CHAPTER 5
SUMMARY AND CONCLUSIONS

5.1. INTRODUCTION

This chapter includes brief summary of the study, findings, conclusions, educational implications and suggestions for further research.

5.2. BACKGROUND OF THE STUDY

Modern education emphasis on learner centered and joyful learning which is the need of the hour as well initiated by educationists. They opine that, children need to keep active throughout the teaching and learning process and encourage self-learning and independent learning. Such practice is considered as constructivist teaching in education field. It is one of the novel practice emerged during 1950’s and 1960’s. It is considered as leading theory of learning. It has changed the educational practice and converted Passive Learner Centered Environment into Active Learner Centered Environment.

Constructivism believes that learning is not encouraged in zero ground but on previous experience and prior knowledge. It is the beginning for construction or learning of new knowledge. Hence, the word constructivist teaching advocates construction of knowledge by the learner rather than importing knowledge from teacher. There are three forms of constructivism namely, cognitive constructivism, social constructivism and radical constructivism. The first type of constructivism was contributed by Jean Piaget. His cognitive development theory leads to cognitive constructivism and focus on knowledge construction in an individual process. In this perspective, individual construct new knowledge by restructuring and enlargement of mental pattern based on existing mental patterns. Thus, individual prior knowledge helps us to construct our new knowledge. Social constructivism is the second type of constructivism and it was pioneered by Vygotsky. His socio culture history addresses social constructivism in education. The prior cognition is existing in our society, culture, family etc. students interact with in these social agents to construct their knowledge. In case of classroom, learning is considered as social process, student entered the classroom with their prior knowledge. This prior knowledge is the basis to
interact with their peer and helps to construct their knowledge in group. The third type of constructivism is radical constructivism and popularized by Glaserfeld. In this approach students construct their knowledge in subjective nature. In this study, based on the nature of social science subject, social constructivism is considered for Constructivist Teaching (CT).

Constructivism is practiced by using different approaches. 5 E’s instructional model, cooperative learning, problem based learning, project based learning etc. were used in school education. Among these, 5 E’s Instructional model and cooperative learning strategies were recent emerging practice, which are initiating learner centered education and engage children in knowledge construction. These approaches were emphasized in present school and teacher education curriculum of Karnataka.

5 E’s instructional model is the most used constructivist method. It was developed by Roger Bybee for Biological Science. Also called as Bybee constructivist design (Lord, 1998). It is also popularly known as BSCS 5 E’s instructional model. It uses continuous instructional process for better understanding and proceeds instruction in systematic phases (Dass, 2015). The model uses the features of cognitive and social constructivism in engaging students. It implements constructivist process in 5 E’s instructional phases namely engage, explore, explain, elaborate and evaluate (Ergin, 2012). As an instructional approach, it is used to engage students based on prior knowledge and subsequently students are encouraged to construct new knowledge through process of exploring the ideas in a given situation, following explanation of explored ideas and elaboration to novel situation and thereby, at the end, teacher evaluate the students understanding of knowledge construction. By following sequential steps “5 E’s Instructional Model serves as an understandable and manageable application of an integrated instructional sequence” (Bybee, 2013). The approach and its steps are taking prominent position in 21st century education. Booker and Kopp (2013) expressed that; constructivist oriented 5 E’s Instructional model useful in addressing the 21st century skills such as critical thinking, communication, collaboration and creativity among the students. All these skills effectively developed by linking prior knowledge and present knowledge. Additionally these skills were very basic requirement for teaching science and social science subject.
Cooperative learning approach and its strategies are group oriented activities used in school for child centered learning. Constructivism and cooperative learning are intimately and integrally related. Basically constructivist perspectives provide theoretical basis for cooperative learning (Applefield, Huber, & Moallem). Lev Vygotsky’s sociocultural theory of learning, Piagetian cognitive learning theory and Albert Banduras socio cognitive theory of learning are the main theoretical premise behind development of cooperative learning. Indeed, “Constructivist approach to teaching typically make extensive use of cooperative learning, on the theory that students will more easily discover and comprehend difficult concepts if they can talk with each other about the problems” (Slavin, 2003). Constructivism uses cooperative learning tasks as well as peer tutoring and dialog for engaging in problem solving. Lastly, in order to reach Zone of Proximal Development, again cooperative learning takes the help of peer group and encounter the potential zone (Applefield, Huber, & Moallem). In this way, cooperative learning strategies are useful in engaging children in constructivism. The popular cooperative learning strategy is Jigsaw and it is developed based on social constructivist approach and engages child in group activity. There are two types of Jigsaw; Jigsaw-1 and Jigsaw-2. Jigsaw-1 was developed by Elliot Aronson and Jigsaw-2 by Robert Slavin.

Jigsaw-1 cooperative learning technique, it leads in the form of dividing the entire class into small group and each group is made up of six members. Each member has small section of content, and ‘same section content members’ of different group’s meet and discuss the content to become experts. After that, they return back to their team and each member teaches to their team. Thus, they learn entire portion by listening to their team members (Manning & Lucking, 1991). At last teacher evaluate the achievement of students by asking questions. Jigsaw II modified cooperative learning adopts Student Team Learning Program. In this strategy, the class will be divided into small groups of 4 to 5 students and the students are assigned with same topic than the specific section of content. They read the common content such as book chapter, short story or biography. Further, they receive specific topic on which they mastered. Accordingly, they meet in the expert group and gets mastery over the content. Later, they rerun to their team and teach to their team members. At the end, they take individual quiz which results in individual score and team scores as in STAD (Slavin, 1996). Thus, Jigsaw cooperative learning strategy follows two
important attributes; home and expert group activity and second one is learning by teaching i.e. peer tutoring. In the present study, Jigsaw- 1 cooperative learning technique is considered.

