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A Case Study of Concept Formation vs Traditional Teaching Methods in Physics at School Level

Kiramat Shah
PhD Scholar in School of Education
Soochow University, Suzhou, China
Kiramatshah2u@gmail.com

Majid Khan
PhD Scholar in School of Physical Science and Technology, Soochow University, Suzhou
Jiangsu, 215006 China
mk6218701@gmail.com

Ponam Saba
PhD Scholar in School of Education
Soochow University, Suzhou, China
ponamsaba86@yahoo.com

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Abstract

The present study investigated the development of concept formation in formation learning for the class IX students in Physics to find out the efficacy of concept formation and traditional methods of teaching at school level. It was experimental in which both methods of teaching was compared with traditional method of teaching. A sample of 300 students were selected from four private high schools of boys and girls of district Peshawar. Pre- test and post- test were used for the collection of data. Each of the experimental and controlled group was taught with concept formation and traditional method of teaching for three months. Pre-test was arranged in the beginning of the experiments. After three months post-test is taken to know the effectiveness of concept formation and traditional methods. To determine the effects of concept formation method of teaching on achievement of Class IX students in the subject of Physics, the significance of difference between the mean achievement scores of experimental and controlled groups was tested by applying *t* Test. The experimental group shows good result than the controlled group in post-test because of concept formation method of teaching. Hence the ultimate results of the study indicated that concept formation method of teaching was more effective as compared to traditional method.

Keywords: Physics, School level, concept formation, traditional method.

Introduction

Concept formation is an inductive teaching strategy that helps students for a clear understanding of a concept through studying a set of examples of the concept. Teaching is an important technique used by the teacher to transfer information and guideline to the students. It must be a dynamic and planned rather than a static one. Effective teaching is an important guideline to promote the understanding of the students. Several teaching methods have been used time and again to make the teaching process more effective. Like the third world countries Pakistan is also a developing country and the development of our country is based on the quality and quantity of education. To improve the quality of education the instruction inside the classroom must be improved. Teacher is the key factor in this direction. It is believed that skill, knowledge, and teaching methodology which can be used by the teacher can affect the teaching process and improved the learning ability of the students. This is possible only when a suitable method is used by the Teacher. According to shah (2019) Concept formation is one of the modern and successful method used for the clarification and understanding of the students' concept. It is an inductive teaching method which helps to form a clear understanding idea and concept through studying a small set of examples of the concept.

Holly (2016) usually the learning process of the students is based on memorization. The teacher is unable to encourage his students to take part in the activities of the classroom. This type of teaching methodology has only one aim as to prepare students just for examination and better grade. The present classroom teaching is based on strict discipline, memorization, fixed and ridged curriculum. The classroom is full of fear, tension, formalities and strict control. The most important of educational system is to find out some new teaching methodologies to facilitate the learning process. It is the responsibility of the class teacher to use an effective teaching method based on thinking and interest rather than memorization and compulsion.

Hand (2017) It is the general observation that the aim of education is to prepare adult for truth and precision and mental discipline. Khan (2015) concluded that Concept clarification is based on appropriate teaching method. A method is not merely advice adopt for communicating certain items of information to students. It links the teacher and his pupil into an organic relationship with the constant mutual interaction. The quality of students' life may rise by applying good methods and bad methods may debase it. Good methods play a great role in the development of concepts.

Concept formation method is a proper teaching method, used by the teacher to transfer information to the students. It allows simplification and the expansion of knowledge from known objects to unknown. Examples are provided from the events, things, and process to make a link between the teacher and the students. Thus, concept must be formed at the initial stage to find out the solution of the problem. Thus, it is the need of the situations to find out new method or techniques in addition of the traditional teaching method for the clarification of students' concept.

Research Objectives

1. To know the level of understanding and concept formation of students in Physics at School level.
2. To know the effect of concept formation method of teaching in Physics at School level.
3. To find out the difference of the academic achievements of the students when taught by concept formation and traditional teaching method.

Literature Review

Mondell, B.C. (2013) studied the effect of Information Processing Model on teaching Science. He found that the efficacy of Concept formation Model against the traditional methods of teaching science is very high. The experimental group found better cognitive skills and creativity then the control group.

