CHAPTER FIVE

FINDINGS, CONCLUSIONS AND SUGGESTIONS

AN OUTLINE

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CHAPTER FIVE

FINDINGS, CONCLUSIONS AND SUGGESTIONS

In the previous chapters the entire plan of the research carried for the completion of the study, the analysis and interpretation of data have been discussed in detail. The present chapter provides an opportunity to describe the essence of the entire research work in a precise and concise way. As a lot of sincere and hard work is involved in every research project, in order to discover and solve its underlying intricacies, a researcher can succeed in obtaining the rich harvest of research work only by following various steps systematically and correctly.

Since, the main thrust of the present study was to develop systems approach based resource material for teaching physics to secondary school students and to evaluate its effectiveness on dependent variables: spiritual and emotional intelligence, academic achievement in physics and systems thinking skills, therefore, on the basis of the analysis and interpretation of data presented in the previous chapter certain findings and conclusions have been drawn. In the light of these findings and conclusions, certain educational implications have also been determined. All these findings (objective wise), conclusions, educational implications, limitations and suggestion have been summarized in the present chapter which is organized under the following headings:

5.1 Findings of the study
5.2 Testing of Hypotheses
5.3 Conclusions
5.4 Educational implications of the study
5.5 Limitations of the study
5.6 Suggestions for further research
5.1 Findings of the Study

In accordance with the aims and objectives, the findings of the study are presented in the following sections.

5.1.1 Findings Related to Objective 1

The first objective of the study was ‘To explore and analyze the resources available and difficulties of science students related to science learning and teaching’. The findings (based on the responses of 400 secondary school level science students) obtained in this regard are discussed in this section.

5.1.1.1 Findings related to the difficulty level of various topics of secondary level physics for students.

Surveyed students found the topics taught in the first year of intermediate level physics slightly easier than the ones taught in the second year. Electricity was the topic which was rated as the most difficult one whereas ‘Measurement and mechanics’ was rated as the least difficult topic. Electromagnetism, electronics, modern physics, wave motion are the other topics which were found difficult by students (in decreasing order of difficulty). These findings are in agreement with the findings of Driver, 1994; Osborne, 1980; Duit, 1985; Tibergehein, 1983; Thornton et al., 1998; Akarsu, 2011.

Through interviews it was further revealed that students felt that the concepts of electricity, electromagnetism, wave motion were abstract in nature and, therefore, difficult to understand. Students also pointed out that in spite of memorizing various laws and formulae of physics, they keep forgetting them. Ironically, many of the students were
of the opinion that physics should be tagged as the toughest subject of all and all the topics related to it should be marked as very difficult.

5.1.1.2 Findings related to the practical component of physics

i. Regarding the number of periods available for practical work, 72% (288) of the students surveyed were of the opinion that it should be increased and 9% (36) were of the opinion that it should be decreased while 19% (76) were satisfied with the present number of periods for practical. This shows that about three fourth of the students were interested in having increased practical activities in physics.

ii. For facilities available in the physics laboratory, 86% (344) of the surveyed students were of the opinion that facilities were adequate, while 9% (36) found them to be inadequate and 5% (20) could not say anything.

iii. Eighty three percent of the surveyed students were of the opinion that the science laboratory was averagely organized and 69% of the surveyed students said that the working condition of the equipments in the laboratory was average.

Even Shukla (2005) in India Science Report has pointed out the grim scenario of practical aspect of science. First of all, the facilities available are not sufficient most of the time, secondly, majority of science teachers do not have satisfactory knowledge related to practical work in science.
5.1.1.3 Findings related to the library

i. Eighty four percent (336) of the surveyed students rated the condition of science books in school library to be average and only 13% rated them to be in good condition. Three percent of the students were of the opinion that the books were in poor condition.

ii. When asked about the availability of latest edition of books in library, 92% (368) students said that the latest edition books were not available in the library.

iii. To find out the names of the authors whose physics books were preferred, the students were asked to write down the names of three authors whose books they prefer reading. 92% (368) mentioned Kumar and Mittal (Nageen Publication, Meerut), 12% (48) mentioned Subrahmanyan (S. Chand and Company Ltd., New Delhi) and 39% (156) P. Bahadur (S.Chand and Company Ltd., New Delhi). An analysis of these books by the researcher indicated that in all the books the quality of content presented was good, but, the major drawback was that the treatment of the content was linear with no inter-linkages with psycho-socio-spiritual aspects of life and had only limited number of diagrams and pictures in them.

iv. Regarding the amount of time spent by students in library for reading the science books, it was found that 51% i.e. almost half of the sample spend around one hour per week in library for reading books and only 7% spend about 4 hours in library whereas 12% (48) do not spend time reading physics books.
During interviews one student of class XI said that as he found most of the books monotonous, boring and overloaded with textual content with very few diagrams and pictures in them, therefore, he did not like reading them. One of the student also said that she felt more inclined to reading the handouts given by teachers than the books in library. These findings reflect students’ poor reading habits and a need to enhance their interest through teachers’ efforts.

5.1.1.4 Findings related to the pedagogy of science teaching

Students were asked to assign ranks (1 to 5) on the basis of weekly frequency of usage in one column, and desired weekly frequency of usage in the other. It was found that the lecture method was the most commonly used teaching method (97% students rated it at 1\textsuperscript{st}) whereas its desirability was the least (49% students rated it at 5\textsuperscript{th} for desired weekly usage). However, 44% students assigned it 3\textsuperscript{rd} rank for its desired usage i.e. lecture method can’t be completely given up but it certainly needs to be combined with some other methods such as demonstration (rated as 1\textsuperscript{st} for desired weekly usage by 69% of the sample) and activity method (rated at 1\textsuperscript{st} position for desired weekly usage by 49% of the sample).

*Mukherjee (2001)* also mentioned in his study ‘Science Education in India’ that students should be provided the opportunity to observe the world around them, go on field trips, do laboratory experimentation, investigate, analyze – in short do “what scientists do’. There is an urgent need today to devise such learning-teaching strategies which will provide students hands-on-activities to overcome the challenges posed by the abstract nature of concepts of physics. This also highlights the importance for using
analogies, concept mapping and linking the content to be taught with lives of students while teaching.

5.1.1.5 Findings related to the language of instruction

Regarding the language of instruction it was found that the combination of Hindi and English were mostly used for teaching (as agreed by 81% of the sample). This combination was also desired to be used (as 88% of the sample of students agreed for it). Surprisingly the desired usage of English alone (indicated by 11%) was found more than Hindi (indicated by 1%) only as the language of instruction. This indicates the need for using both the languages in learning-teaching situations.

