CHAPTER 5

5.1 Data Analysis and discussion of results:

The opinions of students and teachers on various aspects of the proposed strategy – 'Share the SMILE' has been grouped under various categories and the results are presented in the form of bar charts. The data has been analysed to verify the hypothesis. From the data analysis it has been found that more than 90% of teachers and students agreed with the proposed strategy. The details are given below.

The opinions expressed by students and teachers as ‘Agree’ and ‘Slightly agree’ are classified under “Agree”, ‘Neither agree nor disagree’, ‘Slightly disagree’ and ‘Disagree’ have been classified as “Disagree”. Similarly ‘Very important’ and ‘Important’ are classified under “Important”, ‘Can’t say’, ‘Not important’ and ‘Not at all important’ are classified under “Not Important”. ‘Highly useful’ and ‘useful’ are classified under “Useful”, ‘Can’t say’, ‘not useful’ and ‘not at all useful’ are classified under “Not Useful”.

5.2 Perceptions of students on learning environment (SMILE):

Number of students who participated in the survey is about 1467 and the number of students who responded to various questions varies from 1397 to 1446. Figure 5.1 is a bar graph representation of the responses of students on learning environment (SMILE). Majority of the students supported the hypothesis that a simple, motivating, interactive, learner-centric, collaborative environment facilitates students to enjoy learning and learn with understanding.
The details are shown in the charts given beside. Nearly ninety percent of the responded students preferred a simple, motivating and interactive environment, while seventy seven percent supported a learner-centric environment. Seventy three percent of those responded agreed that the learning environment should be collaborative. The percentage of students who did not agree with the hypothesis varied between 1.5 and 8 (excluding the percentage of Neither agree nor disagree and slightly disagree).

So SMILE with collaboration is considered by a significant majority of students as a learning environment, which helps them enjoy learning and learn with understanding.

There is no perceptible difference between the responses of Boys and Girls except for minor variations. However students from private schools are more favourably inclined to learner-centric and collaborative environment when compared to students from government schools while both of them have given same importance to simple, motivating and interactive elements of the environment. Students following state syllabus were more positively inclined for a learner-centric and collaborative environment when compared to students following central syllabus while the response for other three attributes namely simple, motivating and interactive is similar. However most of the students from all schools irrespective of gender, type of school (private/government) and syllabus followed, preferred a simple, motivating and interactive environment. Majority of students also showed preference for learner-centric and collaborative environment.
5.3 Perceptions of students on benefits of SMILE:

The questionnaire has been designed to elicit the opinion of students on the importance and usefulness of various aspects of SMILE and sharing the networked learning environment through collaboration between students, teachers and schools. Figure 5.2 is a bar graph depiction of the same. The questions have been framed in such a way that they reflect the processes involved in creating and sharing the SMILE.

Important observations:

Innovation in teaching and learning:

More than ninety percent of the students are of the opinion that they enjoy learning if it is made simple and easy to understand; Explaining the concepts with simple, interesting facts relevant to the world around us is important; Visual presentations are useful to explain the concepts and make learning simple and easy and Multimedia
BemRb of SMILE presentations make learning interesting and motivating.

New ways of learning:

Eighty percent of the students agree that Interactive simulations improve understanding of difficult concepts and stimulate creative thinking; Online learning offers learning flexibility; Self-assessment in online environment improves confidence and satisfaction; and Interactive applets and animations are useful in understanding difficult concepts.

Learning flexibility:

Eighty percent of the students consider that Online learning, which helps in learning to learn through search engines such as Google, Wikipedia and educational portals such as BBC is important and Online learning, which offers flexibility to learn how to learn with their preferred learning style is useful.

Learning to share and sharing to learn:

Ninety percent of the students consider that sharing knowledge with friends while doing projects on internet, which provides more learning opportunities is important. Eighty percent
of the students consider that educational portals with open access, which extends learning opportunities to all, are useful.

5.4 Discussion of Results:

Simple and Motivating:

The important observation from the response of students is that more than ninety five percent of students felt that they would enjoy learning if it is made simple and easy to understand. Most of the students concurred with the hypothesis that teaching with the help of multimedia and interactive simulations improve understanding of concepts and makes learning interesting and engaging.

Analysis of response of students indicate that more than ninety five percent of students expressed their opinion that explaining concepts with simple, interesting facts relevant to the world around them is important. This observation indicates the motivational factors like drawing attention of the students through stories and interesting facts, making it relevant to them through the application of what they are learning in the world around them are important. This would result in a simple and motivating environment while offering learning in context through a simple, motivating and learner-centric environment. They also gave importance to self-assessment through on line quizzes, which help them identify areas for improvement without any stressful experience they go through during examinations conducted in a traditional classroom environment. These online quizzes for self-assessment helps them to gain confidence and find their learning experience satisfying. Attention,
Relevance, Confidence and Satisfaction are considered to be important motivational factors by Keller in his ARCS learning model.

