CHAPTER 3
RESEARCH METHODOLOGY

3.1. INTRODUCTION

“Research design is in fact the conceptual structure within which the research is conducted” (Bhattacharryya, 2006). It is “not only detail with the type of research design to be implemented but includes the approach to measuring variables and collecting data from participants, devising a strategy to sample participants to be studied and planning how the data will be analyzed” (Salkind, 2010).

In the present chapter, detailed methodology is presented. It comprises; method of study, stating the problem of the study, defining the terms of the study in an operational definition, objectives of the study, hypotheses of the study, variables considered in the study, sampling technique, research design, validation of experimental procedure, modules, tools and statistical techniques used in the study.

3.2. METHOD OF STUDY

The present study was experimental in nature with two equivalent group design. The study aims at comparing effectiveness of Constructivist Teaching and Technology Based Constructivist Teaching on academic achievement of students. The study was conducted in three phases.

Phase-I: Pre-intervention Phase
Phase-II: Intervention Phase
Phase-III: Post Phase

3.3. 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”.

3.4. OPERATIONAL DEFINITIONS

The following terms were defined operationally in the present study.

3.4.1. 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.

3.4.2. 5 E’s Instructional Model

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

3.4.3. JIGSAW

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

3.4.4. 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.

3.4.5. Impact

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

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

3.5. VARIABLES OF THE STUDY

“Key elements in a research problem are the variables. A variable is defined as a characteristic of the participants or situation for the given study that has different values. A variable must vary or have different values in the study” (Gliner, Morgan, & Leech, 2009). “A concept that can be measured on any one of the type of measurement scale which have varying degrees of precision in measurement is called variable”. In other words a concept that can be measured called variables” (Kumar, 2011). A variable are the building blocks of research and provides direction to research work. Basically there are two types of variables observed in experimental design, namely an independent variable and a dependent variable.

The variable which causes change on another variable is called independent variable. In other words, independent variables are those variables which influence or impact on dependent variable. The study also considered another variable called moderate variable. Moderate variable is a secondary independent variable that affects the direction or strength of the relationship between primary independent and dependent variable. They are created by researcher by taking one variable and multiplicand it by another determine the joint impact of both on dependent variable (Creswell, 2014).

In the present study Constructivist Teaching (CT), Technology Based Constructivist Teaching (TBCT) and types of school were considered as independent variables, whereas academic achievement in Social Science was considered as dependent variable. The researcher manipulated CT and TBCT to know the impact of these two independent variable on academic achievement. Gender and IQ were treated as moderate variables. This study also aims in finding the main and interaction effect of these moderate variables on the academic achievement of students in Social Science. The details of the variables considered are shown in the Table 3.1.
Table 3.1

Variables of the Study

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Constructivist Teaching (CT)</td>
<td>• Academic Achievement in Social Science</td>
</tr>
<tr>
<td>• Technology Based Constructivist Teaching (TBCT)</td>
<td></td>
</tr>
<tr>
<td>• Types of School</td>
<td></td>
</tr>
</tbody>
</table>

**Moderate Variables**

- Gender
- IQ

3.6. 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.
3.7. HYPOTHESES OF THE STUDY

The researcher formulated the following Hypotheses based on the objectives.

**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.

3.8. POPULATION OF THE STUDY

For the present study, the students studying in IX standard of state board schools of Bengaluru city were considered as population of the study.

3.9. SAMPLE OF THE STUDY

The study used 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 them, 80 students were from government school and remaining 76 students from private school. Distribution of the total sample based on types of school and its sub sample are shown in following figure.

![Figure 3.1. Distribution of Sample of the Study](image-url)
3.10. DISTRIBUTION OF SAMPLE OF THE STUDY

Table 3.2

_Distribution of Sample in Experimental Group-1 and Experimental Group-2 of Government School and Private School_

<table>
<thead>
<tr>
<th>Types of School</th>
<th>Groups</th>
<th>N</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government school</td>
<td>Experimental Group-1</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Experimental Group-2</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Private School</td>
<td>Experimental Group-1</td>
<td>39</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>Experimental Group-2</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

The sample of government school comprised of 80 students; further sample is equated into two equal number of students into experimental group-1 and experimental group-2 and each group constituted of 40 students. Similarly, there are 76 students in private school; group is equated into two equal numbers of students into experimental group-1 and experimental group-2 and each group consists of 39 and 37 students respectively.

3.11. DESIGN OF THE STUDY

The main objective of the present research was to develop CT and TBCT package and test the effectiveness of these two on the achievement of students. Hence, the module oriented feature was addressed in the form of adopting the experimental design. Accordingly, the study considered two equivalent group design, which comes under the category of pure experimental design. The main feature of this design is, both the groups are parallel or equal before treatment. In this study mid-term examination scores of students in IX standard social science were used to equalize two groups in both the schools. Initially, students’ mid-term exam scores were arranged from highest to lowest. Later students were allotted to two groups namely group one and group two in both the school. Further, t test was conducted to see whether both the groups were significantly equal. Besides Skewness, kurtoses and Q-Q Normal Plot techniques were also used to test the normality of the groups in both the schools. After confirming the normality, groups were randomly named as Experimental Group-1 and Experimental Group-2 and these were designated for
Constructivist Teaching and Technology Based Constructivist Teaching respectively in both the schools.

The design was found appropriate to compare relative impact of CT and TBCT on academic achievement of students. In the research process, two independent variables namely CT and TBCT modules were manipulated to know their impact level. The other features followed in this research design were: 1) Academic achievement of students in CT group was compared with respect to types of school (government and private school) 2) Academic achievement of student in TBCT was compared with respect to types of school (government and private school) 3) Correlation between IQ and Academic Achievement. 4) In addition to this, IQ and gender were also considered as moderator variables, to examine these variable in the existing condition in terms of its main effect and interaction effect on the academic achievement by using 2 X 2 factorial design. The nature of two equivalent group design shown in the following table.

Table 3.3

<table>
<thead>
<tr>
<th>Description of Nature of Two Equivalent Group Design</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Groups</strong></td>
</tr>
<tr>
<td>Experimental Group -1</td>
</tr>
<tr>
<td>Experimental Group -2</td>
</tr>
</tbody>
</table>
Types of School

GOVERNMENT SCHOOL

Experimental Group-1

Experimental Group-2

PRE-TEST
IQ TEST

Intervention

Experimental Group-1
CONSTRUCTIVIST TEACHING
(CT)

Experimental Group-2
TECHNOLOGY BASED
CONSTRUCTIVIST TEACHING (TBCT)

PRIVATE SCHOOL

Experimental Group-1

Experimental Group-2

PRE-TEST
IQ TEST

Intervention

Experimental Group-1
CONSTRUCTIVIST TEACHING
(CT)

Experimental Group-2
TECHNOLOGY BASED
CONSTRUCTIVIST TEACHING (TBCT)

Post-Test
CT Rating Scale
TBCT Rating Scale
Free Writing Sheet

Figure 3.2. Model of the Research Design
3.12. VALIDATION AND DETAILS OF EXPERIMENTATION

The experimental procedure was validated and conducted in three phases i.e. Phase-I Pre-intervention Phase, Phase-II Intervention Phase and Phase-III Post Phase. The detail of validation procedure presented as follows.

**Phase-I Pre-Intervention Phase**
- Selection of two schools
- Collecting the IX standard social science mid-term examination scores and collecting social science syllabus for development of modules.
- Development and Validation of Conceptual Framework of CT and TBCT Module
- Development of CT and TBCT modules and Validation of 1st Draft of modules by the researcher
- Validation of 2nd Draft of CT and TBCT Module- with the help of research guide.
- Validation of 3rd Draft of CT and TBCT modules- with the help of subject experts.
- Validation of 4th Draft of CT and TBCT models with the help of experts in constructivism.
- Validation of 5 Draft of TBCT module with the help of experts in Technology
- Construction and Validation of Pre-Test and Post-test with the help of guide, subject experts and faculty of B.Ed College.
- Construction and validation of Rating Scale for CT and TBCT and Free wiring sheet with the help of guide and experts in the field of constructivism.

**Phase-II Intervention Phase**
- Try-out of the modules in other than the experimental school and validation of final draft of CT and TBCT modules
- Orientation on nature of CT and TBCT class to experimental group-land experimental Group-2 in experimental schools
- Administration of Pre-Test and IQ Test
- Intervention of CT module.
- Intervention of TBCT module.
- Observation of CT and TBCT lessons by school teachers, principals and research guide
- Administration of Unit-Test

**Phase-III Post Phase**
- Administration of Post-Test
- Administration of CT and TBCT rating Scale
- Administration of Free Writing Sheet

*Figure-3.3: Validation and Details of Experimentation*
Phase I - Pre-Intervention Phase

In this phase, researcher took permission from two schools and collected IX standard Social Science syllabus and mid-term examination scores in social science subject. Based on the mid-term scores groups were equated into experimental group-1 and experimental group-2 in both the schools. Researcher also confirmed that both the groups were equal or parallel in their previous academic achievement based on ‘t’ test and normality of the group find out with the help of Skewness, Kurtoses and Q-Q normal plot. Further, researcher validated the modules in the following way.

Validation of Conceptual Frame Work of CT and TBCT Module

In Conceptual validation, researcher made a thorough literature review related to constructivism and identified various constructivist strategies required for development of module. Researcher has chosen 5 E’s Instructional Model and Jigsaw cooperative learning strategy as a major components and constructivist assessment, ZPD and Scaffolding as basic components for development of CT module. Similarly, technology components identified along with 5 E’s Instructional model and Jigsaw cooperative learning strategy for development of Technology Based Constructivist Teaching as major components and constructivist assessment, ZPD and Scaffolding as basic components for development of TBCT module. Researcher kept TPACK approach for integration of major and basic components in development of TBCT module. In view of these, researcher prepared distinct conceptual framework based draft copy of CT and TBCT module. These modules were scrutinized and assessed by the guide and experts in constructivism.