5.1.1.6 Findings related to the use of audio / visual aids

Regarding the use of audio-visual aids black board was assigned 1st position in its present usage by all (100% of the sample) and its desirable usage is also high (assigned 1st position for desirable usage by 69%). Internet (assigned 5th position for present weekly usage by 93%) and audio-visual presentations (assigned 5th position for present weekly usage by 91%) are the audio-visual aids which were found to be least used for learning physics. Shukla, 2005 has also pointed that there is a lack of proper usage of modern technology in schools for learning–teaching practices and over dependence on conventional methods.

5.1.1.7 Findings related to the interest of students in science

i. Almost all (100%) the students expressed their desire to engage more in science activities in school.
ii. Regarding the causes which prevented students from engaging in science related activities, lack of time (indicated by 89% of the sample) and lack of facilities (indicated by 77% of the sample) were found to be the major causes which prevented students from engaging in science related activities. Fourteen percent (56) of the surveyed students marked lack of interest as the cause behind their lack of involvement in science related activities.

iii. Interestingly 92% (368) of the surveyed students would like to study/learn science to enable them to understand physical realities and metaphysical aspects. To make informed decisions was also chosen by 79% of the sample as a major cause for making them interested in studying or learning science. Though generally believed as the major reason, but, on the contrary only 39% of the surveyed students said that they wanted to study science to score well in exams. This reflects the need for relating scientific facts with physical and metaphysical realities to sustain students’ interest in physics.

iv. Almost all (93%) of the surveyed students were found to enjoy doing experiments and 88% (352) liked watching science-based documentaries/films/fictions etc. Only 38% of the surveyed students liked discussing science related events/discussions etc. This is in agreement with the other findings (section 5.1.1.3) which show students’ lack of interest in reading, due to which they lack sufficient knowledge and in place of active discussion among peer group and with teachers, they prefer passively watching science documentaries. Everyday science (81%) and scientific facts related to
metaphysical issues (51%) have been found as factors about which students were most interested in studying science.

During interview students suggested that for developing interest in science, schools should provide more apparatus, instrument, etc. for experiment and arrange for science tours and fairs, encourage use of computer and internet, organize science events, debates, factory visits, demonstrations, etc.

5.1.2 Findings Related to Objective-2

The second objective of the study was ‘To explore and analyze the academic difficulties faced by the science teachers in science teaching and their suggestions for improving it’. The findings (based on the responses of 20 secondary school level science teachers during interview) obtained in this regard are presented in this section.

i. The self analysis of teachers’ personal attributes reflected that 70% (14) of the interviewed teachers rated their teaching abilities as average and 30% (6) considered themselves above average in teaching. In most of the other attributes also such as pleasing manners, friendly attitude towards students, ability to finish prescribed course in time, democratic temper, altruistic temper, developing good rapport with students, enthusiasm and passion for science learning–teaching, ability to motivate and stimulate learning, etc. teachers considered themselves to be average. Only in attributes such as ability to guide and advise students, impartialness for students and well
developed personal value system, teachers rated themselves to be above average.

ii. *Teachers’ self analysis regarding teaching competencies* reflected that 75% of the interviewed teachers rated themselves to be very good only in one attribute (teacher’s concern for students). Only in competency of achieving closure 80% of teachers rated themselves as below average. In other competencies such as professional perception, giving assignments, illustrating with examples, clarity in presentation and ability to provide intellectual challenges to students, most of the teachers rated themselves to be average.

iii. *Findings related to the science teachers’ efforts for inculcating values in students through teaching of science:* Sixty five percent (13) of the interviewed science teachers answered that they did not get sufficient time, 60% (12) said that they were unable to do so whereas 55% said that they found the task relatively difficult. This reveals that due to overloaded syllabus of science, the teachers are unable to develop values in students neither explicitly nor implicitly, mainly due to paucity of time.

iv. *Availability of computer system and internet facilities at teachers’ homes:* Eighty five percent (17) of the interviewed teachers had computer system at home out of which 30% had internet facility as well.

v. *Availability and accessibility of the facilities in schools for teachers:* Although, 90% (18) of the interviewed teachers said that they had internet facility in their schools, but out of them only 10% (2) said that it was
accessible for teachers. Eighty percent of the surveyed teachers said that they had computer laboratory in schools and 90% said that it was accessible to them easily.

vi. *Purposes for which teachers use the internet facility:* Sixty percent (12) of the interviewed teachers said that they did not use internet facility at all whereas, 40% used it for downloading relevant material for the students.

vii. *Frequency of interrelating scientific facts with metaphysical facts:* Sixty percent (12) of the interviewed teachers were found to rarely inter-relate scientific facts with metaphysical reality while 30% (6) only did so sometimes and 10% did so never.

viii. *Barriers in effective implementation of good teaching:* Majority (90%) of the interviewed teachers pointed out pressure of overloaded syllabus as the major barrier in effective implementation of good learning teaching. Among other common factors were insufficient allocation of budget (indicated by 80%) and lack of students’ motivation (indicated by 70%).

ix. *Importance of lesson planning:*

When asked about the importance of lesson planning in learning-teaching process, almost all the interviewed teachers (20) said that planning is an important aspect of learning-teaching process. However, most of them were of the view that it should be simple and based on practical realities. They considered traditional type of lesson planning to be too time consuming and obsolete. All the teachers said that they did some kind of planning (from a
simple outline of lesson presentation to a detailed plan) depending on the nature of the content to be taught to the students, available time and previous knowledge of the students to be taught.

x. **Suggestions of science teachers for improving physics learning-teaching:**

All the interviewed teachers suggested the need for enriching the theoretical content of all the topics of physics with information which is relevant and interesting and related to the recent developments. Regarding the methods of teaching the analysis showed that the lecture method was preferred by teachers because it saved their time but at the same time they felt the need for incorporating group activities, audio-video presentations, etc. For audio-visual aids - charts, models, equipment for experiment, laptops, projectors, computers etc. were suggested. Good books, multimedia facilities, proper equipment for experiments, internet connectivity and access in schools, extra time, etc. were among the basic needs of teachers for effective learning-teaching as suggested by them.