**Interactive:**

Further, about seventy two percent of students also showed preference for interactivity in learning to facilitate learning by doing similar to Kolb’s experiential learning theory. Seventy nine percent of students considered online learning is important and helps them gain access to rich and accredited content facilitating learning how to learn, leading to life long learning. Ninety percent of students considered project-based learning by sharing ideas, opinions and knowledge with friends through networked environment is important. Sharing of knowledge in an online environment also enhances learning opportunities to many and also facilitates synthesis of diversity of opinions and ideas to arrive at a refreshing, innovative and creative solution. This would also help students to develop communication skills, project management skills, analytical skills and creative thinking. So it can be inferred that SMILE is considered important by students as it offers a motivating, empowering, interactive and collaborative environment to enhance learning experience while helping them learn how to learn.

**Learner Centric:**

Students also expressed their preference for the flexibility in learning at their own pace at the place and time of their choice and according to their own preferred learning style. Online learning also offers learning flexibility and hence would be learner-centric. Hence content in various forms should be made available to students with free and open access so that they have freedom to choose content that is best suited to their preferred learning style, their
background, level of existing knowledge and understanding. Content and access to content should be key elements of the proposed strategy helping students as well as teachers to personalize the learning environment to suit the individual student depending on the nature of subject matter, the learner and the context.

**Leveraging Technology to create and share the SMILE:**

Majority of students responded positively to use of technology in creating a motivating learning environment. Ninety five percent of students felt that visual presentations would be useful in making learning simple and easy. Students also agreed with the opinion that multimedia presentations would make learning interesting while interactive applets and animations are useful in understanding difficult concepts. So it can be inferred that the role of teacher is very important in helping the student in innovative and creative ways by leveraging technology, by sharing best practices with subject matter experts and other teachers and by contributing and sharing the content through a networked learning environment. Hence, technology will be a key element of the strategy which needs to be leveraged to facilitate learning with smile and learning with better understanding of fundamentals. Students also concurred with the idea of educational portals with open access, which can extend learning opportunities to a large audience is useful. Educational portals with accredited and appropriate content if made available with open access helps us achieve our objective — "Every student should achieve his/her full potential". This is in line with the proposed strategy "share the SMILE to learn with smile", to provide learning opportunities for all with every student having access to SMILE.
5.5 Perceptions of students on key elements of the strategy (Content, Technology, Access, Collaboration):

Figure 5.3 is a bar chart, showing the perceptions of students on key elements of the strategy. Majority of the students varying between eighty nine to ninety percent agreed with the proposition that access to accredited and enriching content, technology assisted learning and sharing of knowledge are the key factors. So content, access, technology and collaboration can be considered as key elements of the strategy in creating an environment that makes learning joyful, interactive, enriching and collaborative.

Girls gave more importance to collaboration when compared to boys, which shows that girls are more inclined towards sharing knowledge and learning together. There is no significant difference in response of students from private schools and students from government schools except for minor variations. Similarly there is no significant variation in response of students following state syllabus and students following central syllabus.
5.6 Perceptions of students on proposed strategic actions:

An overwhelming ninety six percent of students agreed that teacher plays a very important role in making learning a joyful experience. So teacher should be the heart of the strategy and should play a central role in evolving and implementing the strategy. The strategic framework proposed in this thesis places teacher at the center of the strategy and the survey validates the idea that it is the teacher who should leverage technology to be innovative in creating an environment appropriate to the learner, the content and the context. Figure 5.4 is a graphical representation of perceptions of students on the proposed strategic actions.

Ninety percent of students agree that educational portals with open access are extremely valuable to both students and teachers. Educational portals offer learning tools and learning flexibility for students while helping teachers to spend more time in being creative and innovative in their teaching practices. Students with access to portals will have wide choice and experiment with various modes of learning to learn how to learn by identifying what works for them. They will be able to reflect on their own ways of learning and find out the appropriate and effective learning methods suitable to their individual learning style and aptitude.
Students also agreed that networking of schools would enable them to share experience and content from subject matter experts and teachers beyond the classroom. Teachers can share their best practices to facilitate professional development and evolve a body of knowledge based on the rich experience of teachers from various schools. Eighty three percent of students agreed that blended learning, which combines traditional classroom learning with online learning offers flexibility in learning. National curriculum framework recommends flexibility in curriculum and assessment in a constructivist-learning environment, which is learner-centric. Blended learning offers new ways of learning by helping students with flexibility in learning, access to rich and varied content, self assessment, interactive learning by working on simulations and games, collaboration with friends from the school and beyond to work on projects and to share knowledge.