Development of CT and TBCT Module

In this stage, based on approved conceptual framework, researcher develops the CT and TBCT modules. It proceeded systematically in the form of selection of content based on unit analysis and content analysis, later writing of instructional objectives followed by development of lesson plan and preparation of resource material by bearing in mind the major and basic components of CT and TBCT modules. (See also-3.10.detailed procedure followed in development of CT and TBCT module). Initially 30% of lessons were developed for CT and TBCT.
Table 3.4
Description of CT and TBCT Module

<table>
<thead>
<tr>
<th>INTEGRATION MODULES</th>
<th>JIGSAW</th>
<th>TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 E’s INSTRUCTIONAL MODEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONSTRUCTIVIST TEACHING (CT)</td>
<td>1. Engage</td>
<td>Text, Audio Visual, Audio Visual, Multimedia, Hypermedia, Hyperlink, Hyper Media &amp; PPT</td>
</tr>
<tr>
<td></td>
<td>2. Explore</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Explain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Elaborate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Evaluate</td>
<td></td>
</tr>
<tr>
<td>JIGSAW</td>
<td>1. Formation of Home Group &amp; Collecting the Learning Chunk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Formation of Expert Group &amp; Mastering the Learning Chunk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Return to Home Group &amp; Serving as Teacher</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Organization of Quiz/Achievement Test in Home Group</td>
<td></td>
</tr>
<tr>
<td>TECHNOLOGY</td>
<td>BASED CONSTRUCTIVIST TEACHING (TBCT)</td>
<td></td>
</tr>
<tr>
<td>APPLICATION OF TPACK APPROACH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 E’s INSTRUCTIONAL MODEL</td>
<td>1. Engage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Explore</td>
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</tr>
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<td>JIGSAW</td>
<td>1. Formation of Home Group &amp; Collecting the Learning Chunk</td>
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</tr>
<tr>
<td></td>
<td>2. Formation of Expert Group &amp; Mastering the Learning Chunk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Return to Home Group &amp; Serving as Teacher</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Organization of Quiz/Achievement Test in Home Group</td>
<td></td>
</tr>
</tbody>
</table>

Validation of CT and TBCT Module

As per the conceptual framework, the researcher reviewed the initial draft and validated the I draft of CT module. Further, lessons were submitted to guide and they were scrutinized and assessed. As per the suggestions, the II draft of the lessons were validated. Further, the III draft of lessons and IV draft of the lessons were validated with the help of two subject experts and experts in the field of constructivism respectively. In this way, sixteen (History-4 lessons, Geography-5 lessons, Political Science-3 lessons and Economics-4 lessons) CT lessons were validated under CT module. The details of validation procedure was presented under the validation of experiment as well as in validation of module.

Like CT module, experts were consulted for development of TBCT module. Initial draft was corrected and the I draft of TBCT lessons were validated at the
researcher level. Further, the II draft of lessons were prepared and validated as suggested by the guide. Later III draft and IV draft of the lessons were drafted and validated as per the suggestions of two subject experts and experts in constructivism. Finally they were submitted to experts in technology. With their approval, the V draft of the TBCT module developed and validated for the intervention. In this way sixteen (History-4 lessons, Geography-5 lessons, Political Science-3 lessons and Economics-4 lessons) TBCT lessons were validated.

Table 3.5  
*Number of Lessons Covered in CT and TBCT Modules*

<table>
<thead>
<tr>
<th>Type of Module</th>
<th>Subjects Covered</th>
<th>Total Number of Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Modules</td>
<td>o History – 4 Lessons</td>
<td>16 Lessons</td>
</tr>
<tr>
<td></td>
<td>o Geography – 5 Lessons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Political Science – 3 Lessons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Economics – 4 Lessons</td>
<td></td>
</tr>
<tr>
<td>TBCT Modules</td>
<td>o History – 4 Lessons</td>
<td>16 Lessons</td>
</tr>
<tr>
<td></td>
<td>o Geography – 5 Lessons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Political Science – 3 Lessons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Economics – 4 Lessons</td>
<td></td>
</tr>
<tr>
<td>Total Lessons</td>
<td></td>
<td>32 Lessons</td>
</tr>
</tbody>
</table>

In the pre-intervention phase researcher also developed and validated the 25 marks academic achievement pre-test, post-test, unit-tests and rating scale for CT and TBCT and validated with the help of experts. Validation procedure of these tools also explained in detail under the tools used in the study.

**Phase II - Intervention Phase**

This phase was aimed at try-out of modules and intervention of modules in the experimental groups.

**Try-out**

Try-out was conducted initially to test few lessons to get empirical suggestion and evidence based support for development and validation of module. Few lessons were tried-out in other than the experimental schools. The schools selected were government as well as private. In the beginning CT lessons were tried out and followed by TBCT lessons. The classes were observed by the subject experts and also by the guide. Based on the tryout responses and also the suggestions given by the guide remaining lessons of CT and TBCT lessons were developed.
Intervention of CT and TBCT Module

After try-out, CT and TBCT modules were taught systematically in government and private schools. The experimentation was carried out for two and half months covering one period for orientation, 16 teaching period and nine testing period (IQ test, pre-test, four unit-tests, post-test, rating scale and free writing sheet) for CT and TBCT module. Totally 26 periods were separately taken for CT and TBCT classes in both the schools. Lessons were taught from History (Bhakti Panth), Geography (Industries of Karnataka), Political Science (National Integration) and Economics (Laobur and Employment) unit respectively.

In the beginning both experimental group-1 and experimental group-2 were administered with pre-test and IQ test. Later, orientation was given to both the classes separately with a purpose to create awareness about 1) seating arrangements 2) nature of learning and teaching environment 3) and role of teacher and pupil’s in the classroom. The orientation cleared all uncertainties related to classroom practices. Successively, experimental group-1 of both the schools treated with CT module and each day single lesson was taught. During the period of intervention, some lessons were supervised by subject teacher, Head Master/Misters of the school and research guide and feedback was received concerned to effective implementation of CT. The researcher took 16 periods to complete the 16 lessons and 4 periods for conducting the Unit-Tests. And Unit-Tests were administered after the close of each unit. Similarly, experimental group-2 of government and private schools were treated with TBCT module. Keeping the same number of teaching period and testing period.

Phase III - Post Phase

In this phase researcher administered the post-test to collect students overall academic achievement in social science subject. Rating Scale for CT and TBCT and free writing sheet were also administered to collect opinion about the effectiveness of CT and TBCT modules.

3.13. RATIONAL FOR INTEGRATION 5 E’s INSTRUCTIONAL MODEL, JIGSAW FOR CONSTRUCTIVIST TEACHING

The main pre-request for teaching social science is integration of social skills such as discussion, presentation, negotiation, questioning etc. among the students.
Comprehensive literature review also shown many approaches for teaching social science. Among these approaches, literature survey also shown that 5 E’s Instructional model is widely used not only in Science but also in Social Science Subject. In addition to this, Jigsaw technique is useful cooperative learning approach developed based on social constructivism adopting peer tutoring as major tool. These approaches fit to engage students in social science subject. Additionally, the Rachana Kaliki training module developed by DSERT, Karnataka identified 5 E’s Instructional model and Jigsaw as the rational strategies in implementing constructivist practice in teaching Social Science.

The literature survey also witnessed that constructivist assessment strategies, ZPD and scaffolding are the minimum and basic components of constructivist teaching including 5 E’s Instructional model and Jigsaw. With this back ground, the study asserted to integrated 5 E’s Instructional model and Jigsaw cooperative learning strategy as major components and constructivist assessment strategy, ZPD and scaffolding as the basic components for present study to develop CT module.

3.14. RATIONAL FOR INTEGRATION 5 E’s INSTRUCTIONAL MODEL, JIGSAW AND TECHNOLOGY COMPONENTS FOR TECHNOLOGY BASED CONSTRUCTIVIST TEACHING

From last decade, new-fangled tendency has raised in education regarding the use or application of technology components in new method and approaches. Fortunately, such efforts created Technology Based methodology practices in education. Literature survey indicates that technology not only helped for transmission of information but also for construction of knowledge. The technology sources namely; multimedia, hyperlinks, simulations, spreadsheets, virtual tour and hyper texts are the best sources for engaging students in knowledge construction. In this context, the study offers yet another technology based constructivist practice or approach in IX standard social science subject. The study integrated 5 E’s Instructional model, Jigsaw and technology components with the help of TPACK approach and referred it as Technology Based Constructivist Teaching (TBCT). Extensive review also helped the researcher to ascertain (as mentioned chapter I) that technology tools like text, audio, visual, audio visual, multimedia, animation etc. help in developing technology based constructivist assessment strategy, ZPD and
Scaffolding. These components were retained as basic components along with three major components: 5 E’s Instructional model, Jigsaw and technology components. However, the fundamental concern of TBCT methodology is creating students ownership of their learning with joint effort of all these components.

3.15. Development and Validation of CT Module

In this study CT module used to teach experimental group one of government and private school. CT module consist of lessons. These lessons were developed by the researcher with the help of experts. As a major step of validation procedure, experts were consulted to seek the opinion and their technical knowledge for the development of the module. Development and validation of CT module conducted in six steps. First step, development and validation of conceptual frame work of the CT module. Second step, selection of content, writing of instructional objectives followed by development of lesson plan and preparation of resource material. Third step, Validation of I draft of CT module at researcher level. Fourth step, validation of II draft of CT module with the help of guide. Fifth step, validation of III draft of CT module with the help of two subject experts. Sixth-step, validation of IV draft of CT modules with the help of experts in constructivism. Seventh step, Tri-out and validation of final draft of CT module. The procedure of development of CT module presented in the Figure 3.4

Validation of Conceptual Frame Work of CT Module

To develop a module, researcher needs to get sound theoretical knowledge of the research area. In this back ground, researcher conducted intensive review of literature related to the constructivism. Out of which with relational reason and research gap identified potentiality of 5 E’s Instructional Model and Jigsaw cooperative learning strategy in ensuring constructivist learning in social science subject. Obviously decided to integrate and blend both for developing Constructivist Teaching.
Primarily steps of Jigsaw cooperative learning was integrated into steps 5 E’s Instructional model. Besides, ZPD, Scaffolding technique and constructivist assessment strategies integrated as requirement of any constructivist teaching. Considering all these components researcher kept Herbart lesson plan format as the base and developed nature of four material resource: constructivist lesson plan;
learning chunk; learning and teaching materials; and daily assessment sheet and named it as Constructivist Teaching module. In this way researcher developed the draft of conceptual frame work of CT module. Further researcher reviewed the entire conceptual frame work of the module in view of constructivist learning. Thereafter, the draft was presented to guide. These materials were scrutinized and assessed by the guide and validated the conceptual frame work of the CT module. Further the draft was submitted to experts in constructivism to seek their opinion. They appreciated the nature of module and recommended to consider the following suggestions developing the lesson plan and to meet the objectives of the study.