### 5.1.3 Findings Related to Objective 3

The third objective of the study was ‘To develop systems approach based resource material and learning-teaching strategies for secondary level science students’. As described in the third chapter, cyclic research was carried for the development of systems approach based resource material for teaching physics to the secondary level science students. During this cyclic research sub-phase first a preliminary draft of systems approach based material (PSARM) and learning-teaching strategies (SLTS) (for teaching
science students of class XII: Semiconductors, Diodes and Transistors; class X: Electricity and light) were developed on the basis of the findings of the explorative sub-phase with which the first two objectives of the study were linked. This draft was validated by two science teachers of intermediate classes and two teacher educators, and then field tested topic wise on groups of six students of class XII (science stream of two different intermediate schools) and five students of class X of schools affiliated to U. P. Board of Secondary Education). Data related to this field test was collected through various qualitative and quantitative tools such as interviews, observations, written tests of students, class assignments, etc. and analyzed. The findings related to the first field test of the PSRM and SLTS led to some modifications in it.

Again this modified draft was tried out in a second field test and on the basis of the findings of the second field test the final Systems Approach Based Resource Material (SARM) was developed (c.f. Appendix G). Relevant and good quality videos animations and a computer programme ‘SAUS’ (Systems Approach to Understanding Semiconductors) developed by the researcher were also provided in a compact disc along with the booklet of SARM. The booklet, the CD – Rom of SARM and learning-teaching strategies employed have been described briefly in this section.

5.1.3.1 An outline of the developed final systems approach based resource material (SARM)

SARM has been prepared by the researcher keeping in view the findings of the explorative phase related to the exploration and analysis of the difficulties faced by the students in science subjects (more specifically physics) and the academic problems of
science teachers. Various features of final draft of SARM (c.f. Appendix G) have been described in this section.

(i) **Objectives:** The objectives of the content of the booklet were decided according to the requirement of the topics to be covered in it prior to the designing and development of the booklet under the overall purview of systems approach. During the specification of objectives importance have been given to the affective and psychomotor domains of students’ personality, along with the cognitive domain.

(ii) **Introduction:** The introduction has been provided to give the reader an idea of the topics covered and content arrangement in the booklet.

(iii) **Textual content:** On the basis of the needs of the students and as per the desirability of the concerned science teacher of the school where the field testing was supposed to take place, the topics ‘Semiconductors: diodes and transistors’ were chosen for developing the SARM and SLTS for class XII; and the topics related to electricity, electromagnetism and light were chosen for class X (Science) - U.P. board. Various techniques and concepts of systems approach like concept mapping, whole to part to whole, input-process-output system, cybernetics etc. were employed for arranging the content of the booklet so as to enable students to not only easily comprehend the concept and principles of semiconductors: diodes and transistors; electricity, electromagnetism and light, effectively but also to retain them for longer period.
The textual content of the booklet dealing with semiconductors was covered under five sections mainly Electronics, Systems perspective to electronics, Semiconductors, p-n Junction diode, Transistor. These were further sub-divided into sub-sections. Each section encompassed well labeled diagrams, illustrations, tables, pictures, etc. Keeping the examination pattern in mind questions were framed under the following categories – conceptual questions, and numerical problems. Similar pattern was followed for developing SARM booklets on topics electricity, electromagnetism and light for class X.

(iv) Summary: At the end of the booklet a short summary of all the topics discussed in the booklet was also given so as to make it easy for the students to revise the topics. A quick look at the summary is supposed to provide students an overview of the whole course material of the booklet. The summary was in the form of points so that it does not put the pressure on students for reading in too much detail.

(v) Test for Summative Evaluation: Although, various types of short and long answer questions were provided throughout the content of the booklet to assist students in evaluating themselves, but since, there is always a need for summative evaluation also to find out the extent to which knowledge has been grasped and retained, therefore, questions based on the U.P. Board examination pattern were also given at the end of the booklet. Along with this an answer key was also given in the booklet.
(vi) **Some other special features of the booklets:** In order to make the booklets different from other commonly available texts on similar topics and to make it more useful in developing coherent understanding and holistic perception some special features incorporated in the booklets were:

a) systems approach principles for the arrangement of content in the booklet  
b) diagrams, pictures, comparative tables etc. for easy comprehension  
c) mnemonics to facilitate memorizing of formulae etc.  
d) point wise discussion of various topics to make reading of the booklet lucid  
e) exercises for self-practice,  
f) mentioning of relevant books, internet sites etc. for further reading (in case students want to gain more information regarding something)

### 5.1.3.2 An outline of the content of the CD (audio-video)

This CD was prepared as a component of SARM to facilitate learning-teaching through the ready to use audio-visual presentations. The main objective of this CD was to enrich learning-teaching activities and make it interesting for students and teachers as well. The need for this CD was felt because both students and teachers had expressed their desire for the use of audio-visual presentations but at the same time due to the paucity of time, resources, technical skills etc. they could not develop such aids. Most of the videos and the programme SAUS can be simply watched on normal computer systems easily available. Only for viewing some online simulated animations internet connectivity is required. The contents (folders) of the CD have been described in this section.

*(i) Self learning Programme: Understanding Semiconductors: Diodes and Transistors (USDT)*

This programme is based on the concept of systems approach such as concept mapping, whole to part to whole, cause-effect pattern, use of analogies, etc. The
first slide of the programme is the title slide. The second slide provides certain options such as content, summary, formulae, numerical, links to important sites. By pointing at the desired option and clicking the left button of the mouse the user can access it. The first slide of the content option describes how the various topics to be studied are inter-related and provides a holistic picture of the entire chapter to be covered. For detailed information regarding any of the topics, the user just needs to click the left button of the mouse and the information related to that topic will be displayed. Similarly, by simply pointing and left clicking the desired option the relevant textual matter will get displayed.

(ii) Videos related to various topics: The researcher explored intensively on the internet and downloaded good quality videos related to the various topics. These videos have been arranged in a proper sequence in the folder named ‘videos’ in the CD

(iii) Website Linkages for animations to be viewed online: The folder website linkages provide linkages and url addresses of various internet sites on which online animations can be viewed for learning-teaching purposes. (c. f. Appendix H)

5.1.3.3 Systems Approach based Learning-Teaching Strategies

During the review of related research literature, the investigator explored a number of systems approach based learning-teaching strategies which can be utilized for teaching the topics of physics efficiently. The systems approach based learning-teaching strategies
which were found effective and helpful to the students during the cyclic research sub-phase are reported in this section.

i. **Systems approach based lesson planning:** Although, there is not any fixed format available for systems approach based lesson planning, but, keeping in view the general principles and ideologies of systemic perspective and needs of the present times, the steps for systems approach based lesson planning have been decided by the researcher with the help of teacher educators and psychologists. Considering an instructional situation as a system, the steps for systems approach based lesson planning have been delineated in this part.