Constructivism and constructivist related practice like 5 E’s instructional model and Jigsaw, technology and integration of technology are important practices encourage students’ independent learning. In the present educational context, educational technology and computer technology are becoming popular in the form of drill and practice, tutorial etc. It is used for independent learning, information processing and developing critical thinking skills. It can be seen that technology also substantiates constructivist procedure. Therefore, the integration of technology into constructivist teaching makes knowledge construction process meaningful and effective. Use of such practice is highly useful in social science subject.

5.3. NEED FOR THE STUDY

Learning is an important task of learner. Teacher engage learner in real learning situation to cultivate active learning. But traditional practice like rote learning, repetition and practice may not engage students in active learning. In true sense “Learning takes place within the mind of the learner” (Sivarajan & Faziluddin, 2007). It means, learner internalizes their ideas, views and thoughts in their mind and it is the duty of the teacher to create situation to engage the students in meaning making experience. The emphasis here is on “interaction between the learner and learning environment” (Sivarajan & Faziluddin). Thus, there is a need for using previous experiences or ideas for shaping new knowledge. In reality, active role of students in conceptualization of their learning is important and it is termed as constructivist pedagogy and constructivist movement in education. In this pedagogy, teacher is called constructivist teacher, studentes are termed as constructive learners and environment is called constructive learning environment. Thus, the approach is a paradigm shift from traditional learning environment into constructivist learning environment.

According to Jean Piaget “Schemata or thought strutures or world realities are constructed by incorporating relevant new information into existing information”. In constructivist perspective “learner discover inadequacies between their existing
concepts and new situations they encounter as they explore their environment, children construct or conceptualize their existing knowledge with their new information to construct more complete high-order concepts” (Ornstein, Levine, Gatek, & Vocke, 2011). This theory holds that “learning always builds upon knowledge that a student already knows; this prior knowledge is called a schema. Because all learning is filtered through pre-existing schemata, constructivists suggest that learning is more effective when a student is actively engaged in the learning process rather than attempting to receive knowledge passively” (Santhoshi & Babu, 2014). The approach also claims that student learns individually, collectively through various learning strategies like problem solving, discovery learning, critical thinking, active learning and interactive learning in a dynamic way. In this regard, constructivism encourages “constructing something” instead of “receiving something” in the classroom. On the similar note Narang (2013) viewed that “Constructivist paradigm calls for a change in classroom culture, attitudes, beliefs and practice. Role of teacher in this paradigm shift from transmitter of knowledge to investigator and explorer of knowledge. Role of student changes from knowledge acquisition to knowledge construction”. In this way constructivist theory of learning brought revolutionary changes in education and it is rightly accepted as one of the pedagogical practice in National Curriculum Framework 2005 and National Curriculum Framework for Teacher Education 2009 in India. The approach is also introduced in school education of Karnataka by revising the primary and secondary school curriculum 2012. Similarly, to meet the standards of school education, DSERT prepared the Karnataka Elementary Teacher Education Curriculum 2012 and successfully implemented in primary teacher education from the academic year 2013. Accordingly, secondary teacher education curriculum is also revised at the university level by keeping in view the constructivism as rational approach for curriculum transaction. Thus, constructivism is considered as one of the important practices in our national and state education school curriculum document to encourage learner centered education.

Apart from constructivist approach, technology and technology integration highly influence present education system. It is used to develop remembering and understanding of the information using skills of the students (Upadhyay & Sikdar, 2012). The technology era indicates that, it is necessary to use technology tools in the
construction of knowledge. Constructivist approaches also carried using technology tools like concept-mapping, multimedia and hypermedia etc. These tools are useful to engage learner actively in many thinking skills such as manipulation of information, problem solving, own illustrations and self-learning etc (Sikdar & Bhojwani, 2010). Jonaseen has rightly termed these tools as “Mind Tools”. These tools are highly useful in constructivist teaching. Use of situated cognition is another important constructivist component which often helps in engaging the student’s in construction of knowledge based on social constructivist approach. Its main assumption is, knowledge exist in people, culture and language, and those helps in knowledge construction. Technologies also present these aspects in the form of technology tools like multimedia, pictures, animation, videos etc. These will help in engaging the students in knowledge construction in social aspects. Along the similar lines, the contemporary approach mind and learning in learning sciences emphasized various tools and technology components mediate and engage human kind in thinking and problem solving activity (Gee, 2010).

The forgoing discussion furnish that constructivism as well as technology tools are used in the construction of knowledge. It is also evident from the ideas emphasized by constructivist teaching practitioners as discussed in the integration of technology under section 1.7.3 chapter I summarizes that technology tools like text, audio, visual, audio visual, multimedia, hyper media, PPT etc useful in engaging learner in technology based constructivist teaching. In this context, there is a real call for technology integration in constructivist practice and gives new framework for learning, teaching as well as for learner centered educational environment. Particularly, usage of such blend of technology is useful and relevant for social science subject to encourage active learning and upturns the students’ involvement. Hence, the present study is conducted to study the impact of Technology Based Constructivist Teaching on academic achievement of IX standard students of Social Science subject.