- Content must be analyzed systematically into teaching points and learning frame for designing the learning chunks.
- Module should focus higher level objectives such as analysis, evaluation and creation/critical thinking to visualize constructivism.
- Step wise instruction needed and necessity to mention clearly in lesson plan to engage the students in own learning.
- Learner autonomy must be kept in mind across the development and implementation of module for experimentation.

Selection of Content, Writing of Instructional Objectives followed by Development of Lesson Plan and Preparation of Resource Material

Selection of content: In view of conceptual frame work of the module and suggestion given by the experts, researcher carried out the unit analysis and content analysis for the selected topics of social science subject. Initially common lessons were selected from IX standard social science subject namely Bhakti Panth, Industries of Karnataka, National Integration and Labour and Employment in both the schools. Later analyzed each unit into sub-units or lessons, lessons into teaching points and teaching point into learning frames. Likewise the draft of content analysis was prepared and submitted to guide, and with correction and changes final content analysis was drafted.

Writing of instructional objectives followed by development of lesson plan and preparation of resource material: After identifying the unit, under each unit content analysis was done. Later instructional objectives were written. In the next task, with distinct and systematic care in the light of CT components: 5 E’s Instructional model,
Jigsaw, constructivist assessment, ZPD and scaffolding each teaching points addressed sequentially in the form of instructional objective, learning experience and its assessment strategies in the lesson plan. Based on this, initially 30% of CT lessons were developed and each lesson includes lesson plan, learning chunk, learning resources and daily assessment sheet. The following care was taken in developing the resources;

- Learning chunk was designed with suitable learning experiences to meet the prerequisite of the lesson plan.
- Appropriate learning resources (like maps, KWL chart, exit cards, graphic organizers) identified for each lesson.
- 10 marks objective type based daily assessment sheet was prepared to assess the impact of each lesson.

In this pattern lesson plans and resource materials were developed for CT module and written in the form of preliminary draft by the investigator.

**Validation of I Draft of the CT Module by the Researcher**

Initially at researcher level the preliminary draft of CT lessons assessed critically in the light of dimensions of CT component. Accordingly, I draft CT module was prepared.

**Validation of II Draft of the Module with the Help of Guide**

Further, I-draft of CT lessons were submitted to guide for checking suitability of integration of CT components in the lesson plan, learning chunk, learning and teaching resources and daily assessment sheet. Accordingly CT lessons were checked, scrutinized and assessed by the guide based on the criteria CT module. The suggested modifications were incorporated by the way II draft was prepared and validated with the help of the guide.

**Validation of III Draft of CT the Module with the Help of Subject Experts**

For validation of III draft researcher consulted the two subject experts who were having minimum five years of experience in teaching social science subject at school level and knowledge of constructivism. They were asked to evaluate the lessons and all the materials in reference to the conceptual framework of the module.
They critically evaluated and made following modifications to achieve the objective the study.

- Learning chunks must be written in simple language. And label with A/B/C/D to help the students in engaging Jigsaw activity.
- Based on the obligation prior knowledge questions, guided questions and activities need to mention in respective content chunk.
- Maps, pictures, diagrams, tables, illustrations, graphic organizers, mind map etc. may be presented on the back side of the learning chunks.

Based on the suggestions researcher modified the draft and prepared III draft of the lessons.

Validation of IV Draft of the CT Module with the Help Expert in Constructivist Teaching

III draft of the lessons were submitted to two experts in the field of constructivism and requested to validate the module. The experts were selected from the faculty of teacher education field with having the working experience in curriculum committee and constructivism. Experts went through the steps of the lessons and asked the researcher visualize orally about the nature of CT class with each step. Based on this, they suggested following modifications

- Appreciated the nature of integration of 5 E’s Instructional model, Jigsaw and other components.
- Minimum variety should be there in using constructivist assessment strategies to enhance knowledge construction.
- Variety must be in objective type questions related to Daily Assessment Sheet.
- Elaboration stage activities must engage the students in knowledge construction beyond the text book.
- Learning material, peer and teacher assistance operate like scaffolding components in helping the students in the process of knowledge construction.
- Learning chunks must free from language errors.

Based on the above suggestions researcher made changes in the lessons and prepared IV draft. In this manner IV draft of the module validated with the help of
specialist in constructivism. In this method, sixteen (History-4 lessons, Geography-5 lessons, Political Science-3 lessons and Economics-4 lessons,) CT lessons developed and validated for intervention of Constructivist Teaching. A sample CT lesson form history portion is given in Appendix VIII (Lesson Plan) and Appendix IX (Learning Chunks).

**Try-out and Validation of Final Draft of CT Module**

One of main tendency of any experimental research process is tryout of the module before its use in final experimentation. By acknowledging this, few lessons were selected and tried-out in other than the experimental schools to get empirical evidence about efficiency, educational value of the module. One lesson each from portion of History, Geography, Political Science and Economics tried out in government as well as private school. The classes were observed by the subject experts and also by the guide and gave their feedback. The empirical evidence of try-out and observation and feedback were; 1) CT lessons were useful in engaging students in Constructivist Teaching environment 2) Module was pedagogically useful and effective in enhancing achievement of the students 3) Researcher was confident about the CT class 4) Seating arrangement was systematized and decided to orient the experimental group one about seating arrangement and nature classroom operation.

**3.16. Development and Validation of TBCT Module**

The TBCT module was developed and validated with taking the opinion of guide, two subject experts and constructivist specialist. Despite two education technology specialist were consulted to ensure validity of the TBCT lessons. There are seven steps followed in development of the module. They are: first step, development and validation of conceptual frame work of the TBCT module. Second step, selection of content, writing of Instructional Objectives followed by Development of Lesson Plan and preparation of resource material for TBCT module. Third step, validation of I draft of TBCT module at researcher level. Fourth step, validation of II draft of TBCT module with the help of guide. Fifth step, validation of III draft of TBCT module with the help of two subject experts. Sixth-step, validation of IV draft of TBCT module with the help of experts in constructivism. Seventh step, validation of V draft of TBCT modules with the help of experts in education.
technology. Last step, try-out and validation of final draft of TBCT module. The procedure of development of TBCT module presented in the Figure 3.5.

**Validation of Conceptual Frame Work of TBCT Module**

- Selection of Content
- Writing of Instructional Objectives
- Development of Lesson Plan and PPT Based Resource
- Validation of 1st Draft of TBCT Module at Researcher Level
- Validation of 2nd Draft of TBCT Module with the Help of Guide
- Validation of 3rd Draft of TBCT Module with the Help of Subject Experts
- Validation of 4th Draft of TBCT Module with the Help Experts in the Field of Constructivism
- Validation of 5th Draft of TBCT Module with the Help Experts in the field of Technology
- Try-out and Validation of Final Draft TBCT Module

*Figure 3.5. Development and Validation of TBCT Module*
Validation of Conceptual Frame Work of TBCT Module Based on TPACK

Researcher conducted literature review at two stages to prepare the conceptual framework. In first stage, reviewed the technology components for constructivist teaching along with the CT literature review and identified components for CT module as well as few ideas and components of technology based constructivist teaching. In the second stage, with extensive literature review identified the technology components and approaches and also decided to adopt TPACK approach for development of TBCT module. The rational reason for selection is that, the TPACK use three main domains—content knowledge, pedagogical knowledge and technological knowledge—in integration and development of technology module. Again, three of these domains interact and result in three main aspects such as Technological content Knowledge, Pedagogical content knowledge and Technological Pedagogical knowledge for development of module.

In this study 5 E’s Instructional Model, Jigsaw, ZPD, Scaffolding and constructivist assessment strategies kept under pedagogical knowledge. Selected topics of IX standard Social Science subject as content knowledge and all technological components such as audio, visual, audio visual, hypermedia, hyperlink, PPT under the category of technological knowledge. Out of these three main domain pedagogical content knowledge, Technological Content knowledge and Technological Pedagogical knowledge drawn to develop TBCT module. Further, decided to integrate all these systematically into constructivist teaching lesson plan format. Subsequently decided to prepare the PPT based package. Altogether, TBCT model includes lesson plan and PPT package developed using text, audio, video, multimedia, hyper link and hyper media etc. The draft of the nature of TBCT class presented to guide. These resources were scrutinized and assessed by the guide. Further conceptual model was presented to expert for the opinion. They accepted the module and suggested to take the help of experts in the field computer technology for preparation of module for the study. Accordingly two experts were consulted before starting the development of the module to get some special skills related to design and development of PPT. The conceptual frame of TBCT module is diagrammatically shown in following Figure 3.6.
Selection of Content, Writing of Instructional Objectives followed by Development of Lesson Plans and Preparation of Resource Material

Selection of content. The content analysis drafted for CT module was used for TBCT module.

Writing of instructional objectives followed by development of lesson plans and preparation of TBCT based resource material:

In this stage, methodical effort made to design the lesson plan and TBCT package. Based on the nature of teaching point and learning frame suitable text, visual, audio, visual, multimedia, animation etc. were identified under the domain of technology components and consequently converted into instructional objectives and learning experiences with in the frame work of pedagogical domain (pedagogical components such as 5 E’s Instructional model, Jigsaw, constructivist assessment strategy, Scaffolding and ZPD). As a result three main aspects such as Pedagogical content knowledge, Technological Content Knowledge, and Technological Pedagogical knowledge were drawn to develop TBCT module. By following this procedure initially nearly 30% of TBCT lessons were developed and each lesson includes lesson plan, PPT based package, learning chunk and daily assessment sheet.
In this order, lesson plan and PPT based package had been developed. The PPT based TBCT module designed in the following way.

- PPT based resource created mainly using text, audio, visual, audiovisual, word art, animations, smart arts, tables, hyperlinks and multimedia etc.
- Slides and its content matters designed and linked systematically with the help of animation and hyperlinks.
- Hyperlink tool used to link the slides with in the PPT and other sources stored outside such as video, word files and other lesson related document. Which helps to use and link the required documents and slide to engage the students in the various steps of constructivist teaching.
- Animation tool used to link the contents presented in each slide in the form of shapes, tables, text, pictures etc. This helps to present experience in sequential order to engage knowledge construction.
- All the stages of constructivist teaching are linked with in the PPT slide based on the main slide, sub-main slide and learning experience slides.
- Main slide displayed with steps of constructivist teaching. By clicking, one can link to sub-main slide which displayed with the concern stage of constructivist teaching.
- Sub-main slide links to learning experience slides.
- Each learning experience slide includes various learning experience designed and presented based on animations to link the learning experience with in the slide and link the other slides and some of the documents stored outside the slide (the video, word files and other document stored outside the PPT).