1. **Writing down the various systems aspects of the specific instructional situation involved, in terms of:**
   
a. Product aspect (including objectives related to affective, psychomotor and cognitive domain of students’ personality, and criteria for success)
   
b. Inputs (related to students, teachers, available resources, constraints, etc.)
   
c. Alternative learning-teaching strategies
   
d. Mechanism for receiving students’ feedback
   
e. Environment (whether rural or urban, cultural and social conditions, etc.)

2. **Systems analysis of the various constituents of systems aspects listed in the first step:** In this step, the teacher is supposed to analyze the entire situation based on the listed components and then decide which all objectives have to be worked for and what would be the criteria of success (depending mainly on the nature of inputs (students, teacher, resources and constraints and environment), which learning-teaching strategies have to be selected (based on the selected objectives and inputs), kind of mechanism required for receiving and analyzing students’ feedback, etc.
3. **Developing a table for presenting finalized desired outcomes, resources required, learning-teaching strategies selected, activities for evaluation of students:**

<table>
<thead>
<tr>
<th>Teaching point and time required</th>
<th>Desired behavioural outcome</th>
<th>Resources required</th>
<th>Learning-teaching strategy</th>
<th>Activities of</th>
<th>Evaluation</th>
<th>Remarks for improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Teacher</td>
<td>Questions to be asked</td>
<td>Good</td>
</tr>
<tr>
<td>1.</td>
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<td>2.</td>
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</tbody>
</table>

**Fig. 5.1 Table for presenting finalized parameters for the instructional situation**

4. **Presentation of the lesson in real classroom learning-teaching situation:** With the help of the developed table of finalized learning-teaching parameters for the instructional situation, classroom learning-teaching can be carried out, accordingly.

5. **Interpretation of the results of evaluation and improving learning-teaching:**

During the real classroom learning-teaching teacher is supposed to evaluate the success of her lesson planning in terms of students’ responses to the questions put up to them, and this can be noted in the column ‘Quality of students’ response’. After the classroom learning-teaching session is over, the teacher can interpret the results of evaluation by assessing the quality of students’ responses and its cause, and decide the kind of modification required in the desired outcome or learning-teaching strategy for the related teaching point.
ii. **Concept mapping:** Concept map is a useful knowledge representation tool, primarily for representing “static” relationships between concepts. Even “dynamic” relationships between concepts can be represented in Cyclic Concept Maps, which represent the functional relationships among a constellation of concepts. These are in the form of a graph comprised of boxes and circles connected with labeled arcs (Figure 5.2). Words or phrases that denote concepts are put inside the boxes, and relationships between different concepts are specified on each arc (Novak and Gowin, 1984).

![Concept Maps](image)

Fig. 5.2 Illustrations of two concept maps based on (i) electric circuits and (ii) transformation of matter and energy in the universe.

iii. **Stock flow diagrams:** A stock is a term for any entity that accumulates or depletes over time, whereas, a flow is the rate of change in a stock. The stock and flow diagram shows relationships among variables which have the potential to change over time. For example, second law of thermodynamics is illustrated using stock and flow diagram in the Figure 5.3.
iv. **Behaviour over time graph:** It allows students to examine on a timeline or a graph the behavior / variable over a series of events. These can be used for concepts of capacitances, current in electric circuits, electromagnetism, etc.

v. **Causal-Loop diagram:** It is a visual representation of the feedback loops in a system. These diagrams demonstrate how a system works and how the sub-systems interact when used with each other. These are most effective when used in the debriefing culmination of a unit of study. These allow students to see graphically the outcomes of their predictions. The causal-loop diagrams show relationships and identify circular feedback within a system. Cause becomes effects, then causes, then again effects and so on.

vi. **Cyclic representation of phenomena:** Cyclic relationship among concepts is the basis of cybernetics (Wiener, 1961), and systems thinking and modeling (Ashby, 1957; Forrester, 1961; Sterman, 2000). The approach has played a significant role in the modeling and understanding of organized complexities in biological, electro-mechanical, and social systems. For example, the cyclic relationship between input, transfer function, output, and the difference between desired output and the actual output, which is fed back into the system for corrective
purposes (negative feedback), can be applied to how a thermostat regulates the room temperature, or to understand various other natural phenomena.

vii. Whole Part Whole approach: This reverses the order of the stages in the traditional approach taking the study of complete systems first, next identifying sub-systems or building blocks, then putting them together to create useful systems.

viii. Making use of analogies: As it is commonly believed that the universe is governed by universal laws and principles, which exhibit themselves through a myriad of events in our life. Although, in order to understand them these are taught through various streams of knowledge, but the basic essence and values behind them remain unchanged. For example, in physics students are taught about various concepts of electricity such as current, power, resistance, voltage, etc. In daily life events, these concepts are similar to that of the flow of water in pipes from a high level position to a low level position. When seen form a higher perspective, voltage and resistance are analogous to motivation and obstacles or challenges respectively, which we come across in our personal lives. As without resistance current can not be put to use, same way, obstacles and challenges provide us with experiences and intellectual, emotional and social maturity. Another example is related to the principles of energy which reflect that we all are simply energy bubbles in the vast ocean of energy and thus, we all are connected to each other. The incorporation of similar type of analogies was found useful in developing reflective attitude in students regarding various social, emotional and
spiritual aspects of life. These were mainly incorporated for developing the affective domain of students’ personality and for enhancing their spiritual and emotional intelligence.

ix. Identifying similarities and dissimilarities: The ability to break a concept into its similar and dissimilar characteristics allows students to understand complex problems by analyzing them in a more simple way. Teachers can either directly present similarities and differences, accompanied by discussion and enquiry, or simply ask students to identify these on their own. Venn diagrams, comparison charts, metaphors, analogies, etc. can also be used for this purpose.

x. Flowcharts: is a tool for precisely and concisely representing the flow of information among various stages in the development of a theoretical concept or in the formulation or analysis of any problem. It was noticed during the field tests by the researcher that students often showed concerns about not being able to understand where a lecture was headed or how the concepts taught in previous lectures related to the concepts presented in the new lecture. Flowcharts were found to deal effectively with this concern. Flowcharts allow to exhibit flow of thought in a presentation, and also help in relating previously covered topics to the new ones. For using flow-charts the teacher can partition the blackboard into two sections; one for presenting the lecture and the other for developing a flowchart as the lecture progresses. At the start of the lecture the flowchart can consist of a single block where the goals of the lecture can be clearly spelled out. As the lecture proceeds, the flowchart is updated by adding more blocks to
indicate the significant concepts and arrows connecting the blocks to indicate the flow of thought. The flowchart, which is essentially a summary of the lecture, also makes it easy for the teacher and students to revise the lecture at the end of the class. Students also reported that they found the flowcharts very useful for revision purpose during exams.

xi. **Graphic Organizer**: Visual format that helps students to organize their understanding of information being presented or read and the relationships between various parts of the information.

xii. **Mnemonics**: A device or code used to assist memory by imposing an order on the information to be remembered.

xiii. **Summarizing**: is a process of analyzing the whole content to expose what is essential and then putting it in one’s own words. This not only helps in revision of the main points but also provides a systemic perspective of the whole topic covered.