5.4. TITLE OF THE STUDY

The title of the study is “An Impact of Technology Based Constructivist Teaching on Academic Achievement of IX Standard Students of Bengaluru City”.

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5.5. OPERATIONAL DEFINITIONS

Constructivist Teaching (CT)

Constructivist Teaching refers to a process in which learning environment is created by the teacher to engage students in knowledge construction based on prior knowledge in the group, wherein peer interacts with one another with the help of the materials provided by the teacher and construct new ideas and concepts.

Constructivist Teaching is based on integration of major components such as 5 E’s Instructional Model and Jigsaw Cooperative Learning strategy. Basically it follows features of Social Constructivism.

5 E’s Instructional Model

It is an approach in which the teacher follows five ‘E’s model (Engage, Explore, Explain, Elaborate, and Evaluate) to facilitate the learners to create their own knowledge.

JIGSAW

Jigsaw is a cooperative learning technique in which students are engaged in learning through home group and expert group activity.

Technology Based Constructivist Teaching (TBCT)

In this study, it refers to an approach in which the researcher integrates components of technology in constructivist teaching.

In TBCT researcher integrates components of technology in Constructivist Teaching using 5 E’s Instructional Model and Jigsaw Cooperative Learning Strategy.

Impact

It refers to, the effect of CT and TBCT on the Academic Achievement of students studying in secondary school level.

Academic Achievement

It refers to the achievement of students in selected topics of Social Science, before and after the intervention of CT and TBCT.
5.6. VARIABLES OF THE STUDY

Keeping the problem and objectives, three types of variables i.e. independent variable, dependent variable and moderate variables were considered in the study. Constructivist Teaching (CT) and Technology Based Constructivist Teaching (TBCT) and types of school were considered as independent variables, whereas academic achievement in Social Science was the dependent variable. Gender and IQ were termed as moderate variables. Variables of the present study are presented in the following headlines.

Independent Variables

- Constructivist Teaching
- Technology Based Constructivist Teaching
- Types of School-Government and Private School

Dependent Variables

- Academic Achievement in Social Science Subject

Moderate Variables

- Gender - Boys and Girls
- IQ - High and Low IQ

5.7. OBJECTIVES OF THE STUDY

The main objectives of the study were

1. To develop Constructivist Teaching (CT) and Technology Based Constructivist Teaching (TBCT) package for selected units of IX standard Social Science subject.
2. To find out the impact of CT and TBCT on the academic achievement of students.
3. To find out whether any difference exists between the group taught by CT and TBCT with respect to academic achievement.
4. To find out whether any difference exists in the academic achievement of students of government and private school with respect CT and TBCT.
5. To find out whether there would be any difference between boys and girls with respect to their academic achievement, due to the impact of CT and TBCT.

6. To find out whether there would be any difference between High IQ and Low IQ students with respect to their academic achievement, due to the impact of CT and TBCT.

7. To find out whether there would be any correlation between IQ and academic achievement of students.

8. To find out the main effect and interaction effect of IQ and Gender on the academic achievement of students.

5.8. HYPOTHESES

The main hypotheses of study were

**Hypotheses 1:** There is no significant difference between pre-test and post-test mean scores of academic achievement of students taught by Constructivist Teaching (CT) with respect to experimental group-1 of government school.

**Hypotheses 2:** There is no significant difference between pre-test and post-test mean scores of academic achievement of students taught by Technology Based Constructivist Teaching (TBCT) with respect to experimental group-2 of Government school.

**Hypotheses 3:** There is no significant difference between pre-test and post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of private school.

**Hypotheses 4:** There is no significant difference between pre-test and post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of private school.

**Hypotheses 5:** There is no significant difference between the post-test mean scores of academic achievement of students taught by CT and TBCT with respect to experimental group-1 and experimental group-2 of government school respectively.
Hypotheses 6: There is no significant difference between the post-test mean scores of academic achievement of students taught by CT and TBCT with respect to experimental group-1 and experimental group-2 of private school respectively.

Hypotheses 7: There is no significant difference between the post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of government and private school.

Hypotheses 8: There is no significant difference between the post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of government and private school.

Hypotheses 9: There is no significant difference between the post-test mean scores of academic achievement of boys and girls taught by CT with respect to experimental group-1 of government school.

Hypotheses 10: There is no significant difference between the post-test mean scores of academic achievement of boys and girls taught by TBCT with respect to experimental group-2 of government school.

Hypotheses 11: There is no significant difference between the post-test mean scores of academic achievement of boys and girls taught by CT with respect to experimental group-1 of private school.

Hypotheses 12: There is no significant difference between the post-test mean scores of academic achievement of boys and girls taught by TBCT with respect to experimental group-2 of private school.

Hypotheses 13: There is no significant difference between the post-test mean scores of academic achievement of High and Low IQ students taught by CT with respect to experimental group-1 of government school.

Hypotheses 14: There is no significant difference between the post-test mean scores of academic achievement of High and Low IQ students taught by TBCT with respect to experimental group-2 of government school.
Hypotheses 15: There is no significant difference between the post-test mean scores of academic achievement of High and Low IQ students taught by CT with respect to experimental group-1 of private school.

Hypotheses 16: There is no significant difference between the post-test mean scores of academic achievement of High and Low IQ students taught by TBCT with respect to experimental group-2 of private school.

Hypotheses 17: There is no significant correlation between IQ and post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of government school.

Hypotheses 18: There is no significant correlation between IQ and post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of government school.