In this pattern investigator developed the preliminary draft of TBCT module based on PPT resource.

**Validation of I Draft of TBCT Module by the Researcher**

Researcher reviewed the lesson plan and PPT slide show and evaluated the preliminary draft of TBCT lessons assessed critically in the light of dimensions of TBCT component. Accordingly I draft CT module was prepared.
Validation of II Draft of the Module with the Help of Guide

I-Draft TBCT lesson and resource material were shown in laptop based slide show presentation to get suggestion for refinement and modification. Accordingly CT lessons were scrutinized, and modification was done regarding flow of presentation using animation. Thus, changes were incorporated and II draft of lessons were validated.

Validation of III Draft of TBCT Module with the Help of Subject Experts

II-draft of the TBCT module has been shown to two subject experts who are having minimum of five years of teaching experience in social science subject and also in the field of computer technology at school level. They saw the lesson presentation in all the aspects of criteria and suggested to use the following changes to improve the module.

- Sub slide pattern need to be changed for engage and explanation stage.
- Use of pleasant color combination for design of PPT.
- Each slide must be linked to main slide with the help of hyperlink.
- Real-time manage of PPT slide show and learning chunk with scaffolding technique.

By incorporating the above suggestions III draft of TBCT module was developed.

Validation of IV Draft of the TBCT Module with the Help Experts in the field of Constructivist Teaching

The III draft was shown to two professors of teacher Education College who are having rich experience in curriculum construction and constructivism. They observed the Lap top based presentation. They evaluated the module in the relevant to PPT based technology in engaging constructivist teaching and made the following suggestions.

- Prepare specific instructions for students to engage in different stages of TBCT.
• Suggested to adopt teacher controlled student engaged technology based constructivist teaching.

• Mind maps, graphic organizers, videos based evaluation must design in logically and need to present based on constructivist principles.

In the light of the above suggestion modifications incorporated to validate the IV draft of TBCT module.

Validation of V Draft of the TBCT Module with the Help of Experts in the field of Technology

The IV draft of the module was shown to two technology experts. They observed the few lessons in laptop based presentation and analyzed and assessed the flow and nature of causation of technology components in constructivism. They made suggestions related to how to use more realistic in the classroom. In this manner, the researcher developed and validated the final draft of modules with the help of experts in technology.

Totally sixteen (History-4 Lessons, Geography-5 Lessons, Political Science-3 Lessons and Economics-4 Lessons,) TBCT lessons were validated based on the recommendation and suggestion made by the experts. A sample TBCT module form Political Science lesson given in Appendix XI (Lesson Plan) and Appendix XII (TBCT Source Material).

Try-out and Validation of Final Draft of TBCT Module

Like CT lessons, few TBCT lessons were preliminarily experimented in IX standard students of government and private school to found effectiveness of the TBCT module for final intervention. The schools selected were other than the experimental school. The classes were observed by the subject experts and guide and they recoded the following feedback. The feedback realized following points.

• TBCT lessons were enriched with engaging students in Technology Based Constructivist Teaching environment.

• Module helps impact on academic achievement.

• Researcher was confident about the TBCT class.
3.17. TOOLS USED IN THE STUDY

To meet the purpose of the research design, the various tools are used to collect the data. They are Daily Assessment Sheet (DAS), unit-test, pre-test and post-test to measure the academic achievement at different levels. Whereas rating scale for CT and TBCT modules were used to collect opinion about the effectiveness of CT and TBCT modules. Besides free wiring sheet was given to collect some qualitative data about the effectiveness of Constructivist and Technology Based constructivist teaching. Revens progressive Matrices (RPM) was used to measure IQ of the students. Except RPM all the tools and modules were developed by investigator and validated with the help of experts.

In the study Raven’s Advanced Progressive Matrices was used. This tool is one of the standard Intelligence Test used to measure the IQ of the children as well as adults. It is non-verbal Intelligence Test prepared in two sets. I set comprised of 12 non-verbal intelligence test whereas second set includes 36 non-verbal tests. Totally there are 48 non-verbal test items in Raven’s Advanced Progressive Matrices. The tools used in the study were presented in Table 3.6.

### Table 3.6
**Tools Used in study**

<table>
<thead>
<tr>
<th>Name of the Tool</th>
<th>Use of the Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>To test the achievement of students before intervention of the module.</td>
</tr>
<tr>
<td>RPM</td>
<td>To test the IQ level the student</td>
</tr>
<tr>
<td>Post-test</td>
<td>To measure impact of treatment on academic achievement of students in Social Science subject.</td>
</tr>
<tr>
<td>Rating Scale for CT</td>
<td>To measure the effectiveness of Constructivist Teaching in the form of collecting the rating of the students.</td>
</tr>
<tr>
<td>Rating Scale for TBCT</td>
<td>To measure the effectiveness of Technology Based Constructivist Teaching in the form of collecting the rating of the students.</td>
</tr>
<tr>
<td>Unit-Test Achievement</td>
<td>To test the achievement of student in each unit. Unit- test developed for History, Geography, Political Science and Economics.</td>
</tr>
<tr>
<td>Daily Assessment Sheet</td>
<td>To test the achievement of students in daily lesson.</td>
</tr>
<tr>
<td>Free Writing Sheet</td>
<td>To collect some qualitative data about effectiveness of Intervention</td>
</tr>
</tbody>
</table>
3.18. CONSTRUCTION AND VALIDATION OF TOOLS

3.18.1. Construction and Validation of Pre-Test and Post-Test

Researcher constructed content based achievement test of 25 marks to measure the achievement before and after intervention of the modules. Pre-test was used to test the students’ entry level achievement and post-test for measure the impact of intervention on academic achievement. Bhakti Panth, Industries of Karnataka, National Integration and Labour and Employment units were considered to construction of pre and post-test. Both the tests were constructed by adopting the general format of the achievement test and validated with the help of guide, subject experts and the professors working in the B.Ed. College. The Development and validation procedure was presented in the Figure 3.9.

Adoption of General Format of Achievement Test

Most commonly used procedure for construction and validation of content based achievement test follows the steps of teacher made achievement test. It gives theoretical and practical format to construction of academic achievement test. The format was presented to guide and experts and gets approved from them to develop achievement test. Meanwhile, according to the opinion of expert decision decided to coin dissimilar questions in each test. Thus, questions coined in pre-test and post-test are not the same questions. So, there was no influence of pre-test performance on subsequent post-achievement test. The steps are presented in table 3.7.

Table 3.7

Steps Used in the Development of Content Based Pre-Test, Post-Test and Unit-Test

<table>
<thead>
<tr>
<th>Steps</th>
<th>Features</th>
</tr>
</thead>
</table>
| Planning | • Selection of objectives and sub units  
| | • Weightage to objectives  
| | • Weight age to different areas of content  
| | • Weight age to different forms of questions  
| Designing Blue Print | • Preparation of Blue Print  
| | • Selection of test items  
| Editing of Achievement Test | • Grouping of test items  
| | • Instructions to examinees  
| | • Preparing marking scheme and scoring key  
| Reviewing of Achievement Test | • Question wise analysis  
| | • Critical evaluation of the test |
**Construction Pre-test and Post-Test**

Considering the above format researcher prepared separate plan for construction of pre-test and post-test for selected units of IX standard Social Science subject. In first step, planning was done through selection of units and objectives. The researcher allotted weightage to knowledge, understanding, Application/Critical Thinking and Skills under weightage to objectives. The objectives considered based on the revised version of Blooms Taxonomy of Educational objectives which fulfill the potential of constructivist teaching. Weightage was decided to objective type questions (Fill in the blanks, match the following and multiple choice questions), Very Short Answer Questions, Short Answer Questions and Essay Type questions identified under weightage to types of questions. Whereas weightage to content was considered and decided based on relative importance of the selected units. In second step, all the weightages were converted into three dimensional blue-print. In third step, test-items were selected and grouped under different sections of question paper according to the blueprint. Further general instructions written to entire achievement test paper and specific instruction for each section of the question paper. For the purpose of objective evaluation of achievement test marking scheme written for short answer and essay type questions and scoring key for objective types questions. Finally achievement test paper cum answer sheet was prepared separately to pre-test and post-test.

The details of construction and validation of pre and post achievement test shown in the Figure 3.7.
Figure 3.7. Construction and validation of Pre-Achievement Test and Post-Achievement Test
Distribution of content, number of items, objectives covered in pre-test and post test presented in the table- 3.8 and table-3.9.

Table 3.8

*Distribution of Content, Number of Items, Objectives Covered in Pre-Test*

<table>
<thead>
<tr>
<th>SL No</th>
<th>Content</th>
<th>No of Items</th>
<th>Objectives</th>
<th>Marks</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bhakthi Panth</td>
<td>6</td>
<td>Knowledge, Understanding</td>
<td>7</td>
<td>28%</td>
</tr>
<tr>
<td>2</td>
<td>National Integration</td>
<td>3</td>
<td>Knowledge, Understanding, Critical Thinking</td>
<td>5</td>
<td>20%</td>
</tr>
<tr>
<td>3</td>
<td>Industries of Karnataka</td>
<td>4</td>
<td>Knowledge, Understanding and Skill</td>
<td>6</td>
<td>24%</td>
</tr>
<tr>
<td>4</td>
<td>Labour and Employment</td>
<td>5</td>
<td>Knowledge, Understanding, Critical Thinking</td>
<td>7</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td>Number of Unit-4</td>
<td>18</td>
<td>Knowledge, Understanding, Critical Thinking, Skill/Creation</td>
<td>25</td>
<td>100%</td>
</tr>
</tbody>
</table>

Weightage Table, Blue Print and Pre-Test question paper cum answer sheet given in the Appendix I.