### 5.1.4 Findings Related to the Secondary Objective of the Study

The secondary objective of the study was ‘To evaluate the effectiveness of the systems approach based resource material (SARM) and learning-teaching strategies (SLTS) on Spiritual Intelligence, Emotional Intelligence, Academic Achievement in Physics and Systems Thinking Skills of secondary school science students.’ The findings obtained in this regard are summarized in this section.
5.1.4.1 Findings related to the effect of systems approach based resource material and learning-teaching strategies on spiritual intelligence of secondary school science students.

For the purpose of studying the effect of systems approach based resource material and learning-teaching strategies on spiritual intelligence of secondary school science students, first the nature of the distribution of scores of pre and post test obtained on the Spiritual Intelligence Assessment Scale by the control and the experimental groups was analyzed followed by the analysis of the significance of difference between the means of pre and post test of the two groups.

5.1.4.1.1 Nature of the distribution of scores of pre-test and post-test obtained by the secondary school students of the control group and experimental group on Spiritual Intelligence Scale (SIA).

The mean values of scores of pre and post tests obtained on SIA by the control group were found to be 234.7 and 236.8 respectively, and by the experimental group these were found to be 233.2 and 252.1 respectively. The standard deviation of the scores of pre and post tests of the control and the experimental groups calculated to be 21.84, 22.68, 27.52 and 25.09 are indicators of slight heterogeneity among the four sets of scores. The slightly negative values of the sets of scores of pre and post tests of the control and the experimental groups (-0.63, -0.12, -2.03 and -1.31 respectively) point out that majority of the students have scored above average on the SIA. The values of kurtosis which are more than 0.26 re-affirm the prevalent heterogeneity within the control and experimental groups. The notable reduction in the value of kurtosis of the post test (3.06) from that of pre test (6.82) of the experimental group can be said to be due to the effect of the systems approach based learning-teaching, thus decreasing the heterogeneity within the group.
The values of co-efficient of correlation for the pre and post tests of control group (0.83) and the experimental group (0.82) showed that the scores obtained by the two groups were highly correlated.

5.1.4.1.2 Significance of difference between the means of scores of pre-test and post-test obtained by secondary school students of experimental (EG) and control group (CG) on Spiritual Intelligence Assessment Scale (SIA).

It was found that the means of scores of pre test of the experimental (234.5) and the control (233.2) groups did not differ significantly (CR value = 0.41), which affirmed that the two groups were equivalent and correlated to each other with reference to spiritual intelligence.

The value of mean of scores of post test of experimental group (252.1) was found to be higher than that of the control group (236.8), and it was found to differ significantly at .01 level (degree of freedom 44). This reflected that systems approach based learning-teaching resulted in significant difference in the means of scores of the post test of control and experimental groups obtained on Spiritual Intelligence Assessment Scale. There was no significant difference in the means of scores of the pre and post tests obtained on Spiritual Intelligence Assessment Scale of the control group, which was taught using conventional style.

The value of the mean of post test scores (252.1) was found significantly higher than the value of the mean of the pre-test scores (233.2) obtained on Spiritual Intelligence Assessment Scale by the students of the experimental group, as the calculated CR value (7.97) is much higher than the t-table value (2.69 at .01 level of significance) for degree of freedom of 44, reflecting that systems approach based learning-teaching can be effective in improving the level of spiritual intelligence of students.
5.1.4.2 Findings related to the effect of systems approach based resource material and learning-teaching strategies on emotional intelligence of secondary school students.

For the purpose of studying the effect of systems approach based resource material and learning-teaching strategies on emotional intelligence of secondary school science students, first the nature of the distribution of scores of pre and post test obtained on the Emotional Intelligence Scale by the control and the experimental groups was analyzed followed by the analysis of the significance of difference between the means of pre and post-tests of the two groups.

5.1.4.2.1 Nature of the distribution of scores of pre-test and post-test obtained by the secondary school students of the control group and experimental group on Emotional Intelligence Scale

The mean values of scores of pre and post tests obtained on EIS by the control group were found to be 124.10 and 124.70 respectively, and by the experimental group these were found to be 124.49 and 132.51 respectively. The standard deviation of the scores of pre and post tests of the control and the experimental groups calculated to be 12.92, 11.55, 12.32 and 9.09 were indicators of slight heterogeneity within the four sets of scores. The slightly negative skewness values of the sets of scores of pre and post tests of the control and the experimental groups (-0.27, -0.80, -0.65 and -0.42 respectively) pointed out that majority of the students scored above average on the EIS. The notable reduction in the value of kurtosis of the post test (-0.02) from that of pre test (0.15) of the experimental group can be said to be due to the effect of the systems approach based
learning-teaching, thus, further increasing the homogeneity within the group. The values of co-efficient of correlation for the pre and post tests of control group (.84) and the experimental group (.80) showed that the two sets of scores were highly correlated.

Thus, the distribution of the scores was found to be normal with slight deviation, and negligible values of skewness and kurtosis, which could be due to sample fluctuation, sample size, etc.

5.1.4.2.2 Significance of difference between the means of scores of pre-test and post-test obtained by secondary school students of experimental (EG) and control group (CG) on Emotional Intelligence Scale (EIS).

The means of scores of pre test of the experimental (124.49) and the control (124.10) groups did not differ significantly (CR value = 0.22), which affirmed that the two groups were equivalent to each other in terms of emotional intelligence. The value of coefficient of correlation (0.57) also reflected that the two sets of data were moderately correlated.

It was found that the value of mean of scores of post test of experimental group (132.51) was larger than that of the control group (124.7). The calculated value of critical ratio (4.88) for this was also significant at .01 level, which reflected the effectiveness of systems approach based learning-teaching in enhancing emotional intelligence of secondary school students.

No significant difference was found in the means of scores of the pre and post tests obtained on Emotional Intelligence Scale of the control group, which was taught using conventional style of learning-teaching.
The value of the mean of post-test scores (132.51) was found significantly higher than the value of the mean of the pre-test scores (124.49) obtained on Emotional Intelligence Scale by the students of the experimental group, as the calculated CR value (7.16) was much higher than the t-table value (2.69 at .01 level of significance) for degree of freedom of 44. This indicated efficiency of systems approach based learning-teaching in improving emotional intelligence of secondary school students.