Hypotheses 19: There is no significant correlation between IQ and post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of private school.

Hypotheses 20: There is no significant correlation between IQ and post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of private school.

Hypotheses 21: There is no significant interaction effect of boys and girls (gender) and high and low IQ students (IQ) on the post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of government school.

Hypotheses 22: There is no significant interaction effect of boys and girls (gender) and high and low IQ students (IQ) on the post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of government school.

Hypotheses 23: There is no significant interaction effect of boys and girls (gender) and high and low IQ students (IQ) on the post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of private school.
**Hypotheses 24:** There is no significant interaction effect of boys and girls (gender) and high and low IQ students (IQ) on the post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of private school.

**Hypotheses 25:** IQ is not a significant predictor of academic achievement scores of students taught by CT with respect to experimental group-1 of government school.

**Hypotheses 26:** IQ is not a significant predictor of academic achievement scores of students taught by TBCT with respect to experimental group-2 of government school.

**Hypotheses 27:** IQ is not a significant predictor of academic achievement scores of students taught by CT with respect to experimental group-1 of private school.

**Hypotheses 28:** IQ is not a significant predictor of academic achievement scores of students taught by TBCT with respect to experimental group-2 of private school.

**5.9. SAMPLE OF THE STUDY**

The study employed purposive sampling technique. The sample comprised of 156 students studying in IX standard of two schools (Government and Private School) of Bengaluru city affiliated to state board. Among these 80 students were from government school and remaining 76 students from private school.

**5.10. DESIGN OF THE STUDY**

In this study, two equivalent group design was considered. Before the intervention of modules, mid-term examination scores in social science subject was collected. Later, scores were arranged from highest to lowest and students were allotted to group 1 and group 2. Further, ‘t’ test was conducted to see whether group 1 and group 2 were significantly equal. Based on this, groups were randomly considered as experimental group-1 and experimental group-2 for intervention of CT and TBCT modules. Skewness’, kurtoses and Q-Q normal plot technique were used to test the normality of the both the groups of government school and private school.
5.11. VALIDATION AND DETAILS OF EXPERIMENTATION

The entire experiment was validated and conducted in three phases: pre-intervention phase, intervention phase and post phase.

In pre-intervention phase, researcher took permission from the two schools and collected IX standard Social Science syllabus and mid-term examination scores in social science subject. Based on these scores groups were equated into two groups - Experimental Group-1 and Experimental Group-2 and identified for intervention of CT and TBCT. Further, based on the review of related literature conceptual framework of the CT and TBCT modules were validated with the help of guide and experts in the field of constructivism. Accordingly, CT and TBCT modules were developed by researcher and validated with the help of guide, subject experts, experts in the field of constructivism and experts in technology. In this way sixteen lessons were (History-4 lessons, Political Science-3 lessons, Geography-5 lessons and Economics-4 lessons) developed under CT module by keeping 5 E’s Instructional Model, Jigsaw, Constructivist assessment strategies, ZPD and Scaffolding. Whereas, same number of lessons (History-4 lessons, Political Science-3 lessons, Geography-5 lessons and Economics-4 lessons) were developed in TBCT module keeping 5 E’s learning module, Jigsaw cooperative learning strategy, technology components, constructivist assessment strategies, ZPD and scaffolding.

In this phase, researcher also constructed the pre-test, post-test, unit-test, and rating scale for CT and TBCT and free writing sheet and validated based on the opinion of experts.

Phase II comprises of try-out and intervention of the modules. In tri-out researcher has tested few modules and got the empirical evidence about the effectiveness of the module for final intervention. Later intervention was carried out in the actual experimental school. In the beginning three periods were used to orient the class regarding administration of pre-test IQ test and experimental procedures in both the schools. Later CT and TBCT modules were taught systematically in government and private school. Totally intervention was carried out for two and half months. A few lessons were also observed by the guide, principles and experts, and feedback was received concern to effectiveness of CT and TBCT class. The details of experimentation related to CT and TBCT modules were given under chapter III-3.18.
In post phase, post-test, rating scale for CT and TBCT were administered to get the data and feedback were also collected about CT and TBCT learning experience with the help of free writing sheet.

5.12. TOOLS USED IN THE STUDY

The researcher has used the following tools for data collection;

1. Ravens Progressive Matrices developed by Raven to test the IQ of the students.
2. Daily Assessment Sheet prepared and validated by the researcher with the help of guide and subject experts.
3. Pre-test, post-test and unit-test constructed and validated by the researcher with the help of guide, subject experts and method professors of B.Ed. College.
4. Rating Scale for CT and TBCT constructed and validated by the researcher with the help of guide, subject experts, exerts in constructivist and experts in technology.
5. Free writing sheet constructed and validated by researcher with the help of guide and experts in constructivism.

The details of construction and validation of tools were given under chapter III-3.16

5.13. STATISTICAL TECHNIQUES USED

Keeping the objectives and the hypotheses, the collected data was analyzed using normality test, descriptive statistics, and inferential statistics.

Normality Test

- Normality Test such as Skewness, Kurtosis and normal Q-Q plot technique were used to test the normality of experimental group-1 and experimental group-2 in both the schools.

Descriptive Statistics

- Descriptive statistics namely Mean, Median, SD and Bar Graph were used to compare pre-test and post-test mean scores; post-test mean scores of academic achievement; unit-test mean scores in different sections of social science subject; and mean scores of CT and TBCT rating scale.
Percentage analysis was used to analyse the responses related to two questions.