Every society has a number of challenges such as feeding and accommodation for the population, wellness and healthy living, protection and shielding of the environment, producing sufficient energy, supplying of clean water, and climate change. By working together in participatory ways, we can better solve and obtain the goals and outcomes of science education and perform research with the values, needs and expectations of the society (European Union 2012). Concept formation provides job opportunities as well as cultural awareness and the ability to act towards people as well-informed and good citizens around the whole world (European Commission 2013).

Colleges occupy an extremely important position in our education system, because in all Colleges, science education is provided with facilities for students. Colleges provide healthy and sound conditions to prepare students for higher education and promote science education. So, it is clear that the colleges fulfil their important role in the national development, having rich physical facilities for healthy academic atmosphere. For students, there should be hostel accommodation and well balanced curriculum and co-curriculum activities should he provided to the students (NEP1979, P.88)

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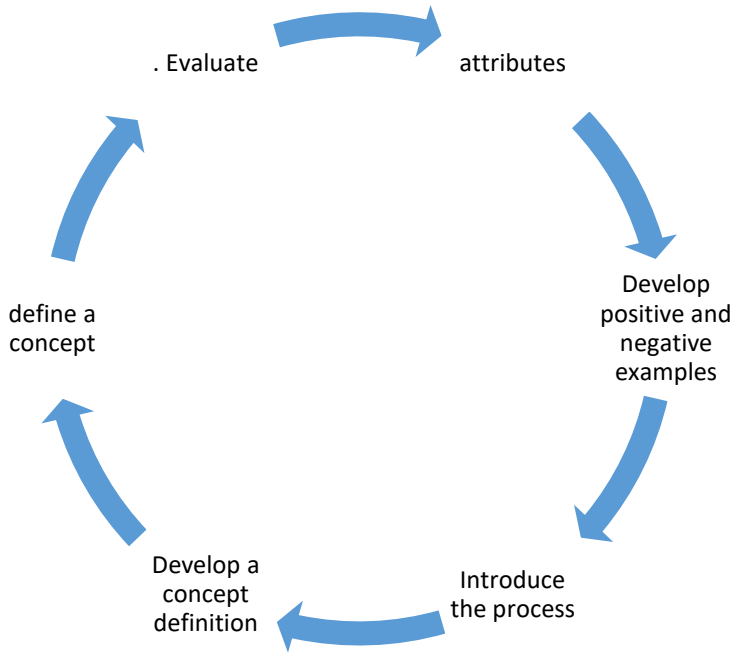
Steps of Concept Formation

1. Select and define a concept
2. Select the attributes

3. Develop positive and negative examples
4. Introduce the process to the students
5. Develop a concept definition
6. Evaluate



Johnson and Alibali in (2002) found out a relationship in conceptual development and mathematical procedure skill. The result finds out show that conceptual change is important in the procedural skill for mathematics.

Howson and Howson (2004) through an article showed the effect of teaching by using student's earlier knowledge and the strategies for the conceptual change in the learning of science. The study was basically conducted for the effect of alternate conceptual change toward scientific concept. The students show a significant improvement in the achievement of scientific concept with the help of teaching strategies and the use of related learning materials. In the field of Chemistry related to the topic of equilibrium for the misconception of the students learning power. She fined that learning power of the students is increased if suitable questions are asked from the students related to the topic. She concluded that if the existing concept of the students in promoted to a new concept the learning power can be increase in a satisfactory manner.

Nari in (2016) found out with the help of a paper the conceptual development in science education. Through evidence it was find out the traditional method of teaching is not satisfactory for the conceptual development. In this paper stressed were given on the formation of fresh concept for the achievement of knowledge. Geban (2005) conducted a research on

acid-base in the subject of Chemistry. The research was conducted for the class 10th students to promote the conceptual development and the textbook oriented teaching accompanied with resemblance. They find out through research work that conceptual changes are a process of the replacement of the old concept followed by the addition of new materials in learning process of the students. The conceptual changes materials should be arranged in such a way to motivate the students for better understanding. From the research it was concluded that results of the experimental group were through conceptual changes than the results of the controlled group through traditional teaching methodologies.

