.90	3.60	58	3.70	0.001
Experimental (n=30)	Originality	27.50	6.90			

Table 4 indicates that in the creative thinking test control group has mean score in originality is 7.90 in post-test. In the same skills, the experimental group has a mean value originality in post-test is 27.50. The t-value for comparison of the performance of control group and experimental group is 3.70 at *df* (58), ρ>0.002is significant.

Findings

These findings were observed from the analysis of the data:

1. The results of data analysis revealed that in the pre-test, the two groups were at the same mean score so should be treated as equal before the experiment.
2. Overall attainment of the high school science students taught with the guided inquiry was significantly better than the students taught without it. The experimental group has significant improvement in the form of creative thinking skills as found by the data. Consequently, null hypothesis H_o1 was discarded.
3. On fluency of ideas' assessment based test items, the experimental group appeared on better mean score than control in the posttest. Therefore, the null hypothesis H_o2 was discarded. Therefore, in case of Originality, the improvement found by experimental group is significantly higher than the control group as found by the data.
6. On an originality of ideas' assessment based test items, experimental group appeared on the better mean score than control in the

posttest. Therefore, the null hypothesis $H_0 3$ was discarded. Therefore, in case of Originality, the improvement found by experimental group is significantly higher than the control group as found by the data.

Conclusion

This study provided insight into the inquiry-based teaching, which fostered the acquisition of complex skills like creative thinking among science students. Skills and knowledge that can be applied across disciplines are the current social demands of the world. The following conclusion is made from the findings and data analysis:

It is concluded that traditional methods of teaching are not effective for inculcation of creative thinking skills in Pakistan. The inquiry method of teaching is better than traditional methods for producing the creative thinking of students in Pakistan at elementary level. Guided Inquiry method of teaching improved the originality in creative thinking skills as compared to routine practices of teaching creative thinking skills.

Recommendations

1. The inquiry-based teaching method is recommended for science teachers of elementary schools in order to enhance creative thinking of their students.
2. The inquiry might be valuable for trainings, workshops, and seminars for teachers to create awareness about inquiry-based teaching methods and creative thinking skills.
3. Studies on effect of inquiry-based teaching on creative thinking of students of primary and elementary level are also recommended.
4. It is recommended to check Effect of inquiry method on critical thinking of students at all educational levels.

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