**Inferential Statistics**

- t-Test was used to test the significant difference between the pre-test and post-test mean scores of academic achievement and post-test means scores of boys and girls, high and low IQ students, CT and TBCT group of government and private school.
- Correlation technique was used to calculate the correlation between post-test mean scores of academic achievement and IQ.
- 2 X 2 Factorial design was used to examine the main effect of two moderate variables namely of IQ (High IQ and Low IQ) and gender (Boys and Girls) on academic achievement and combined interaction effect of both on academic achievement.
- Regression technique was used to derive the equation to relate independent variables with dependent variable.

**5.14. MAJOR FINDINGS OF THE STUDY**

**5.14.1. Findings of Inferential Statistical Analysis**

**Findings of t-Test**

1. There is a significant difference between pre-test and post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of government school \( t (39) = -17.662, p = .000, 95\% \text{ CI} [-15.32, -12.15] \).

2. There is a significant difference between pre-test and post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of government school \( t (39) = -29.846, p = .000, 95\% \text{ CI} [-15.99, -18.31] \).

3. There is a significant difference between pre-test and post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of private school \( t (38) = -11.179, p = .000, 95\% \text{ CI} [6.87, -4.77] \).
4. There is a significant difference between pre-test and post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of government school \( t (36) = -13.06, p = .000, 95\% \text{ CI } [-7.31, -5.34] \).

5. There is a significant difference between the post-test mean scores of academic achievement of students taught by CT and TBCT with respect to Experimental group-1 and Experimental group-2 of government school respectively \( t (78) = -2.834, p = .006, 95\% \text{ CI } [-4.46, -.78] \).

6. There is a significant difference between the post-test mean scores of academic achievement of students taught by CT and TBCT with respect to Experimental group-1 and Experimental group-2 of private school respectively \( t (74) = -7.02, p = .000, 95\% \text{ CI } [-4.19, 4.19] \).

7. There is no significant difference between the post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of government and private school \( t (77) = -1.192, p = .237, 95\% \text{ CI } [-.85, -.42] \).

8. There is a significant difference between the post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of government and private school \( t (75) = -3.969, p = .000, 95\% \text{ CI } [-3.93, -1.31] \).

9. There is no significant difference between the post-test mean scores of academic achievement of boys and girls taught by CT with respect to experimental group-1 of government school \( t (38) = -.095, p = .925, 95\% \text{ CI } [-.32, -.28] \).

10. There is a significant difference between the post-test mean scores of academic achievement of boys and girls taught by TBCT with respect to experimental group-2 of government school \( t (38) = -3.269, p = .002, 95\% \text{ CI } [-5.57, -1.31] \).
11. There is no significant difference between the post-test mean scores of academic achievement of boys and girls taught by CT with respect to experimental group-1 of private school \( t(37) = 1.167, p = .251, 95\% \text{ CI } [-.82, 3.07] \).

12. There is no significant difference between the post-test mean scores of academic achievement of boys and girls taught by TBCT with respect to experimental group-2 of private school \( t(35) = -1.413, p = .149, 95\% \text{ CI } [-2.50, .39] \).

13. There is a significant difference between post-test mean scores of academic achievement of High IQ and Low IQ students taught by CT with respect to experimental group-1 of government school \( t(38) = 2.236, p = .031, 95\% \text{ CI } [.30, 6.07] \).

14. There is no significant difference between post-test mean scores of academic achievement of High IQ and Low IQ students taught by TBCT with respect to experimental group-2 of government school \( t(38) = 1.112, p = .273, 95\% \text{ CI } [-1.09, 3.76] \).

15. There is a significant difference between post-test mean scores of academic achievement of High IQ and Low IQ students taught by CT with respect to experimental group-1 of private school \( t(37) = 2.918, p = .006, 95\% \text{ CI } [.76, 4.25] \).

16. There is no significant difference between post-test mean scores of academic achievement of High IQ and Low IQ students taught by TBCT with respect to experimental group-2 of private school \( t(35) = -1.083, p = .289, 95\% \text{ CI } [-2.22, .68] \).

**Findings of Correlation Analysis**

17. There is a significant correlation between IQ and post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of government school \( r = .423, N = 40, p = .007 \).
18. There is no significant correlation between IQ and post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of government school \([r = .300, N = 40, p = .060]\).

19. There is a significant correlation between IQ and post-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of private school \([r = .418, N = 39, p = .08]\).

20. There is no significant correlation between the IQ and post-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of private school \([r = -.100, N = 37, p = .554]\).

**Findings of General Linear Model to Measure Two-Way ANOVA [Between-Subjects Effects (2 X 2 Factorial)]**

21. The analysis of 2 X 2 ANOVA with respect to CT group of government school revealed that there is no significant main effect of gender on post-test mean scores of academic achievement \([F (1, 36) = .027, p = .87, \eta^2_p = .001]\). There is no significant main effect of IQ on post-test means scores of academic achievement \([F (1, 36) = 6.783, p = .013, \eta^2_p = .159]\). Whereas combined interaction effect of gender and IQ is not significant \([F (1, 36) = 3.472, p = .071, \eta^2_p = .088]\).

22. The analysis of 2 X 2 ANOVA with respect to TBCT group of government school revealed that, there is significant main effect of gender on post-test mean scores of academic achievement \([F (1, 36) = 4.524, p = .040, \eta^2_p = .112]\). There is no significant main effect of IQ on post-test means scores of academic achievement \([F (1, 36) = 2.046, p = .161, \eta^2_p = .054]\). Whereas the interaction effect of gender and IQ is not significant \([F (1, 36) = 1.915, p = .175, \eta^2_p = .051]\).