Eighty seven percent of students agreed that training is very important to be able to effectively leverage technology for improved learning. So it is proposed that a center for excellence in educational technologies is required to train teachers who in turn can help students to effectively utilize computers, and the technology assisted collaborative learning environment.

Girls showed relatively more interest in blended learning and training by about five percent when compared to boys. They also emphasized the role of teacher a little more than boys as ninety nine percent of girls agreed that teacher plays a very important role in making learning a joyful experience as against ninety four percent of boys who agreed with the role of teachers being very important. This however may not be a very significant difference but indicates that girls are slightly more inclined towards blended learning without compromising on the role of teacher. Students from private schools are slightly more inclined towards
blended learning, educational portals and networking of schools when compared to students from government schools. However students following state syllabus showed slightly more preference for educational portals, networking of schools and blended learning with learning flexibility when compared to students following central syllabus.

5.7 Perceptions of students on strategic objectives related to the benefits of strategy:

Questions addressed to students have been grouped under four strategic objectives we propose to achieve namely: enjoy learning, active learning, learning to learn and collaborative learning. Table 5.1 lists these question numbers.

<table>
<thead>
<tr>
<th>Study tool</th>
<th>Strategic Objectives</th>
<th>Variables related to the benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students questionnaire</td>
<td>Enjoy learning</td>
<td>Q11_1; Q11_2; Q12_1; Q13_1; Q13_2</td>
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<tr>
<td></td>
<td>Active Learning</td>
<td>Q11_3; Q11_4; Q12_2; Q12_3; Q13_3</td>
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<tr>
<td></td>
<td>Learn to learn</td>
<td>Q12_4; Q13_4</td>
</tr>
<tr>
<td></td>
<td>Collaborative Learning</td>
<td>Q12_5; Q13_5</td>
</tr>
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</table>

Table 5.1
Figure 5.5 clearly represents the opinions of students on the conditions, which lead to the proposed strategic objective, i.e., enjoy learning.

From the figure 5.5 we can come to a conclusion that majority of students are in agreement on the following:

Ninety six percent of the students concur that explaining the concepts with simple, interesting facts relevant to the world around us is essential. Ninety five percent of the students are of the same opinion that explaining the concepts through visual presentations makes learning interesting and engaging. Eighty nine percent of the students positively responded that multimedia presentations, which make learning simple and easy to understand and motivating are useful.

Ninety one percent of the students go with the opinion that teaching with the aid of multimedia presentations makes learning interesting and engaging. Eighty nine percent of the students positively responded that multimedia presentations, which make learning interesting and motivating are useful.
These findings suggest that students enjoy learning in an environment where teachers explain the subject matter including concepts and principles in creative and innovative ways by leveraging technology. Media rich content with appropriate structuring, sequencing and presentation makes it simple and easy to understand, facilitating learning with understanding. The application of concepts in real world through specific examples and instances helps students to retain what they learn and also to relate multiple concepts in solving practical problems which makes learning relevant and meaningful. Attention of the student can be gained and sustained through the multimedia based visual presentations, interactive simulations, analogies, examples and applications relevant to the world around us. These multimedia presentations and simulations makes learning a joyful experience by helping teachers to explain the complex concepts and principles of abstract generalization in a way, which is simple and easy to understand.
Figure 5.6 is a bar graph representation of the opinions of students on the conditions which lead to the proposed strategic objective i.e., active learning.

Eighty seven percent of the students harmonize that interactive simulations improve understanding of difficult concepts and stimulates creative thinking. Eighty four percent of the students feel that online quizzes with worked out examples and solutions to improve confidence and satisfaction are important. Eighty one percent of the students concur that interactive applets and animations to explain difficult concepts are useful. Eighty percent of the students go with the opinion that they should have the flexibility to learn anytime, anywhere at their own pace, to suit their learning preferences. Seventy three percent of the students coincide with the opinion that interactivity in e-Learning facilitates learning by doing, which in turn encourages the active participation of the student in the learning process.
E-learning /online learning provides scope for active involvement of the student in the learning process by way of opportunity to work on interactive simulations, applets and animations. This would facilitate Learning with understanding by helping students to experience the cause and effect relationships by active experimentation on simulations. This is a way of learning by doing which is considered to be most effective way of learning. Self-assessment through online quizzes and games promotes self-directed, self-motivated active learning by students. This helps students to be actively involved in the learning process through appropriate blending of traditional classroom learning with online learning. Online learning facilitates active learning by way of access to enriching, appropriate and accredited content, which helps students to explore, enquire, reflect and collaborate to understand the subject in their own unique and innovative ways. "Active learning" facilitates active involvement of students and helps them in applying what they have learnt in new situations and develop problem-solving skills. Active learning also facilitates creative thinking and new ways of synthesizing the different concepts to solve problems in innovative ways.