Table 3.9

*Distribution of Content, Number of Items, Objectives Covered in Post-Test*

<table>
<thead>
<tr>
<th>SL No</th>
<th>Content</th>
<th>No of Items</th>
<th>Objectives</th>
<th>Marks</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bhakthi Panth</td>
<td>4</td>
<td>Knowledge, Understanding</td>
<td>5</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>National Integration</td>
<td>4</td>
<td>Knowledge, Understanding and Critical Thinking</td>
<td>6</td>
<td>24%</td>
</tr>
<tr>
<td>3</td>
<td>Industries of Karnataka</td>
<td>5</td>
<td>Knowledge, Understanding, Critical Thinking and Skill</td>
<td>8</td>
<td>40%</td>
</tr>
<tr>
<td>4</td>
<td>Labour and Employment</td>
<td>5</td>
<td>Knowledge and Understanding</td>
<td>6</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td>Number of Units-4</td>
<td>18</td>
<td>Knowledge, Understanding, Critical Thinking, Skill/Creation</td>
<td>25</td>
<td>100%</td>
</tr>
</tbody>
</table>
Weightage Table, Blue Print and Post-Test question paper cum answer sheet given in the Appendix II.

3.18.2. Construction and Validation of Rating Scale for CT and TBCT

Since the study is an experimental design, researcher developed and validated modules (CT and TBCT) and achievement tests (Pre-test, post-test and Unit-test). Yet, there is a need to know the opinion of the students about the nature and effectiveness of module. To accomplish this, CT and TBCT rating scales has been constructed to measure the students’ opinion about CT and TBCT intervention. The following procedure was used to develop the rating scale.

Planning of Rating Scale

Planning is the first step for construction and validation any rating scale. Here researcher prepared a plan to develop CT and TBCT rating scale. Researcher identified dimension of CT and TBCT scale from the unique features of validated CT and TBCT modules. Further review was also done specially with respect to rating scales available in 5 E’s Instructional Model, Jigsaw, ZPD, Scaffolding, Constructivist assessment and Technology Related Constructivist Teaching. Based on these sources, researcher has collected content and information from journals and books. Later objective of the scale, dimension and components for each dimension were identified based on the nature of CT and TBCT module.

Writing Items for Rating Scale for CT and TBCT

Based on different dimension, initially items were polled as many as possible by the researcher. Then written items were scrutinized and the first draft of CT and TBCT scale was constructed. Initial draft of each scale consists of 40 statements. And decided to follow 5 point likert scale to measure the response of students and instruction were written for the scale.

Validation of Draft of CT and TBCT Rating Scale

The validity of the CT and TBCT rating scale established by four experts in the field of constructivism and technology. They requested to give their opinion in the pattern of ‘accept’, modify, and ‘reject” of statement. And also asked to write their
valuable suggestion for improving the scale. Accordingly many statements were accepted, some statements were modified and several were rejected. Besides they sorted the items; coined the few unique items based on the module and made their few suggestions for further consideration with acceptance of researcher and guide.

Further changes were incorporated in approval of guide. Finally 20 statements were considered for the final draft of CT and TBCT rating scale. Each scale constituting of four dimensions and collects students response about effectiveness of CT and TBCT modules. Apart from this, final draft of the scales again sent to expert in the field of constructivist teaching and technology. They confirmed face, content and construct validity CT and TBCT scale. In this way, the final draft of the CT and TBCT scale were validated.

**Dimension of Constructivist Teaching Scale and Scoring Procedure**

Constructivist teaching rating scale comprised of four dimensions namely Effectiveness of Constructivist Teacher (ECT), Effectiveness of Jigsaw (EJ), Effectiveness of Constructivist Teaching Learning Activity (ECTLA) and Effectiveness of Constructivist Evaluation (ECE). Each dimension constitute of 5 statements, there are 20 statements are there in CT scale. All are positive statements. The scale was developed against 5 point Likert scale and student were requested to respond against 5 levels namely, A= Strongly Agree, B= Agree, C=Undecided, D= Disagree and E= Strongly Disagree. The students were required to opinion their response by selection of one response. The scouring was done by using the scoring key. For all the positive statements the scoring procedure is 5,4,3,2 and 1.

The description of the CT scale was shown in the Table 3.10.
Table 3.10

Description of Constructivist Teaching Rating Scale

<table>
<thead>
<tr>
<th>Dimensions of CT Rating Scale</th>
<th>Number of Statement</th>
<th>Serial Number of the Questions</th>
<th>Nature of Statements</th>
<th>Scoring Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructivist Teacher (ECT)</td>
<td>5</td>
<td>1,2,3,4 &amp; 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jigsaw (EJ)</td>
<td>5</td>
<td>6,7,8,9 &amp; 10</td>
<td>Positive Statements</td>
<td>Strongly Agree- 05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agree-04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Undecided-03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Disagree-02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Strongly Disagree-01</td>
</tr>
<tr>
<td>Effectiveness of</td>
<td></td>
<td></td>
<td>Highest Score=100</td>
<td></td>
</tr>
<tr>
<td>Effectiveness Technology</td>
<td>5</td>
<td>11,12,13,14 &amp; 15</td>
<td>Positive Statements</td>
<td></td>
</tr>
<tr>
<td>Teaching, Learning &amp; Activity (ECTLA)</td>
<td></td>
<td></td>
<td></td>
<td>Lowest Score=20</td>
</tr>
<tr>
<td>Constructivist Evaluation</td>
<td>5</td>
<td>16,17,18,19 &amp; 20</td>
<td>Positive Statements</td>
<td></td>
</tr>
<tr>
<td>(ECE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Statements/Items</td>
<td>20</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The rating scale for CT given in the Appendix-III.

Dimensions of Technology Based Constructivist Teaching Scale and Scoring Procedure

TBCT rating scale consisted of 20 statements with 4 dimensions and each dimension comprises of five statements. The five dimensions are: 1. Effectiveness Technology Based Constructivist Teaching (ETBCT); 2. Effectiveness Technology Based Jigsaw (ETBJ); 3. Effectiveness of TBCT teaching learning and activities (ETBCTLA); and 4. Effectiveness of TBCT based Evaluation (ETBCTE). The students were asked to specify the effectiveness of TBCT statements on five point Likert scale from A= Strongly Agree, B= Agree, C=Undecided, D= Disagree and E= Strongly Disagree. The students were required to rate their response by selecting or encircling one option. The scoring was done by using the scoring key. For all the positive statements the scoring procedure is 5,4,3,2 and 1.

The description of the TBCT scale was showed in following table 3.11.
Table 3.11

*Description of Technology Based Constructivist Teaching* Rating Scale

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Number of Statements</th>
<th>Serial Number of the Question</th>
<th>Nature of Statements</th>
<th>Scoring Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Based Constructivist Teacher (ETBCT)</td>
<td>5</td>
<td>1,2,3,4 &amp; 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jigsaw (ETBJ)</td>
<td>5</td>
<td>6,7,8,9 &amp; 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology Based Constructivist Teaching, Learning &amp; Activities (ETBCTLA)</td>
<td>5</td>
<td>11,12,13,14 &amp; 15</td>
<td>Positive Statements</td>
<td>Strongly Agree-05 Agree-04 Undecided-03 Disagree-02 Strongly Disagree-01</td>
</tr>
<tr>
<td>Technology Based Constructivist Teaching Evaluation (ETBCTE)</td>
<td>5</td>
<td>16,17,18,19 &amp; 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Statements/Items</td>
<td>20</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The rating scale for TBCT given in the Appendix-IV.

**3.18.3. Construction and Validation of Unit Tests**

Unit-tests were used to assess the achievement of students after completion of teaching of specific unit. Four unit-tests were prepared and developed each from the selected section of IX standard social science subject. These test developed in Achievement Test in History (ATH), Achievement Test in Geography (ATG), Achievement Test in Political Science (ATPS) and Achievement Test in Economics (ATE) for assessing the academic achievement of students in Bhakti Panth, unit Industries of Karnataka, National Integration, and Labour and Employment respectively. Alike, pre-test and post-test the same procedure used to developed and validate the unit tests.

All the units were constructed and validated following general format of construction of achievement test namely; 1) Planning, 2) Designing blue-print 3) Editing the achievement test 4) and Review of achievement test. After preparation of first draft of unit test achievement test by researcher, these tests were validated with the help of research guide (Based on feedback II-Draft was prepared), subject experts (Based on feedback III-Draft was prepared), and the method faculty of B.Ed. College (Based on feedback final draft was prepared).
Weightage Table, Blue Print and Achievement Test in History (ATH) question paper cum answer sheet given in Appendix VII.

3.18.4. Construction and Validation of Daily Assessment Sheet (DAS)

Daily Assessment sheet is simple achievement test related to each lesson. It is used to assess the effectiveness of teaching of each lesson at the end. Totally 16 daily assessment sheets separately constructed for CT and TBCT lesson. Each daily assessment sheet carries 10 marks.

The daily assessment sheet were developed using differ types of objective types questions like fill-in-the blank question, true-false question, match the following, multiple choice question, one sentence answer question, location relate skill oriented questions. Based on the nature of the module suitable objective types questions deliberated in the DAS. Initially the model formats of daily assessment sheets were presented to guide along with the lesson plan. They were scrutinized and assessed and validated by the guide. Further sheets were submitted to subject experts. They corrected the nature of question, grammar etc. Changes were incorporated in the final draft of DSA. In this way, daily assessment sheets were validated with the help of guide and subject experts in Social Science subject.

A sample of Daily Assessment Sheet of lesson from Bhakti Panth and Ramanand given in Appendix X.

3.18.5. Construction of Free Writing Sheet

It is a simple writing sheet which includes two sections. In the first section, the students need to express their overall experience about the steps of CT and TBCT module. Second section, they requested to write their comment and opinion about the CT/TBCT approach. In second section rate their opinion on two questions based on five point scale. First question is overall my rating for Constructivist /Technology Based Constructivist Teaching and second question I need CT/TBCT class in other school subject to improve my learning.

The detail of free writing sheet of CT and TBCT given in Appendix V and VI respectively.
3.19. EXPERIMENTATION OF CT AND TBCT MODULES

The entire experimentation was covered in two and half month period. Experimentation was conducted in the following way.

Firstly, IX classes of both schools were equated into two groups as experimental group-1 and experimental group-2. In both the schools experimental group-1 gets the treatment of CT module and Experimental group-2 get the treatment of TBCT module. The first three periods were used for orientation, administration of pre-test and IQ test in CT as well as for TBCT classes. In first period researcher briefed the nature of CT class for experimental group-1 and TBCT class for experimental group-2. The main aim of the orientation was to give complete picture of nature of CT or TBCT class, nature of seating arrangement and role of students and teacher during intervention. Second, period students administered with pre-test and third period administered with IQ test separately for CT and TBCT class. Detail of intervention was presented in following headline. Subsequently CT and TBCT modules were taught in both the school.