23. The analysis of 2 X 2 ANOVA with respect to CT group of private school revealed that, there is no significant main effect of gender on post-test mean scores of academic achievement \([F (1, 35) = 1.853, p = .182, \eta^2_p = .050]\). There is a significant main effect of IQ on post-test means scores of academic achievement \([F (1, 35) = 8.197, p = .007, \eta^2_p = .190]\). Whereas the interaction effect of gender and IQ is not significant \([F (1, 35) = 0.02, p = .963, \eta^2_p = .000]\).
24. The analysis of 2 X 2 ANOVA with respect to TBCT group of private school revealed that, there is no significant main effect of gender on post-test mean scores of academic achievement \[ F (1, 33) =1.341, p=.225, \eta^2_p = .039 \]. There is no significant main effect of IQ on post-test means scores of academic achievement \[ F (1, 33) =1.341, p=.225, \eta^2_p = .039 \]. Whereas the interaction effect of gender and IQ is significant \[ F (1, 33) =10.085, p=.003, \eta^2_p = .234 \].

**Findings of General Linear Regression Model**

25. A simple linear regression was calculated with respect to CT group of government school to predict post-test mean scores of academic achievement based on IQ reveals that, there is significant correlation between post-test mean scores of academic achievement and IQ with \[ r = 423, R^2 = .179 \]; which indicate that 17.9% of variance in post-test academic achievement is explained by IQ. Obtain p value for F test is significant \[ F (1, 38) =8.268, p<.001 \], which indicate that IQ also explained a significant proportion of variance in post-test mean scores of academic achievements. Linear regression coefficient indicates that both intercept (constant) and slope (IQ) are significant \[ t=-2.875, p=.007, \beta =.423 \], with the intercept estimate 10.842 and the slope estimate 0.163. It means, the IQ strongly supports the increase in post-test mean scores of academic achievement and IQ predicts the academic achievement of students \( y \). Thus regression equation for predicating academic achievement from IQ is

**Academic Achievement (Y) = 10.842+.163 (IQ)**

The results indicate that with 95% of confident that the slope of the true regression line is somewhere between .048 and .278.

26. There is no significant correlation between post-test mean scores of academic achievement and IQ with respect to TBCT group of government school. Therefore a simple linear regression was not calculated to predict post-test mean scores of academic based on IQ.

27. A simple linear regression was calculated with respect to CT group of private school to predict post-test mean scores of academic achievement based on IQ reveals that, there is significant correlation between post-test mean scores of academic achievement and IQ with \( r = 418 \). \( R^2 = .175 \); which indicate that
17.5% of variance in post-test academic achievement is explained by IQ. Obtain p value for F test is significant \[ F (1, 37) = 7.851, \ p < .001 \]. Which indicate that IQ also explained a significant proportion of variance in post-test mean scores of academic achievements. Linear regression coefficient indicates that both intercept (constant) and slope (IQ) are significant \[ r = .2802, \ p = .008, \ \beta = .418 \], with the intercept estimate 12.289 and the slope estimate 0.092. It means, the IQ strongly supports the increase in post-test mean scores of academic achievement and IQ predicts the academic achievement of students \((y)\). Thus regression equation for predicating academic achievement from IQ is

\[
\text{Academic Achievement (Y)} = 12.289 + .092 \times \text{IQ}
\]

The results indicate that with 95% of confident that the slope of the true regression line is somewhere between .025 and .158.

28. There is no significant correlation between post-test mean scores of academic achievement and IQ with respect to TBCT group of private school. Therefore, a simple linear regression was not calculated to predict post-test mean scores of academic achievement based on IQ.

5.14.2. Findings Based on the Comparison of Unit-Test Mean Scores of Academic Achievement in Various Sections of Social Science Subject.

29. There is mean difference in the unit-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of government school in selected units of Social Science subject. Accordingly, as observed there is higher achievement mean score recorded in ATPS (15.50) and followed by ATH (14.85), ATE (12.65) and ATG (12.55) respectively.

30. There is mean difference in the unit-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of government school in selected units of Social Science subject. Accordingly, as observed there is higher achievement mean score recorded in ATPS (16.95) followed by ATE (15.90), ATH (15.73) and ATG (12.80) respectively.
31. There is mean difference in the unit-test mean scores of academic achievement of students taught by CT with respect to experimental group-1 of private school in selected units of Social Science subject. Accordingly, as observed there is higher achievement mean score recorded in ATH (20.33) and followed by ATPS (18.13), ATG (17.38) and ATE (17.05) respectively.

32. There is mean difference in the unit-test mean scores of academic achievement of students taught by TBCT with respect to experimental group-2 of private school in selected units of Social Science subject. Accordingly, as observed there is higher achievement mean score recorded ATE (21.56) followed by ATH (21.48), ATPS (20.38) and ATG (19.81) respectively.

5.14.3. Findings Based on the analysis of scores of Rating Scale for CT and TBCT

33. The students of experimental group-1 ($M=83.5$) of government school considered CT intervention is highly effective approach. Within the comparison of dimensions of CT, the students rated ECE ($M=21.97$) and EJ ($M=21.85$) dimensions are effective than the other dimensions i.e., ECTLA ($M=21.50$) and ECT ($M=18.17$). However, there is considerable mean difference among ECTE, EJ and ECTLA.