5.1.4.3 Findings related to the study of the effect of systems approach based resource material and learning-teaching strategies on academic achievement in physics of secondary school students.

In order to study the effect of systems approach based resource material and learning-teaching strategies on academic achievement in physics of secondary school science students, first the nature of the distribution of scores of pre and post test obtained on the Academic Achievement Test by the control and the experimental groups was analyzed followed by the analysis of the significance of difference between the means of pre and post test of the two groups

5.1.4.3.1 Nature of the distribution of scores of pre test and post test obtained by the secondary school students of the control group and experimental group in Physics Academic Achievement Test.

The standard deviation of the scores of pre and post tests of the control and the experimental groups calculated to be 6.84, 7.26, 6.78 and 7.50 were indicators of slight heterogeneity within the four sets of scores. The positive values of skewness of the sets of
scores of class test and post test of the control and of the class test of the experimental group (0.2, 0.44 and 0.091 respectively) pointed out that majority of the students have scored below average in physics tests, except in the case of post test of the experimental group, for which the skewness value (-0.06) is slightly negative. The values of coefficient of correlation for the pre and post tests of control group (.74) and the experimental group (.69) showed that the scores of the four sets were highly correlated. These findings indicated the distribution to be normal with slight deviation and negligible values of skewness and kurtosis.

5.1.4.3.2 Significance of difference between the means of scores of pre-test and post-test obtained by secondary school students of experimental (EG) and control group (CG) on Physics Academic Achievement Test (PAAT).

The means of scores of pre test of the experimental (24.02) and the control (24.18) groups were not found to differ significantly (CR-value = 0.18), which showed that the two groups were equivalent to each other. The value of coefficient of correlation also reflected that the two sets of data were substantially correlated.

The value of mean of scores of post test of experimental group (35.27) was higher than that of the control group (27.20). This difference was found to be significant at .01 level. This showed that systems approach based learning-teaching resulted in significant difference in the means of scores of the post tests of control and experimental groups obtained on Physics Academic Achievement Test.

It was inferred that there was significant difference in the means of scores of the pre and post tests obtained on PAAT of the control group, which was taught using
conventional style of learning teaching. This could be because of the same teacher teaching both the groups, and giving same kind of attention to the problems (related to theoretical and practical aspects of physics) of the students of both the groups. Although, the students of the experimental group were instructed not to pass on the learning material (which focused mainly on academic aspects of physics) provided to them to the students of the control group, but, some of the students could have ignored the instructions.

The value of the mean of post test scores (35.30) obtained on PAAT was found significantly higher than the value of the mean of the pre-test scores (24.02) obtained in class tests by the students of the experimental group, as the calculated CR value (13.27) was much higher than the t-table value (2.69) for degree of freedom of 44, indicating effectiveness of systems approach based learning-teaching in improving the level of academic achievement in physics.

These finding agree with those of O’Shea, 2007; Shunin, 2006; Chandi, 2000, etc. who have reported effectiveness of incorporating principles of systems approach and systems thinking in teaching various subjects such as biology (Chandi, 2000; Riess, 2009), mathematics (Hamadanizadeh, 1980), English (Shunin, 2006), Character education (Marshall, 2011).
5.1.4.4 Findings related to the effect of systems approach based resource material and learning-teaching strategies on systems thinking skills of secondary school student.

To evaluate the effect of systems approach based resource material and learning-teaching strategies on systems thinking skills of secondary school science students, first the nature of the distribution of scores of pre and post-tests obtained on the Systems Thinking Skills Test by the control and the experimental groups was analyzed followed by the analysis of the significance of difference between the means of pre and post test of the two groups.

5.1.4.4.1 Nature of the distribution of scores of pre test and post test obtained by the secondary school students of the control group and experimental group in Systems Thinking Skills Assessment.

The distribution of the scores was found to be normal with negligible values of skewness and kurtosis. The mean values of scores of pre and post tests obtained on STSA by the control group were found to be 20.36 and 21.33 respectively, and by the experimental group were found to be 20.78 and 31.40 respectively. The standard deviation of the scores of pre and post tests of the control and the experimental groups calculated to be 6.095, 6.55, 5.51 and 6.25 indicated slight heterogeneity among the four sets of scores. The slightly negative values of skewness for the sets of scores of pre and post tests of the control group and post tests of the experimental groups (-0.01, -0.29 and -0.6 respectively) pointed towards majority of students scoring above average in these cases, on STSA. The notable reduction in the value of kurtosis of the post test (-0.1) from that of pre test (-0.49) of the experimental group can be said to be due to the effect of the
systems approach based learning-teaching, thus decreasing the heterogeneity within the group. The values of co-efficient of correlation for the pre and post tests of control group (0.65) and the experimental group (0.64) show that the scores of the four sets were substantially correlated.

5.1.4.4.2 Significance of difference between the means of scores of pre-test and post-test obtained by secondary school students of experimental (EG) and control group (CG) on Systems Thinking Skills Assessment (STSA).

It was found that the means of scores obtained on STSA of pre test of the experimental (20.78) and the control (20.36) groups did not differ significantly (CR value = 0.70), showing that the two groups were equivalent to each other. The value of coefficient of correlation (.76) also reflected that the two sets of data were highly correlated.

The value of mean of scores of post test of experimental group (31.40) was larger than that of the control group (21.33), and was found to differ significantly at.01 level indicating the effectiveness of systems approach based learning-teaching in enhancing systems thinking skills of the students.

In case of the control group, taught using conventional style, there was no significant difference in the means of scores of the pre and post tests obtained on STSA, further confirming that the increase in the post test scores of the experimental group could be due to the effect of systems approach based learning-teaching.

The value of the mean of post test scores (31.40) was significantly higher than the value of the mean of the pre-test scores (20.78) obtained on STSA by the students of the experimental group, as the calculated C R value (14.35) was much higher than the t-table
value (2.69 at .01 level of significance) for degree of freedom of 44. This clearly reflected that systems approach based learning-teaching could be effective in improving level of systems thinking skills of students.

5.2 Testing of Hypotheses

In accordance with the hypotheses of the study the following conclusions have been drawn:

Hypothesis 1: There is no statistically significant difference between the means of the scores obtained on Spiritual Intelligence Assessment Scale by the secondary school science students of the experimental group (taught using systems approach based resource material and learning-teaching strategies) and the control group (taught by conventional method).