Seating Arrangement in CT and TBCT Class

Constructivist Teaching and Technology Based Constructivist Teaching carried in special seating arrangement. It is essential to operate classroom activities based on Jigsaw cooperative social constructivist approach, which is blended in CT and TBCT classroom. The main activity in this approach is home group and expert group activity in the class. In order to initiate the activity, class begins with home group seating arrangement and further they will forms Expert Group complete the steps of CT and TBCT. In both the intervention, during engage stage students’ sits in home group, later class will be formed into expert group in explore stage. Again they will back to their respective home groups and will be engaged in remaining stages namely explain, elaborate and evaluation. The seating arrangement in CT and TBCT classroom is diagrammatically shown in the following Figure 3.8.
3.19.1. Intervention of CT Module

First of all, experimental group-1 of both the schools exposed to Constructivist Teaching (CT). The total of number of class took for treatment of CT module was 16 period. The portion covered from Bhakti Panth, Industries of Karnataka, National Integration and Labour Employment covered. Time duration of each lesson is 45 minutes. Each day single lesson was considered and after completion of each unit achievement test at unit-level was administered. In morning session CT class was
took at government school, where as lessons were taught after noon period for private school. The detail unit and lessons were given in the following table.

Table 3.12

*Detail of Units and Lessons Covered in Intervention of CT Module*

<table>
<thead>
<tr>
<th>Title of the Lesson</th>
<th>Subject: History</th>
<th>CT Module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 1: Bhakti Pant</strong></td>
<td><strong>Subject: History</strong></td>
<td></td>
</tr>
<tr>
<td>Lesson 1 : Bhakti Panth and Ramananda</td>
<td></td>
<td>• CT module Developed Based on 5 E’s Instructional Model, Jigsaw cooperative learning strategy, Constructivist Evaluation, ZPD and Scaffolding.</td>
</tr>
<tr>
<td>Lesson 2 : Kabir and Chaitanya</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 3 : Gurunanak and Meerabai</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 4 : Sufi Saints and Effects of the Bhakti Movement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unit 2: Industries of Karnataka</strong></td>
<td><strong>Subject: Political Science</strong></td>
<td></td>
</tr>
<tr>
<td>Lesson 1 : Development of Industries in Karnataka</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 2 : Iron and Steel Industry &amp; Cement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 3 : Sugar Industries and Paper Industries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 4 : Sugar Industries and Paper Industries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 5 : IT Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unit 3: National Integration</strong></td>
<td><strong>Subject :Political Science</strong></td>
<td></td>
</tr>
<tr>
<td>Lesson 1 : Unity in Diversity</td>
<td></td>
<td>• Number of Teaching Periods 16. Each period of 45 Minutes</td>
</tr>
<tr>
<td>Lesson 2 : Nationalism and National Integration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 3 : Problems Hindering National Integration Lesson</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unit 4: Labour and Employment</strong></td>
<td><strong>Subject: Economics</strong></td>
<td></td>
</tr>
<tr>
<td>Lesson 1 : Labour and Gender Dimension of Labour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 2 : Types of Labour and Abolition of Bonded and Child Labour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 3 : Unemployment and it Types</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 4 : Division of Labour</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Nature of CT Classroom Environment and Intervention**

Experimental gourp-1 was taught using CT module. In this classroom environment students were engaged in 5 steps constructivist approach with in Jigsaw cooperative group oriented learning environment. For implementation CT intervention students were coached to sit in special seating procedure and instructed to follow the same throughout the intervention. During the course of intervention the lessons were also observed by the class room teacher, guide and head mistress/master and feedback received related to effectiveness. The steps of CT teaching modules showed in the following Figure 3.9.
Engage

Engage is the first stage of Constructivist Teaching, in which students were instructed to sit in home groups and nearly 6 to 7 group will be there in the class and it may increase depend on the strength. Each home group constituted of four students. For the purpose of cooperative learning activity students were also provided with color ribbon tags in order to engage students in home and expert group activities. In this stage, students were motivated for new lesson by linking their prior knowledge and new knowledge. The teacher used appropriate devices and identify the prior knowledge of the child based on the nature of the topic. The main function of this stage was to create curiosity in the students for learning new concept or lesson and to form disequilibrium. Lastly, teacher state the aim of the lesson and distribute the Constructivist Learning Resource Pockets for each group. Leader collects the pocket and distribute the content chunk to respective students as for the color of the tag and alphabet. The time duration for Engage is 7 minutes.

Explore

Explore is second stage of constructivist teaching. Chiefly the stage begins with formation of expert group. At this point teacher gives clear instruction to students to form expert group based on the respective content chunk and gives direction to engage them in group activity. It means, A-Sheet students’ of different home groups together forms one group and sit in circle, further explore and construct
their knowledge step-by-step in the form of reading, discussion and interaction with group members related to their content chunk. Unlike B, C, D will also carry their exploration activity in their expert groups based on their learning chunks. In this way, each student with support of group mates and gets a complete mastery over the content. In the interim teacher will supervise activities of each group and if necessary, help and clarify the doubts (Scaffold) of students in process of knowledge construction to reach the ZPD. At the end of this stage, each expert group and their members will mastery over their respective content part. The time duration for this stage is 08 minutes.

**Explain**

An explain phase typically includes several steps, teacher direct the students to return and form their home group and instructed to explain and share their ideas and content to their group members. The main tasks of this stage is to engage home group members in knowledge construction of entire content. As for direction of teacher A chunk holder student will explain his/her portion to team members i.e. B, C, and D. Similarly, B, C and D will explain one by one to their group members. They present, share, and discuss their knowledge in the group and teacher attends each group and clarifies doubt if required. The time during of this stage is 18 minutes. The activities of this stage are showed in the following table.

<table>
<thead>
<tr>
<th>Table 3.13</th>
<th>Activities of Explanation Stage of CT Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students Return to their Home Group And</strong></td>
<td><strong>Teacher Activity</strong></td>
</tr>
<tr>
<td><strong>A</strong> → Will share and explain to B, C &amp; D</td>
<td>Discuss with their friends by asking questions, clarification and in-depth discussion</td>
</tr>
<tr>
<td><strong>B</strong> → Will share and explain to C, D &amp; A</td>
<td>+</td>
</tr>
<tr>
<td><strong>C</strong> → Will share and explain to D, A &amp; B</td>
<td></td>
</tr>
<tr>
<td><strong>D</strong> → Will share and explain to A, B &amp; D</td>
<td>Attend each group and helps the students by clarification of their doubts.</td>
</tr>
</tbody>
</table>

**Elaborate**

The stage carried out in home group. At this juncture, teacher invites the students to extend their knowledge in the form of question and answer or completing the mind maps or presentation or exist card activity or any another other relevant application oriented knowledge construction activity. The stage represents application of knowledge from known area to unknown or learns content to their daily life.
situation. Prominently, the stage advances students understanding and encourages in elaborating their knowledge beyond the text book. It helps in cover the uncovered content area in there group. Obviously, but actually the stage also helps in sharing hidden curriculum in the class. The time duration is 5 minutes.

**Evaluation**

The stage meant to know the effectiveness of understanding and knowledge construction of the students. Teacher distributes the Daily Assessment Sheet and instructed to answer. It will carry out in individually in the group. Sooner, answers will be interacted with question and answer session. The time duration is 7 minutes.

**3.19.2. Intervention of TBCT Module**

Intervention of TBCT class started once close of the CT module. During this stage researcher engage the students in knowledge construction process with the help of Technology Based Constructivist Teaching modules. Keeping the same number of lesson and time duration TBCT lessons taught in both the school. The total number of period taken for invention was 16 periods for invention and 4 periods for unit test. Each day single lesson was taught in experimental group-2 of government and private school. In morning session TBCT class took in private school, where as lessons taught in afternoon in the private school. After completion of each unit, unit-test was administered to collect data related academic achievement in respective unit. The detail of lesson and units of intervention of TBCT modules was presented in the following table 3.14.
Table 3.14

Detail of Units and Lessons Covered in Intervention of TBCT Module

<table>
<thead>
<tr>
<th>Title of the Lesson</th>
<th>Subject: History</th>
<th>TBCT Module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 1: Bhakti Pant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson 1</td>
<td>Bhakti Panth and Ramananda</td>
<td>TBCT modules Developed based on 5 E’s Instructional Model, Jigsaw cooperative learning strategy, technology components, Constructivist Evaluation, ZPD and Scaffolding.</td>
</tr>
<tr>
<td>Lesson 2</td>
<td>Kabir and Chaitanya</td>
<td></td>
</tr>
<tr>
<td>Lesson 3</td>
<td>Gurunanak and Meerabai</td>
<td></td>
</tr>
<tr>
<td>Lesson 4</td>
<td>Sufi Saints and Effects of the Bhakti Movement</td>
<td></td>
</tr>
</tbody>
</table>

| **Unit 2: Industries of Karnataka** | **Subject: Geography** |             |
| Lesson 1 | Development of Industries in Karnataka | LCD projector and Laptop. |
| Lesson 2 | Iron and Steel Industry & Cement |             |
| Lesson 3 | Sugar Industries and Paper Industries |             |
| Lesson 4 | Sugar Industries and Paper Industries |             |
| Lesson 5 | IT Industry |             |

| **Unit 3: National Integration** | **Subject: Political Science** |             |
| Lesson 1 | Unity in Diversity |             |
| Lesson 2 | Nationalism and National Integration |             |
| Lesson 3 | Problems Hindering National Integration Lesson |             |

| **Unit 4: Labour & Employment** | **Subject: Economics** |             |
| Lesson 1 | Labour and Gender Dimension of Labour |             |
| Lesson 2 | Types of Labour and Abolition of Bonded and Child Labour |             |
| Lesson 3 | Unemployment and its Types |             |
| Lesson 4 | Division of Labour |             |

Nature of TBCT Classroom Environment and Intervention

TBCT classroom was unique classroom environment, researcher used blended components of 5 E’s Instructional Module, Jigsaw and technology components, constructivist assessment, ZPD and Scaffolding so as to engage students in knowledge construction. A key feature of physical appearance of TBCT classroom was use of LCD project, screen, Laptop and sound system in course of intervention of 16 modules. Besides, proper seating arrangement made and instructed to follow the same through the intervention of TBCT module. Each day a single lesson was taught in both the schools. Few lessons were also observed by the subject expert, guide and headmistress/master during intervention. Feedback was received with respect to improvement of the lesson. The detailed steps of Technology Based Constructivist Teaching shown in the following Figure 3.10.
Engage

Engage is the first step of Technology Based Constructivist Teaching. Here, students were instructed to sit in home group and each group comprised of four students. Strength of the class decides the number of home groups. Like CT class students were also provided with the ribbon tags. In this stage, researcher motivates and creates curiosity in the lesson with the help of technology components such as PPT slide presentation. Here, teacher use or present PPT slide and instructed to interact by means of question and answer or recognition or completing the mid map or any relevant constructivist activity. Students interact with technology based content displayed on the screen and involved in relevant activity connected to the prior knowledge. This led to formation of disequilibrium in the students and creates curiosity in learning day content. At the end, teacher display the aim of the lesson with the help of PPT slid and states it clear to the students. Later, teacher distributes the resource pocket to each home group. The leader of the home group collects and distributes the content chunk to respective students. The time duration of this stage is 7 minutes.