Whereas the students of experimental group-2 ($M=90.55$) of government school considered TBCT intervention is highly effective approach. Within the comparison of dimension of TBCT, the students rated ETBCTLA ($M=23.30$) has higher level effective than the other dimensions i.e., ETBCE ($M=22.77$), ETBCT ($M=22.40$) and ETBJ ($M=22.07$).

Comparison of ratings of experimental group-1 and experimental group-2 of government school with respect CT and TBCT intervention revealed that, the TBCT intervention ($M=90.55$) is effective than the CT intervention ($M=83.50$). Similarly, comparison of mean scores of students rating concern to dimensions CT and TBCT rating revels that in all the dimensions of TBCT is more effective than the CT.
34. The students of experimental group-1 ($M=78.28$) of private school considered CT intervention as highly effective approach. Within the comparison of dimensions of CT, the students rated that ECT ($M=19.90$) is effective than the other dimension i.e. EJ ($M=19.67$), ECE ($M=19.41$) and ECTLA ($M=19.36$). The student opined that ECTLA ($M=19.36$) is less effective dimension.

Whereas the students of experimental group-2 ($M=80.08$), of private school considered TBCT intervention is highly effective approach. Within the comparison of dimension of TBCT, the students rated that ETBCT ($M=20.54$) has higher level effective than the other dimensions i.e., ETBJ ($M=19.54$), ETBCTLA ($M=20.46$) and ETBCE ($M=19.62$).

Comparison of ratings of experimental group-1 and experimental group-2 of private school with respect CT and TBCT intervention revealed that the TBCT intervention ($M=80.08$) is effective than the CT intervention ($M=78.28$). Similarly, comparison of mean scores of students rating concern to dimensions CT and TBCT rating reveals that except Jigsaw in all the dimensions of TBCT dimensions were more effective than the CT.

5.14.4. Findings Based on the Analysis of Scores of Question Related to CT/TBCT: Overall Rating for CT/TBCT

35. Distribution of rating obtained from 40 students of experimental group-1 of government school in response to the question “overall my rating for constructivist teaching”, 26 (65%) students rated excellent; 12 (30%) students rated very good and 2 (5%) students rated good. And no one considered Constructivist teaching is fair and poor teaching. Overall, the students of experimental group-1 of government school considered CT as an effective teaching approach.

36. Distribution of rating obtained from 40 students of experimental group-2 of government school in response to the question “Overall my rating for technology based constructivist teaching”, 15 (37.5%) students rated excellent and 25 (62.5%) students rated very good. And no one considered TBCT is good, fair and poor teaching. Overall, the students of experimental group-2 of government school considered TBCT as an effective teaching approach.
37. Distribution of rating obtained from 39 students of experimental group-1 of private school in response to the question “overall my rating for constructivist teaching”, 9 (23.1%) students rated excellent; 16 (41%) students rated very good; 8 (20.5%) rated good and 6 (15.4%) are rated fair. And no one reported poor. While overall indication of very good and good, than adding together two good categories yields 24 (61.5%) students. Hence the students of experimental group-1 of private school considered TBCT is effective teaching approach.

38. Distribution of rating obtained from 37 students of experimental group-2 of private school in response to the question-1 “overall my rating for technology based constructivist teaching”, 8 (21.6%) students rated excellent and 20 (54.1%) students rated very good, 7 (18.9%) rated good and 2 (5.4%) rated fair. And no one student rated poor. After adding the two good categories, out of 37 students 27 (73%) students are in agree category. Hence the students of experimental group-2 of private school considered TBCT is effective teaching approach.

5.14.5. Findings Based on Analysis of Scores of Question Related to CT/TBCT: I Need CT/TBCT Class in Other School Subject to Improve My Learning

39. Distribution of rating obtained from CT and TBCT group of both the school with response to question “I need CT/TBCT class in other school subject to improve my learning” revealed that maximum number of students rated strongly agree and agree. It indicates that they need CT/TBCT class to improve their learning in other school subjects.

5.15. CONCLUSION

The findings of the present study helped to draw important conclusions. The study found that the students of both CT and TBCT group were performed better in their post-test compare to pre-test in government as well as private school. This means, the treatment CT and TBCT has influenced on the students’ academic achievement.
Further comparison of academic achievement of students in CT and TBCT groups revealed that students of TBCT group performed for better in their post-test mean scores of academic achievement when compare to CT group. It indicates that, students were focused more in knowledge construction in the TBCT group with the help of technology component (integration of technology) along with the 5 E’s Instructional model, Jigsaw, constructivist assessment, scaffolding and ZPD. This has created interest in their learning as well motivated them to engage and discusses more actively with the help of technology rich and peer supported knowledge construction environment. As a result, in this study the students of TBCT group perform higher scores in post-test mean scores of academic achievement.

The study also reveals that there was no significant difference in academic achievement of students’ taught by CT in government and private school. This means students who taught by CT intervention accomplished same achievement in both the school. Therefore, the study reveals that CT approach is equally useful and suitable for both the school in improving the academic achievement of the students. Thus, types of school as not influenced CT intervention. Whereas with respect to intervention of TBCT, the study found that there was significant different in academic achievement, and the students of private school scored higher than the students of government school. It indicates that TBCT is more effective for private school in improving the academic achievement of students in private school compare to government school. Another interesting factor was, student’s achievement observed in both the school separately in relation to their pre-test and post-test achievement showed that in both the school TBCT approach was helped them to gain more scores in their post-test. But the mean gain score recorded in the government school is higher than the private school. Therefore, it is a clear evidence of effect of intervention on experimental group-2 of government school. It means the students who scored less in their pre-test were able to score more in the post-test due to the intervention. Thus, it can be concluded that TBCT approach was found to be effective for both the school in academic achievement.