The working group of Institute of Max Plank and Haifa (2007) in Berlin found out through a research that how the understanding of the students can be revised, shifted and gained with the help of concept formation teaching methodology. According to these researcherss there is a link in the gain, shift and the revision of knowledge.

Onder (2005) concluded through a research through conceptual development for the class 10th students on the topic of the equilibrium in the solubility in the subject of Chemistry. From the study it was clear that results of the experimental group students were better through conceptual changes then the results of the traditional group students.

Howson (2007) put forward his research proposal for the conceptual change in the subject of Physics. From the result obtained it was concluded that transfer of knowledge through conceptual development is an effective mean in teaching learning process.

Bisbey (2007) concluded that concept development is an important cognitive agent where transfer of knowledge related to the example of objects and events in the daily life.

Baser (2007) arranged a research for the understanding heat and temperature for the grade 2 primary school students. Two groups of the students such as experimental and controlled group were selected. From the results obtained it was clear that score obtained were considerably higher than the score of the controlled group students.

Revenscoft (2008) through an article showed the promotion of conceptual changes and thinking power of the students in digital discussion game. The review of this paper was a dialogue based research in the past 10 year's conclusions of conceptual changes and dialogue in the digital game.

The paper of Attilla (2008) is based on the effective teaching of science and presented six principles for the teaching of science effectively like encouraging the students, dealing with students, promoting the concept, how to apply the new concept and skill, feedback from the teacher, cooperative learning.

Vosniadon (2008) presented a paper on the conceptual changes in education. He concluded that for effective learning and conceptual changes students are not relied only memorization process. Students must learn how to construct a new concept base on the daily life examples and experience. Conceptual changes are only possible when the teacher used a systematic method of teaching. Teacher first creates an effective social environment of the classroom which helps and motivates the students for the learning process.

Pecina (2009) concluded through a research the indication and assessment of fundamental teaching procedures needed for the encouragement of conceptual changes of the students. They find out significant learning of Physics, it is needed that the teacher find out alternate concept which help the students to overcome the difficulties that arise in the formation of an effective concept.

Boumova Viera (2009) conducted a research study on traditional vs. modern teaching methods' advantages and disadvantages. From the study it was concluded that how to modify the concepts of the students in learning of language through traditional and modern methodology.

Pinarba (2010) performed research for the promoting of conceptual development on the topic of chemical equilibrium. He fined that when conceptual a development student shows significant results than the students of the traditional teaching method. The result of the students having better conceptual changes have better results in the learning of Physical equilibrium.

Ozmen (2010) concluded through an article the importance of conceptual development in computer animation for class 11^{th} students. Student having better conceptual development shows significantly higher results in the computer animation. Muhammad and Pardhan conducted research and published a paper in (2006) on conceptual understanding of the students in science and mathematics. With the help of this paper, they found out that for the teaching of science and mathematics the skill of the teacher and their novel teaching are very important.

Rahman and Zaidi (2008) conducted a paper on the study of chemical education in Pakistan. They highlight the curriculum of Physics of class XI and X and the contents included the curriculum. Four periods are allowed within a week with time duration of 40 minutes. Eight months average working session within one year which is about 128 periods for the teaching is available. Stressed were given on the problem solving method of teaching and the used concept formation skill methodology in the teaching learning of Physics.

Awan (2010) finds out through a research the misconception of the students and Meta cognitive effect upon the student's achievement. From the results obtained it was clear that students having refined conceptual changes shows better results about atom, molecules, and matter.

Ammna (2011) conducted a research upon concept formation and its importance over the traditional teaching method in Chemistry for class X students at secondary level. From the results it was clear that student of the experimental group when taught through concept formation method of teaching show significantly better results than students of the controlled group through traditional method of teaching.

Besides these research works, more struggles are needed in the form of research to find out more effective methods and the importance of concept formation and traditional method of teaching to motivate students for better understanding and achievement at secondary level.

Procedure of the Study

The researcherss selected two group of class IX randomly from the selected Private high schools for boys and girls of district Mardan. One group named as experimental group select for the concept formation method of teaching. Second group named as controlled group select for traditional method of teaching. The teacher select for the teaching of both groups were the same qualification and experience such as Postgraduate degree in Physics, B.Ed., and 10 to 15 years of teaching experience. The teachers of both experimental and controlled group students taught the same topic at the same time-period duration of 40 minutes. The researchers taught the Physics itself to the experimental group through concept formation teaching method.