This hypothesis has been rejected as the critical ratio values found by comparing the means of pre test and post test of experimental group and by comparing the means of post tests of control and experimental groups were significant at .01 level.

Hypothesis 2: There is no statistically significant difference between the means of the scores obtained on Emotional Intelligence Scale by the secondary school science students of the experimental group (taught using systems approach based resource material and learning-teaching strategies) and the control group (taught by conventional method).
This hypothesis has been rejected as the critical ratio values found by comparing the means of pre test and post test of experimental group and by comparing the means of post tests of control and experimental groups were significant at .01 level.

**Hypothesis 3:** There is no statistically significant difference between the means of the scores obtained on Physics Academic Achievement Test by the secondary school science students of the experimental group (taught using systems approach based resource material and learning-teaching strategies) and the control group (taught by conventional method).

This hypothesis has been rejected as the critical ratio values found by comparing the means of pre test and post test of experimental group and by comparing the means of post tests of control and experimental groups were significant at .01 level

**Hypothesis 4:** There is no statistically significant difference between the means of the scores obtained on Systems Thinking Skills Assessment by the secondary school science students of the experimental group (taught using systems approach based resource material and learning-teaching strategies) and the control group (taught by conventional method).

This hypothesis has been rejected as the critical ratio values found by comparing the means of pre test and post test of experimental group and by comparing the means of post tests of control and experimental groups were significant at .01 level.
5.3 Educational Implications of the Study

Research for research sake is of little importance. From the point of view of applied aspects until and unless findings have some practical significance, research is futile and wastage of time. Educational research as such bears a lot of significance particularly if its findings can be applied to educational practices. Certain educational implications can also be derived from the findings of the present study which are discussed in this section.

i. Implications for the students:

This study reflects the importance and effectiveness of systems approach to learning – teaching process. The systems approach based resource material (SARM) and learning-teaching strategies (SLTS) will surely help students in better understanding various concepts of Physics and at the same time give an idea of arranging the content related to various chapters of other subjects according to the principles of systems approach. It will certainly reduce the cognitive overload on students and provide them a chance to integrate the knowledge obtained with their previous knowledge for better understanding. Use of analogies and interlinking of subject matter with psycho-socio-spiritual aspects of life would be beneficial not only for raising students’ level of understanding, but, also for their overall personality development.

ii. Implications for the teachers

The systems approach based resource material and learning-teaching strategies can be extremely useful for teachers as these will certainly enable them to enhance teaching-learning activities easily with minimum input of time, energy, money and
other resources. It will also provide them basic knowledge regarding the concepts of systems approach which can be applied for various other aspects of education. Knowledge of systems approach can also be used for analyzing the instructional objectives, available resources, constraints faced, etc. during learning-teaching practices. The use of analogies can be incorporated in classroom teaching for developing affective domain of students, which is generally ignored.

iii. Implications for the parents

In the present time of cut throat competition all parents want their wards to do well academically. At the same time they expect their wards to properly understand the concepts taught to them. For the fulfillment of these desires they do not even hesitate in spending large sum of money on private coaching for their children. This exerts a lot of pressure not just on the students but also on their parents. Based on systems approach such learning – teaching material can be produced which will enable students to study at their own pace on their own and score well leading to self confidence in them and also saving their time. It will thus reduce financial and mental pressure of parents.

iv. Implications for the administrators

Systems concepts can be utilized not just for solving various complex academic issues but various infrastructural and administrative issues as well. Apart from this direct benefit of application of systems approach to learning-teaching process will be manifested in the form of improved academic achievement level of the students of the institution.
v. Implications for the society

System approach holds great implications for learning-teaching all subjects. It implies distinguishing and interrelating different levels of organization and the different concepts at each level. It is helpful in fostering coherent understanding. In addition, systems thinking implies awareness of the fact that physical phenomena can be represented by models that range from very concrete portrayals to highly abstract systems models. These systems models reflect the main characteristics of a chosen systems perspective, i.e. General systems theory, cybernetics and dynamical systems theory. Thinking backward and forward between these systems models and real physical phenomena can enable students to explore the phenomena from a specific systems perspective and develop deeper understanding of the structural, regulation or developmental aspects of those phenomena. Thus, incorporation of system principles in various aspects can be beneficial to the whole society.

Concepts of systems approach can be applied not only in educational and administrative issues, but, also in daily life events such as conflict resolution, management, water and energy conservation, etc. for improving the overall quality of life.

5.4 Conclusion

On the grounds of the findings related to the objectives of the explorative and cyclic research sub-phases of the study, it can be summarized that the present day students and teachers as well, are victims of overloaded academic syllabi. Students are mostly expected to remember a large amount of incoherent informative facts without systematic
arrangement of those factual quanta of knowledge prior to explaining them to students. As a result students generally feel cognitively overburdened and gradually lose their interest in various academic streams. These findings are supported by those of Gulyaev (2002), Kalra (1995) and King (1999).

Teachers, too being under the pressure of course completion in time are not left with any opportunity to think and plan the content to be taught by systematically arranging it so as to enable students to understand easily and retain for longer period. Pressures for ‘delivery’ and ‘coverage’ of an overloaded curriculum militate against deep and secure learning and enhanced motivation. Teachers need time to diagnose learning difficulties and help pupils to improve.

In addition to this problem, there are other issues also such as lack of infrastructural facilities such as books, equipment for practical experiment, accessibility to computers, internet connectivity, multimedia devices etc. which hinder the progress of effective learning – teaching. Similar findings have been also reported in the ‘Indian Science Report – 2005’ by Shukla, 2005. Furthermore, there are certain psychological and behavioral complexities also such as students’ disinterest in studies, poor reading habits, low level of concentration and motivation. Even the science teachers have average level of interest and motivation in teaching and lack the passion required for their job. Moreover, the teachers lack interest for learning new skills for developing various technology based audio-visual aids.

Whatsoever, since the findings indicated that students prefer studying through audio-video presentations and group activity methods rather than lectures and discussions, therefore, these methods should be given weightage in the pedagogy of
science teaching. Regarding the theoretical component of physics learning-teaching it was felt on the basis of the findings that efforts should be made to reduce the cognitive burden on students by incorporating systems approach principles such as whole to part to whole, input-process-output principle, cybernetics etc. and more of pictures, diagrams, mnemonics etc. Since, most of the teachers have shown their willingness for using ready to use audio-visual aids, and systems approach based learning-teaching strategies, therefore, in order to further facilitate learning-teaching activities an audio visual CD having videos on related topics and learning programme such as SAUS (systems approach to understanding semiconductors) have been included in the systems approach based resource material.