The study also revealed that CT and TBCT approaches were not influenced by gender in private school. Thus, gender is not seems to be a major factor in achievement of the students. Whereas in government school TBCT group was
influenced by the gender. With respect comparison of academic achievement of high and low IQ show that difference is exist in CT group but not in TBCT group of both the school. Thus, CT group is influenced by the IQ levels and IQ is not major factor in improving the academic achievement of the students in TBCT group; because there is no influence of IQ on academic achievement.

Correlation analysis revealed that there is a significant correlation between IQ and academic achievement in CT group of government and private school. It reveals that the IQ influenced on the academic achievement of students in CT group of government and private school. Further a simple linear regression equation and line formed to predict post-test mean scores of academic achievement based on IQ. Whereas, there is no significant correlation between IQ and academic achievement in TBCT group of both the schools. It indicates the academic achievement reported in the experimental group-2 of both the school is due to the intervention of TBCT environment not by the IQ of students.

The results of 2 X 2 Factorial analysis reveal that there is no significant main effect of gender on the academic achievement of students with respect CT group of government and private school as well as TBCT group of private school. But the main effect of gender on academic achievement is significant in TBCT group of government school. Further, there is a significant main effect of IQ on the academic achievement of students with respect to CT group of government and private school. But the main effect of IQ on academic achievement is not significant with respect to TBCT group of government and private school.

There is a significant interaction effect of gender and IQ on the academic achievement of private school students of TBCT Group. However, gender and IQ together has not influenced on academic achievement in CT group of government school, private school and TBCT group of government school.

Similar results were also exhibited from the students in their rating relating to rating scale on CT and TBCT revels, the students of both the schools rated CT and TBCT is effective approach. The comparison of mean scores of students’ rating on both the scale found that TBCT approach found to be more effective than the CT
approach in both the school. Dimension wise results showed that mean score is higher in related to TBCT dimension compare to CT dimension. Thus, the study opined that TBCT is more effective than the CT in both the school.

Overall the present study revealed that, CT and TBCT approach were more effective intervention for improving the academic achievement of students in Social Science subject. On the other side TBCT approach found to be more effective than the CT approach in improving the academic achievement of student in the same subject. The maximum number of students also reported that they need CT and TBCT approaches to be followed in other school subject to improve their academic achievement. This is a clear indication of how the students have been benefited by CT and TBCT activity oriented approaches during the course of intervention which is reflected on the academic achievement of students. Even it was proved through their opinion in the form of suggestions and comments.

5.16. EDUCATIONAL IMPLICATIONS OF THE STUDY

The findings of the present study may be helpful to the teachers, school, administrators, and educational planners.

1. The study proved that the students of CT and TBCT group performed better in the post-test compare to pre-test in social science subject. Therefore, the teachers of social science subject should use CT and TBCT method to improve the academic achievement of students.

2. Performance of students in TBCT group is higher than the students of CT group. Therefore, TBCT approach is more effective than the CT. Thus, social science teacher should integrate technology component into constructivist teaching to ensure higher level of academic achievement.

3. Departments like DSERT, CTE and NCERT should organize extensive training programmes on CT and TBCT approaches. Though, the constructivist practice is implemented in schools, based on the recommendations made by NCF-2005 and NCFT-2009 still there is a greater need to train the teachers about TBCT.

4. The study showed that 5 E’s Instructional Model and Jigsaw techniques were effective in motivating the students, school teachers should be trained in this
direction, so that they can motivate the students to perform better in their academic subjects.

5. Overall CT and TBCT approaches should be introduced as compulsory component in both in-service and pre-service of teacher education programme.

5.17. LIMITATIONS OF THE STUDY

1. The study is limited to 9th standard students of government and private school in Bengaluru city.
2. Initially the study was planned for 3 group design (control group, experimental group-1 and experimental group-2), Due to administrative difficulties in the school the study was limited to Experimental group-1 and Experimental group-2.
3. The study is confined to few variables such as Gender, types of school, types of constructivism (Constructivist Teaching and Technology Based Constructivist Teaching), levels of IQ in relating to academic achievement of students in CT and TBCT classroom.
4. The study is limited to selected topics of 9th standard Social Science subject of state syllabus, namely History (Bhakti Panth), Political Science (National Integration), Geography,(Industries of Karnataka) and Economics (Labour and Employment).
5. In this study only English medium schools are selected.
6. Researcher designed and validated CT and TBCT modules were used in this study.
7. There was equal number of students in TBCT group of private school. During the curse of experiment, one student faced accidental death and another student was left the school. Thus there was no equal number in TBCT group.

5.18. SUGGESTIONS FOR FURTHER RESEARCH

1. The effectiveness of CT and TBCT could be studied with respect to certain psychological variables.
2. A study can be undertaken by considering three group experimental design - experimental group-1, experimental group-2 and control group. These groups may be exposed to CT, TBCT and Traditional teaching respectively.
3. This study may be extended to Kannada medium schools.
4. A similar study may be conducted with other school subjects such as science and mathematics.
5. A comparative study may be conducted to find out the impact of CT and TBCT on academic achievement CBSC and State board schools.