Before starting experimental teaching, a pre-test was arranged for both experimental and controlled group students to find out the position of learning of the students' concept in the learning of Physics. The research study was continued for about three months. Each Monday was selected for the test in the lesson studied earlier. Every fourth Monday was selected for monthly test in which all the learned course lessons for one month were included. The weekly and monthly test were components of direct teaching method. All the remaining five days per week, the students were busy in teaching-learning process of concept formation method of teaching.

At the end of the experimental research the pre-test was again arranged as post-test, both for the experimental and controlled group students to know the results of concept formation and traditional method of teaching.

One section of the class IX was selected randomly by the researchers as experimental group for the teaching group of Physics with the help of Concept formation method of teaching. Another group was named as controlled group which was taught by their schoolteacher. Qualification and experience of both the experimental and controlled group teachers were the same such as Postgraduate degree holders of Physics and B.Ed. with 10 to 15 years of teaching experience. The teacher of the experimental and controlled group students taught the same topic with same period of duration of 40 minutes according to the school timetable. The experimental process was observed and proceed for two months.

Research Tools

The following tools were used by the researcherss for the collection of data:

1. An achievement test used by the researchers to know the current position of understanding of the Class IX students in Physics. The conducted test was consisted of 60 multiple choices questions (MCQs). The (MCQs) were selected Physics IX Book of KPK Textbook Board. The Achievement test was arranged for 300 students of four public High Schools for Boys and Girls in district Peshawar.
2. A pre-test was set in Physics to know the level of knowledge of the class IX students. The test was consisting of 60 Multiple Choice Questions (MCQs) from different Chapter the Physics of class IX of KPK Textbook Board Peshawar. The pre-test was arranged for about 150students of Controlled groups and 150 students of experimental group students of Class IX of four selected Private Schools for Boys and Girls in district Mardan.

Data Analysis

The following statistical processes were used for the calculation of data obtained through test instruments.

1. Standard deviation and mean were the statistical terms used for the calculation of the test score of understanding level for the class IX students in Physics (formulas for means, variance, standard deviation S)
2. Similarly, standard deviation and mean were also used for the calculation of test score of the experimental and controlled group students in their pre-test and post-test in Physics for boys and girls of class IX.

	STATEMENT	N	Mean	SD
1	Standard deviation and mean achievement score for male in Physics	150	15.33	10.02
2	Standard deviation and mean achievement score for female in Physics	150	14.66	9.43
3	Test achievement score of the controlled group in their pre-test for school II.	150	15.5	9.00
4	Test achievement score of the controlled group in their pre-test for school III.	150	17.67	10.01
5	Test achievement score of the controlled group in their pre-test for school II	150	15.5	10.77
6	Test achievement score of the controlled group in their pre-test for school IV.	150	17.67	11.01

7	Test achievement score of the controlled group in their post- test for School II	150	18.10	11.51
8	Test achievement score of the controlled group in their post-test for school III	150	18.02	11.56
9	Test achievement score of the controlled group in their post-test for School I	150	15.95	10.64
10	Test achievement score of the controlled group in their post-test school IV	150	18.10	11.12
11	Test achievement score of the experimental group in their post-test for school II	150	25.5	10.87
12	Test achievement score of the experimental group in their post-test for school I.	150	23.68	11.14
13	Test achievement score of the experimental group in their post-test for school III	150	23.32	11.00
14	Test achievement score of the experimental group in their post-test for school IV	150	23.83	9.48