Screen shot of engage stage History lesson shown in the following Figure 3.11.
Explore

Explore is second stage of Technology Based Constructivist Teaching. The stage begins with formation of expert group and teacher display the content list on slide and instructed to form expert group according to their respective content chunk. Further teacher gives direction to engaging them in group activity with the help of content chunk and content presented on the slide. This means, A-Sheet students forms one exert group and sit in a circle, with the help of sheet and technology related material displayed on PPT accordingly encouraged to explore and construct their knowledge step-by-step in the form of reading, discussion and interaction, listing the points etc with help of chunk, PPT slide and group members. Similarly, B, C and D contents holders form expert group and engage in knowledge construction activity with the help of their content chunk and slide content. In the course of exploration teacher attends each group and if needed, clarify the doubts in knowledge construction activity by showing the slide show. Certainly each expert group will get complete mastery over their respective content part. The time duration for this stage is 8 minutes. The activities of this stage are listed below.

Figure 3.11. Screen Shots of Engage Stage of TBCT Lesson- Development of Industries in Karnataka.
Screen shots of Explore Stage of the TBCT Lessons- Development of Industries in Karnataka shown in the Figure 3.12.

**Figure 3.12.** Screen Shots of Explore Stage of the TBCT Lesson- Development of Industries in Karnataka.

**Explain**

Teacher instructs the students to return to their home group and gets step-by-step direction for explanation. The students will return to their respective home group and observe the PPT slide and explain, share and present their mastered ideas and content to their group members with the help of technology mediation. A content portion holder presents ideas to B, C and D. Similarly B will explain to C, D and A. C will explain to D, A, and B. And D will explain to A, B and C. Concurrently
teacher display the slides of respective chunk and extends his supports to groups. Teacher also ensures students autonomy in knowledge construction. The time duration of this stage is 18 minutes. The activities of explain stage of TBCT lesson shown in the Table 3.15.

Table 3.15
Activities of Explanation Stage in TBCT Classroom

<table>
<thead>
<tr>
<th>Students</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Return to their Home Group &amp;</td>
<td>Discuss with their friends by asking questions, clarification and in-depth discussion</td>
</tr>
<tr>
<td>A → Will share and explain to B, C &amp; D</td>
<td>Attend each group and helps by clarification of their doubts with the help of content slide.</td>
</tr>
<tr>
<td>B → Will share and explain to C, D &amp; A</td>
<td></td>
</tr>
<tr>
<td>C → Will share and explain to D, A &amp; B</td>
<td></td>
</tr>
<tr>
<td>D → Will share and explain to A, B &amp; D</td>
<td></td>
</tr>
<tr>
<td>With the help of content sheet and content displayed on the slide.</td>
<td></td>
</tr>
<tr>
<td>• Gets complete mastery over the days content.</td>
<td></td>
</tr>
</tbody>
</table>

Screen shots of explain stage of the TBCT Lesson- development of industries in Karnataka shown in following Figure 3.13.
**Figure 3.13.** Screen Shots of Explain Stage of TBCT lesson- Development of Industries in Karnataka

**Elaborate**

This stage is also carried out in home groups. Teachers display the activity on slide and invite the students to extend their knowledge through technology mediation such as exit card, question and answers, graphic organizers, mind maps etc. The students apply their knowledge in novel situation or new knowledge to life situations. Here students’ interact with technology related content and cover the content which are not covered in explanation stage. With this student widen their knowledge beyond the text book. On the other hand, elaboration activity will helps to transact the hidden curriculum among the students. The time darnation is 5 minutes.

Screen shots of elaborate stage of the TBCT lesson- Development of Industries in Karnataka shown in the Figure 3.14.
Evaluation

The main objective of the stage is assess the achievement of students of day lesson and to know the impact of intervention. Teacher distributes the Daily Assessment Sheets to each group and instructed to collect their respective sheet. Accordingly students write their answer in daily assessment sheet. Later teacher collect sheets and check students understanding level and effectiveness of intervention by asking them to observe and answer the activities or questions displayed on the slide. The time duration evaluation stage is 7 minutes.

Screen shots of elaborate stage of the TBCT lesson- Development of Industries in Karnataka showd in the Figure 3.15.
Figure 3.15. Screen Shots of Evaluation Stage of TBCT Lesson- Development of Industries in Karnataka

3.20. CONTROL OF THREATS TO INTERNAL AND EXTERNAL VALIDITY OF THE EXPERIMENT

Most important task in any experimental design is how researcher controls the threat to validity of research and conduct the investigation to study the real impact or effectiveness of independent variable on dependent variable. The present experimental design was validated and implemented by controlling many threats in the process of conducting the experiment and relating it to generalization and findings of the study. The entire experimental procedure was validated the internal validity and external validity of the experiment. The following threats were controlled in the present study.

3.20.1. Control of Threats to Internal Validity of Experiment

History, Maturation, effect of pre-testing, experimental bias, unstable instrumentation, experimental morality and statistical regression of subjects are important threat to internal validity of the experiment. These threats are called internal because they affect during the time of experimentation of the research work. These
threats are controlled in the present research and increased the validity of the research by selecting appropriate research design and systematic and proper validation of the research. The following threat to internal validity of experiment controlled in the study and presented in Table 3.15.

**History**

History means, the events which are occurs between the pre-test and post-test. History indicates the external factor or external environment which influence on dependent variable. The factors like drill and practice, examination anxiety etc. will impact on the post-measurement and confuse the impact. The researcher had specifically controlled all the other events other than the intervention in the present research and studied the true impact of CT and TBCT intervention on the academic achievement of students. Additionally, two equivalent design with intervention duration was 16 periods each for CT and TBCT class. So, time duration is very less. Therefore, history is completely controlled and study ensures impartial impact of intervention CT and TBCT on the academic achievement of students.

**Maturation**

The maturation level of participants is another effect for experimental design. It hidden the effect of treatment variable. In order to control such variable namely age, interest, maturation etc. researcher has controlled experimental environment in the form of selection of IX standard students who were studying in two schools in 2012-2013 academic year. More than that the duration of intervention period is very short i.e. 16 periods each for intervention of CT and TBCT group. But natural change in maturation accounted only in long time experiments. Both the groups were more or less same in maturation before, during and after intervention. Thus, there is no impact of maturation on experimentation.
<table>
<thead>
<tr>
<th>SL No</th>
<th>Threat</th>
<th>Threat to Internal Validity Controlled in the Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>History</td>
<td>• The duration of Intervention of CT and TBCT period is very short i.e. 16 periods each respectively</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Two Equivalent Group Design</td>
</tr>
<tr>
<td>2</td>
<td>Maturation</td>
<td>• The duration of intervention is very less. Natural development occurs only in long experiment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Two Equivalent Group Design</td>
</tr>
<tr>
<td>3</td>
<td>Effect of Pre-Testing</td>
<td>• Pre-test and post-test are not same. Changes made in all the questions pertaining to post-test</td>
</tr>
<tr>
<td>4</td>
<td>Experimental Bias</td>
<td>• The students and schools selected are completely new to teacher</td>
</tr>
<tr>
<td>5</td>
<td>Selection of Groups</td>
<td>• Two Equivalent Group design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Groups were randomly assigned i.e. group-1 designated as experimental group-1 and group-2 as experimental group-2 and CT and TBCT modules were used respectively</td>
</tr>
<tr>
<td>6</td>
<td>Unstable Instrumentation</td>
<td>• Instruments are validated with standardized format.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Modules are developed and validated with the help of subject experts, experts in Constructivist Teaching and Technology specialist.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Same instruments used for CT and TBCT group</td>
</tr>
<tr>
<td>7</td>
<td>Experimental Morality</td>
<td>• Two Equivalent Group design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• There is no dropout of subject during experiment and data collection. After discussion with the experts the data is not considered</td>
</tr>
<tr>
<td>8</td>
<td>Statistical Regression</td>
<td>• Two Equivalent Group design and statistical regression equally manifest in both the groups</td>
</tr>
</tbody>
</table>

**Effects of Pre-Testing**

Most common threat to internal validity of pre-test and post-test experimental design is effect of pre-test performance on post-test. However there is need of using both to compare the performance of student’s before and after intervention. The threat
is eliminated in developing and validating separate test at pre-test and post-test level in the present study. Both achievement tests are not same, according to the suggestion of experts dissimilar questions coined in the post-test to prevent the influence of performance of pre-test. Thus, achievement of students at post level is completely due to intervention and impact of CT and TBCT modules.

**Experimental Bias**

It is refers to researchers previous knowledge about the subjects who taking part in the research. It may cause the effectiveness of the experimental conduction. The threat is controlled in the study by selecting the school and class which are not familiar to researcher earlier to treatment. The schools and IX class selected for the researcher is completely new. With this the researcher, fair to find out the impact of treatment CT and TBCT module on academic achievement of students in social science subject.

**Selection of Groups**

Selection of groups for intervention of treatment variable is another threat to internal validity of experimental design. The researcher bias in selection of groups affects the impact on the intervention. Conversely, before intervention of CT and TBCT modules in both the schools researcher confirmed the both the groups are parallel in previous academic achievement. The groups were equated based on the mid-term examination scores in Social Science subject and found that groups were equal in their achievement and randomly groups assigned to CT and TBCT. Therefore any selection bias was not found selection of groups.