In the second (Evaluative) phase of the study, on the basis of the plotted smooth frequency curve and calculated values of skewness and kurtosis, the nature of the distribution of scores of pre and post test of the dependent variables was assessed. The overall observation of the smooth frequency curve and the tables showing values of skewness and kurtosis indicated the distribution of the scores of pre test and post test of spiritual and emotional intelligence, academic achievement and systems thinking skills to be normal with slight skewness, which could be due to sample fluctuation and size of the sample. The coefficient of correlation showed that the scores of the pre test and post test of the control and experimental groups were moderately to highly correlated.

The critical ratio values obtained by comparing the means of pre tests of dependent variables (spiritual and emotional intelligence, academic achievement, systems thinking skills) of control and experimental groups were found to be insignificant, indicating that both the groups were equivalent.
The critical ratio values obtained by comparing the means of post tests of dependent variables (spiritual and emotional intelligence, academic achievement, systems thinking skills) of control and experimental groups were found to be significant at .01 level, indicating the effectiveness of the developed systems approach based resource material and learning-teaching strategies.

The critical ratio values obtained by comparing the means of pre-tests and post tests of dependent variables (spiritual and emotional intelligence, academic achievement, systems thinking skills) of control group were found to be insignificant in case of spiritual and emotional intelligence and systems thinking skills, but in case of academic achievement it was found to be significant at .01 level. This could be because of a number of reasons such as the same teacher teaching the control and the experimental groups, the students of the experimental group might have given the material provided to them to the students of the control group, etc.

The critical ratio values obtained by comparing the means of pre-tests and post tests of dependent variables (spiritual and emotional intelligence, academic achievement, systems thinking skills) of experimental group were found to be significant at .01 level. This clearly reflects the effectiveness of the systems approach based resource material and learning-teaching strategies on spiritual and emotional intelligence, academic achievement, systems thinking skills of secondary level students.

Thus, the evaluative phase of the study showed that application of systems approach is highly effective in improving spiritual and emotional intelligence, academic achievement and systems thinking skills of secondary level science stream students and
therefore, can be incorporated for not only enriching learning-teaching practices but, also for an overall complete and sound development of students’ personality.

5.5 Limitations of the Study

Human beings are liable to various shortcomings. It is a universal fact that no study in humanities is free from limitations. Every aspect of changing surroundings affects the human behavior and therefore, to reach any perfect conclusions in behavioral science is not possible. Some of the limitations which the researcher came across due to paucity of time and resources while conducting this study are given in this section.

i. Unavailability of good intermediate level physics books in Agra: Only a few Indian authors’ books for secondary level physics are available in Agra, whereas, there is a vast collection of books available in cities like Delhi, Lucknow, etc. The investigator traveled to these places for acquiring some of the best available books of physics.

ii. The samples involved in various phases of the study were kept small in view of the large number of phases and sub-phases to be covered during the study and to maintain the quality of the work.

iii. Lack of interest of teachers in filling up the questionnaires: The researcher does acknowledge the cooperation and support of science teachers involved in this study without which this study could not have been possible but due to the overloaded school curriculum and shortage of available time the teachers generally lacked the
willingness for filing up the questionnaires. However, the co-operation provided to the researcher during interviews is highly appreciable.

iv. **Shortage of literature and research theses on systems approach in the libraries of Agra:** Although there is abundance of literature, research articles, books etc. related to systems approach on internet but the researcher felt a shortage of them in the various libraries of Agra.

v. Most of the aspects of the study were delimited to the city of Agra. However, during the construction of Spiritual Intellligence Scale and tool for Systems Thinking Assessment, the investigator took suggestions and opinions of national and international level experts and scholars working in the concerned fields.

vi. During the cyclic research sub-phase the teaching lessons taught by the investigator were video recorded (for the purpose of observation later) by another research scholar of Dayalbagh Educational Institute in real classroom conditions. However, all the lessons could not be recorded due to a number of reasons such as the unavailability of persons for this purpose, problems of recording instrument, school schedule, etc.

vii. During the cyclic research sub-phase of the study, the problem of non-availability of students during informal try-outs was often faced by the investigator, which resulted in reduction in the number of students in the try-out step.

viii. The researcher could not find suitable standardized tools for the purpose of needs and resources analysis in physics teaching, interviewing secondary school level
science teachers, assessing spiritual intelligence, academic achievement in physics and systems thinking skills of secondary school level science stream students. Almost all the tools for the testing phases of study viz. developmental and evaluative, were prepared by the investigator herself, although sincere efforts were made for ascertaining the reliability and validity of each testing instrument.

5.6 Suggestions for Further Studies

The statement ‘we live on the past in the present for the future’ is very pertinent in the context of research. Whatever, explored in any study is expected to help future researchers. Some suggestions to remodel the present piece of work are given below.

i. Application of systems approach to learning-teaching can be made to academic streams like English, Hindi, Mathematics, Biology, Chemistry, etc. and the effectiveness can be evaluated through experimentation.

ii. The effect of systems approach to learning teaching can be evaluated for various other levels of education viz. primary, middle, graduation and post-graduation.

iii. Experimental studies can be carried to compare the effect of systems approach based and conventional learning-teaching on various other dependent variables.

iv. A comparative study to assess the effectiveness of systems approach based resource material and learning-teaching strategies on girls and boys of different achievement levels can be conducted.
v. A comparative study can be done to find the effect of SARM on students of different levels of academic achievement.

vi. Spiritual Intelligence Assessment Scale and Systems Thinking Skills Assessment Test can be used to serve the purpose for conducting other studies based on the related variables.

vii. The developmental research design employed in this study can be used for development of resource material and learning-teaching strategies related to various other fields for different target groups.

viii. This study has been delimited to the region of Agra, U.P. Such type of studies can be replicated at the broader platform such as regional level or national level.

ix. The prospective researchers can develop systems approach based resource material based on the entire syllabus as in the present study only some samples could be developed.

x. Future research can be carried to fully evaluate the impact of school learning on life after school, i.e. at home or in some other surroundings, behavior of students with teachers, friends, family members and others, etc. as systems approach concepts resulting in valued learning outcomes are expected to benefit learners beyond school and enhance lifelong and life-wide learning.

5.7 An Overview of the Chapter

In this final chapter, the researcher has summarized the key findings of this study, in accordance with its goals and objectives. The implications and recommendations for
further research into the theory and practice of systems approach in the field of education have also been provided. The researcher has also attempted to outline various limitations faced during the conduction of the study. The chapter concludes with an outline of suggestions for prospective research work related to the area of systems approach, science teaching, spiritual and emotional intelligence.