Test achievement for controlled group in pre-test foe school iii was 9.77 and 15.5 respectively which indicate that the performance of the learners was not satisfactory. School vi data revealed the mean score 11.01 and 11.67 which was the same below standard score. Item 8 result indicated that the SD of the experimental group was 10.74 and 10.75, respectively. Mean was 16.79 and 10.75 respectively and the differences of the mean were less than 0.05 level which is non-significant. Item 9 result shows that SD for the experimental and controlled groups were 10.69 and 9.77 and mean values are 15.95 and 15.54 respectively for the experimental and controlled groups. Hence the difference of the two means was less than 0.05, non-significant. The standard deviation score for the experimental and controlled groups for item 10 were 10.20 and 10.01, respectively. While mean of the experimental group is 17.67 and controlled group is 17.54. The difference is less than 0.05 which is non-significant. The item 11 shows that standard deviation and mean achievement score for the controlled group in their posttest through traditional teaching method were 11.51 and 18.10, respectively. The item 12 indicates that S.D and mean value for the controlled group in their post-test through traditional teaching method were 11.56 and 18.02, respectively. Item 13 shows that S.D and mean value score for the controlled group in their post-test through traditional teaching method were 10.64 and 15.95. Item 14 show that standard deviation and mean value for the controlled group in their post-test through traditional teaching method were 11.12 and 18.10. Item 15 shows that standard deviation and mean value for the experimental group in their post-test through concept formation teaching concept formation teaching method were 10.87 and 25.5. Item 16 results that S.D and mean value for the same group is 11.14 and 23.68. Item 17 results that S.D and mean achievement score were 11.00 and 23.32. Item 18 results that S.D and mean value for the experimental group in their post-test through concept formation teaching method were 9.48 and 23.83. Item 19 results that the mean test score of the experimental group in their

post-test is 25.5 and controlled group in their pre-test is 17.54. Item 20 show that the mean value of the experimental group in their post rest is 23.68 and controlled group in their pre - test is 16.80. Item 21 shows that the mean value for the experimental group is 23.32 and controlled group 15.5. Item 22 show that the mean value of the experimental group in their post- test is 23.83 and controlled group in their pre- test is 17.67. Item 23 show that the mean value of the experimental group in their post- test is 25.5 and controlled group in their pre- test is 18.10. Item 24 indicate that the mean value of the experimental group in their post- test is 23.68 and controlled group in their pre-test is 18.02. Item 25 indicates that the mean test value of the experimental group in their post -test is 23.83 and controlled group in their pre- test is 15.95. Item 26 that the mean value of the experimental group in their post- test is 23.83 and controlled group in their pre- test is 18. 02.

Discussion

This study was to find out the position of understanding of the class 9th class students in physics with the help of concept formation and traditional teaching method. This research work supports the research study of the Hayes in 2003, the study of Atalla 2007, *Awan* 2012. From their statistical calculation, they found that the present position of understanding of the class IX students in physics is not satisfactory. Most of the students find physics as a difficult subject as compared to other science subject. They do not know about the concept of basic definition in physics. Concept bearing teaching is the main factor for the successful understanding in physics which requires experiences and more effort in part of the teacher to teach physics to the students at secondary level. It is the responsibility of a teacher to utilize the preceding knowledge of the students to clarification of the concepts. This research study also supports the research work of the Picina in 2008. They found that teacher should stress on the conceptual changes in Science subjects and especially in physics. The finding of the research of the *Azizoglu* in 2005 indicates that teacher student's interaction through questions inside in the classroom play a pivotal role in the process of learning. The current study of this research is related with the finding that suitable method which clarifies the students' concept make the learning process mere easy. In concept formation teaching method opportunities are provides to the students through question asking and discussion to clarify their concept. This method cause difference in the test score of the controlled and experimental group students. Differences existed in the concepts of the controlled group students and experimental group students. The students of the controlled group students face some difficulties in the explanation of the concept. The experimental group student uses their previous knowledge for the clarification of the concepts.

The present research study is also similar with the finding of the research study of the Porter 2004. According to their studies if the early mistakes of the students are not controlled in the initial stages than the students are habitual of these mistakes. Teacher through proper evaluation and monitoring can rooted out the mistakes to increase the understanding of the students. The finding of the Saleem Khan in 2011 proved with the help of research, the effectiveness of concept formation method of teaching and its importance over the traditional

method of teaching in physics at school level. According to Saleem when the teacher teaches to the experimental group with the help of concept formation method of teaching the concept of the students is clear and their achievement in the post test is increased as compared to the controlled group students as taught by their school teacher through traditional teaching method. The research study also supports the finding of the *Salami* and *Baser* in 2006. According to *these* research studies there is no significant difference in the attainment of the male and female students in physics subject. The study supports the work of the Hewson and Nersessian in 2006. The results of their studies show that with the help of concept formation methodology of teaching the old ideas of the students can be molded in to new and improves ideas. From the results of the pre-test and post-test they proved that concept formation method is helpful to modify the concept of the students.