**Unstable Instrumentation**

Instrument used in the research creates threat to internal validity of the experimental design when it is not consistent and accurate in measuring required criteria. In the present research, researcher used pre-test, post-test, unit-tests, rating scales and intervention modules. All the measuring instruments are designed based on standard format and validated by the subject experts and specialist in constructivist teaching and technology. Scoring also done appropriately with marking scheme and scoring key in case of achievement test and scoring procedure as for Likert scale for
CT and TBCT rating scales. Same instruments were used for CT group and TBCT group. Whereas CT rating scale was used for experimental group-1 of government and private school and TBCT rating scale for experimental group-2. Thus, there is no question of unstable instrumentation as threat to internal validity of the experiment.

**Experimental Morality**

Loss of subjects during the experimentation confounds the effectiveness of experimentation and the outcome. In the course of the experiment, one student left the school and another faced accidental death. By consulting the guide and experts the data of those students were not considered in analysis and interpretation of the data as well as recorded in the limitation of the study. Thus, research is completely free from experimental morality.

**Statistical Regression**

Statistical regression means regression to mean. When students are selected and grouped based on the extremely highest or lowest scorers of previous achievement scores when previous achievement test is not perfectly reliable in assessing the achievement. Such scores have the tendency to move or regress the achievement of students in subsequent achievement test. It hinders the impact of treatment in an educational experiment. Effect of statistical regression is controlled in the form of equating groups. Also same pre-test and post-test was used in the study and regression to mean is also equally manifested in both the groups.

**3.20.2. Controlling the Threats to External Validity of the Experiment**

Threat to external validity of experiment is another category of validity in experimental design. It concerned to generalization of findings to population. The threats to external validity controlled in the study presented in Table 3.17.
Table 3.17

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Threat</th>
<th>Threat to External Validity Controlled in the Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Interference of prior treatment</td>
<td>• Topic chosen for development and validation of CT and TBCT module fresh. They were not taught prior to intervention in both schools</td>
</tr>
<tr>
<td>2</td>
<td>Experimenter Effect</td>
<td>• Teacher variable is controlled by involvement of single teacher i.e. researcher in intervention of CT and TBCT module as well as data collection</td>
</tr>
<tr>
<td>3</td>
<td>Interaction effect of selection biases and</td>
<td>• Two Equivalent Group Design</td>
</tr>
<tr>
<td></td>
<td>the experimental treatment</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Reactive effects of experimental arrangement</td>
<td>• CT and TBCT class were taught in naturalistic classroom environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CT and TBCT components are fairly implemented in class</td>
</tr>
</tbody>
</table>

**Interference of Prior Treatment**

The study has controlled the interference of treatment on academic achievement. First of all, the topics selected for interventions are not covered or taught priory in the class. And only such topics were selected to study the impact of CT and TBCT on academic achievement. Treatment was assigned to experimental group-1 and experimental group-2. Here experimental group-1 was taught with CT and experimental group-2 with TBCT intervention. In this way study examined true effect of treatment on academic achievement and findings are suitable for generalization.

**Experimenter Effect**

The experimenter who conducts the intervention in class again creates threat to the external validity of the experiment, when there is a change in experimenter for intervention groups. Their feeling, attitude, language proficiency, technology usage ability, communication, age, classroom management etc. will influence intervention as well as on data collection reflects on the dependent variable. But, in the present intervention work, researcher in-person was involved in intervention of CT and TBCT
module and data collection in government and private school. Hence teacher variable was completely controlled in the present research.

**Interaction Effect of Selection Biases and the Experimental Treatment**

The study adopted two equivalent group design, in which two parallel groups admitted for intervention of CT and TBCT module. While designating intervention, without any bias experimental group-1 treated with CT module and experimental group-2 with the TBCT module in government and private school. Additionally, both the groups were equal in their performance in mid-term examination in Social Science subject. Thus, there was no chance of interaction effect of selection biases and experiment treatment in the study.

**Reactive Effects of Experimental Arrangement**

The experimental arrangement or intervention condition also threat to experimental process when the students feel that they are observed and tested in the experimental procedure. Such a feeling forms a change in the attitude and behaviour of students and confound the influence of independent variable on dependent variable. It was commonly found in artificial research process. The threat is also called as Hawthorne effect in experiment. Such experimental findings are not suitable for generalization. But in the present study classrooms arranged and modules are taught in students’ friendly environment and activities are attributed to the features of Constructivist Teaching and Technology Based Constructivist Teaching (student’s autonomy). They took part in the research in a naturalistic class and no chance of differently performance of students. In such a way, there is no occurrence of reactive effects of experimental arrangement on the dependent variable.

**3.21. PROCEDURE OF DATA COLLECTION**

The data collection was carried out in all the three phase of the study.

In pre-intervention phase, researcher visited the school and collected mid-term academic achievement scores of students in Social Science subject and IX standard Social Science syllabus for development of modules. The mid-term scores considered for equating the groups in both the school and to identify two parallel groups’ namely experimental group-1 and experimental group-2. Related validation of modules and
tools researcher received feedback and observations from guide, subject expert, specialist in constructivist teaching and technology specialist. The obtained qualitative modification helped in increasing the validity of modules and tools. In Phase-II Intervention Phase, data collection dealt with two levels. In first level, tri-out of modules other than experimental schools and gets empirical inputs to validated modules. In second level, at the time of intervention in experimental school, pre-test and IQ test administered to experimental group-1 and experimental group-2 of both the schools to collect prior knowledge about the intervention topic and IQ level of the students. Further, researcher used CT and TBCT modules to teach experimental group-1 and Experimental group -2 of both the school. And unit-test academic achievement test was administered to collect impact of intervention on different units of social science subject.

Finally in the post-phase, researcher administered the post-test, rating scale for CT and TBCT and obtained the quantitative data. Also qualitative data was collected about effectiveness of intervention with the help of free writing sheet. After successful completion of intervention of module and data collection appropriate statistical technique applied by using SPSS 17 version to analysis the data.

3.22. STATISTICAL TECHNIQUE USED IN THE STUDY

Keeping the objectives and the Hypotheses, the data collected from both the schools were analyzed using normality test, descriptive and inferential statistics. Skewness, kurtosisi and Q-Q Normal Plot techniques used to analyzed the normality of the group, Mean, mode, median, standard deviation were for descriptive statistics. T-test, 2 Way ANOVA, Correlation and Regression analysis were used for higher level of statistical analysis. Also qualitative data was collected about effectiveness of intervention with the help of free writing sheet. The statistical technique considered in this study presented in table 3.18.
### Table 3.18
**Statistical Techniques Used in the Study**

<table>
<thead>
<tr>
<th>Statistical Techniques</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normality Test</strong></td>
<td></td>
</tr>
<tr>
<td>Skewness</td>
<td>To test the normality of the groups.</td>
</tr>
<tr>
<td>Kurtosis &amp; Normal Q-Q Plot</td>
<td></td>
</tr>
<tr>
<td>Mean, Median, SD and Bar Graph and % analysis</td>
<td>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 for analysis of two questions</td>
</tr>
<tr>
<td><strong>Descriptive Statistics</strong></td>
<td></td>
</tr>
<tr>
<td>T-test</td>
<td>Was used to compare the pre-test and post-test and post-test means scores of boys and girls, high and low IQ students, CT and TBCT group, CT group of government and private school and TBCT group of government and private school.</td>
</tr>
<tr>
<td><strong>Inferential Statistics</strong></td>
<td></td>
</tr>
<tr>
<td>Correlation</td>
<td>Was used to find out the correlation between IQ and Academic Achievement.</td>
</tr>
<tr>
<td>ANOVA 2 x 2 Factorial Design</td>
<td>Was used to find-out the main effect of Gender, IQ on Academic Achievement, And to know the interaction effect of Gender and IQ on Academic Achievement.</td>
</tr>
<tr>
<td>Regression Analysis</td>
<td>Was used to find out the equation for analysing the correlation between IQ and academic achievement.</td>
</tr>
</tbody>
</table>

#### 3.22.1. Skewness and Kurtosis

Skewness, Kurtosis and Q-Q normal plot are the useful statistical analysis to check the normality of the group. In the present study, these tests adopted to analyze the normality of the equated groups of both the schools.

#### 3.22.2. T Test

T-test is a statistical technique for testing significant difference between the two mean scores of two groups. The study used independent sample t-test and paired sample t-test. The tests were employed to compare the pre and post-test means scores, post-test mean scores of boys and girls; high and low IQ; CT and TBCT; CT government and CT private; TBCT government TBCT private. It also helps to know the effect of academic achievement.
3.22.3. Pearson Product Movement Correlation

Correlation is most useful test frequently employed to test the dependence of the two variables. It is helpful to estimate the cause and effect association between two variables with simple regression equation. In this study, Pearson correlation coefficient was calculated to explore the correlation between post-test mean scores of academic achievement and IQ.

3.22.4. 2 X 2 Factorial ANOVA

Factorial ANOVA is statistical procedure calculated to measure the effect of two or more independent variable with two or more level on dependent variable. In this study, moderate variables namely Gender and IQ consist of two levels namely boys and girls and high IQ and low IQ and dependent variable is academic achievement. The study examined the main effect of IQ levels and gender on academic achievement and combined together how these two moderator variable effect on academic achievement of secondary school students.

3.22.5. Linear Regression Analysis

Linear regression analysis is a statistical test to calculate the relationship between predicted variable and predictor variable. In the case of present research, it was employed to identify the correlation between independent variable IQ and dependent variable post-test mean scores of academic achievement of students. Further it helps to estimate or predict the amount dependent variable academic achievement explained by the dependent variable IQ. It can be presented in the form of linear equation and linear regression line.

3.23. SOFTWARE USED FOR ANALYSIS

For data entry and data analysis MS Excel and SPSS 17 were used in the study.

3.23.1. MS Excel

The MS excel is used for data entry and to find out the average score of the data. The package was also used for graphical representation of mean differences.
3.23.2. Statistical Package for Social Science (SPSS)

T-test, correlation, 2X2 factorial design, regression analysis and percentage analysis were calculated by using software package SPSS statistical 17 version.

3.24. CONCLUSION

Thus, the present study was conducted systematically based on suitable research design keeping variables, objectives and hypotheses in mind. Accordingly study developed modules, tools with the help of experts and conducted the experiment in government and private school. Finally tools were administered to obtain the data and suitable statistical tools identified and analyzed using the SPSS package. The analysis and interpretation of the data is reported in the chapter IV.