The current research study indicates that the present position of understanding in physics of the class IX students is not satisfactory which is clear from the data of the controlled group. Concept formation teaching method improved the performance of the students as the data obtained from the experimental Group in their post-test.

Summary

The main purpose of this research study was to find a solution to the criticism against the method of teaching and position of understanding of the students in physics at school level. Concept formation and traditional method of teaching was used to teach physics to the class IX students at the school level. Weaknesses of the students were found through proper evaluation of the students with the effectiveness of concept formation and traditional method of teaching.

Two tests were developed for the collection of data to prove the hypothesis.

For the measurement of understanding of the students in physics the test was developed known as achievement test. The test consists of 60 multiple choice questions (MCQs) which were selected from the Physics book of class IX of different chapters from Textbook Board. The achievement test was developed for the purpose to know the knowledge, understanding and application level of students in the class IX in physics at school level. The achievement test given to about 150 students.

Pre-test was arranged in physics of class IX for the Measurement of understanding and knowledge of the class IX students at School level. The pre-test was consisting of 60 multiple choice questions MCQs selected from different chapter of the physics books by KPK Textbook Board.

Pretest was then given to the experimental Group as post-test to know the effect of concept formation and traditional teaching method of the class IX students at School level.

Lesson plans for the concept formation teaching method was developed in different chapter of the physics Book of KPK Textbook Board. The format of the lesson plans was derived from the instruction of McVittie (2002). The expert in physics and education checked and then approved the lesson Plans. The teacher of the traditional group also developed the lesson plans in the same chapter as for the concept formation method through the format of *Herbartain* steps. After collecting of data with the help of achievement tests, statistical methods like standard deviation and t-test were for the analysis of tests data.

The position of the mean of the experimental group in their post-test through concept formation method of teaching for school I school III and school IV. From the values it is clear that all means of the four Private high schools for male and female was greater than 50 percent and position of learning of the experimental group through concept formation method of teaching is better than the performance of the controlled group and satisfactory.

A comparison of the pre-test score of the controlled group and post test score of the experimental group with the help of t-test, the values obtained for school I school II school IV. These values are greater than the table t-values at 0.05 in significance. From the result it is clear that attainment score of the experimental and controlled groups in their pre-test and post was different and performance of the experimental group is better than controlled group.

Conclusions

Based on the findings of the research study the conclusions were made:

1. The current position of learning of both male and female are less than 50 percent, which is not satisfactory.

2. The attainment test score of the controlled and experimental groups of four selected public high schools for male and female is different in their pre-test.

3. The performance of the experimental groups of four selected public high schools for male and female were better in their post-test.

4. The performance of the experimental groups of four selected public high schools for male and female were better in their post- test than their pre-test.

5. The performance of the controlled groups of schools I and II for females were better in their post-test than their pre-test.

6. Better academic attainments of the experimental group of class IX in Physics for male and female students were related to concept formation method of teaching.

7. The attainments test score of the score of the female students of the controlled and experimental groups of four selected private high schools were better than male students.

8. The effects of the concept formation method of teaching were satisfactory for the entire experimental group.

Recommendations

1. Concept formation method of teaching is helpful to change the old and traditional setting inside in the classroom where the students used their own knowledge to resolve their own problems.
2. Concept formation method of teaching is helpful to change the concept of the students, these changes reinforce the concept. Conceptual modification helpful in the formation of composite concept.
3. Teacher used important techniques during the demonstration of lecture. Interesting materials must be included to preserve the interest of the students and increased the learning process.
4. The old and obsolete methods for assigning of homework must be avoided. Comprehensive and concept formed method must be used for the process of evaluation of the students.
5. The results of this research study are a guideline for the policy maker to provide training to teacher based on concept formation method of teaching.
6. The research study recommended concept formation method for Physics and other science subjects at secondary and higher levels.

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