Figure 5.7 clearly depicts the opinions of students on the conditions, which lead to the proposed strategic objective i.e., learn to learn.

Most of the students agreed that learning to learn is one of the strategic objectives. Seventy-nine percent of the students believe that Online learning, which helps in learning to learn through search engines such as Google, Wikipedia
and educational portals such as BBC is important and online learning, which offers flexibility to students to learn how to learn with their preferred learning style is also essential. Online learning provides learning tools and learning flexibility through more ways of learning there by engaging students in creative thinking and reflects on their own learning process. This enables and empowers students to find out the right and suitable learning method appropriate to their aptitude and preferred learning style by trying various approaches; there by helping them learn how to learn. Learning how to learn is essential to pursue life long learning and remain relevant and meet the ever changing demands of the knowledge economy.

Figure 5.8 is a graphical representation of the opinions of students on the conditions which lead to the proposed strategic objective i.e., collaborative learning. Ninety one percent of the students coincide with the opinion that sharing knowledge with friends while doing projects on internet, which provides more learning opportunities is important. Eighty percent of the students concur that educational portals with open access, which extends learning opportunities to all are essential.

Figure: 5.8

Sharing the knowledge enhances knowledge capital of every one and hence should be the most rational choice. Sharing of knowledge through online learning, educational portals extend access to knowledge for all without any discrimination provided they are connected through internet or other means such as Edusat. New approaches like project-based learning
can be implemented effectively through collaborative learning by encouraging students to share their ideas and knowledge online with the help of e-learning tools. This would not only extend learning opportunities but also develops analytical, communication, project management and leadership skills in students who pursue collaborative learning. Collaborative learning facilitates sharing of best practices among schools and provides access to experts and experienced teachers beyond the classroom.

5.8 Perceptions of teachers on SMILE and Key elements of strategy:

Teachers participated in the workshop on SMILE in which an interactive session on the merits of blended learning was discussed along with the live demonstration of a science portal. Teachers expressed their opinion that applets and animations will be useful in explaining concepts like total internal reflection, polarization in Physics and hybridization in Chemistry. They also felt that Edusat programs from subject matter experts and teachers would be of great help in complementing their efforts in classroom. Teachers took time to reflect on the questions and returned back the questionnaire with their opinions after about seven to ten days.

Data shows that total number of teachers responded is 107 out of which 103 teachers responded with their opinion on SMILE. Majority of those responded varying from 87-99
percent agreed that learning environment in which students enjoy learning and learn with understanding should be simple, motivating, interactive, learner-centric and collaborative.

Figure 5.9 is a bar chart showing their opinions on SMILE. However six percent of ninety-nine teachers responded, did not agree on learner-centric environment, while ten percent did not agree that learning environment should be collaborative.

Figure 5.10 is the bar chart representation of the opinions of teachers on the key elements of the strategy. Teachers found the animations and simulations are highly useful in explaining abstract concepts, which require visualization for better understanding. Ninety nine percent of teachers agreed that media rich accredited content with simulations and applets help them to be innovative and creative in teaching and there by enjoy teaching. This also helps teachers to find more time for interaction with students and find the whole experience satisfying and rewarding. Teachers also found that their students are highly motivated while working on simulations and were actively participating in the interactive session. Ninety three percent of teachers agreed that programs such as Edusat, which provide video lectures of expert teachers are highly useful. So, quality content and the access to it are considered as important in meeting our objectives. Ninety four percent of those responded agreed that technology assisted learning enhances classroom experience and provide tools to interact.
and collaborate in sharing knowledge. Technology enabled multimedia presentations offer visualization and learning by doing through simulations, which are interesting and engaging. Technology facilitates a motivating learning environment, which is interactive, collaborative and learner-centric and there by helps students to learn with understanding. Making learning stress free through simple and easy to understand examples, visuals, stories, interesting facts, analogies and applications is our objective and collaboration helps in sharing best practices of teaching. Ninety nine percent of the teachers opinioned that collaboration helps teachers in being creative and innovative in teaching and thereby find their profession exciting and enriching.

5.9 Perceptions of teachers on benefits of SMILE:

Teachers agreed on the benefits of the proposed strategy ‘Share the SMILE” as more than ninety eight percent of teachers concurred with the opinion that students enjoy learning and teachers would be more innovative in a simple, motivating, interactive and collaborative environment. Figure 5.11 is a bar graph depiction of the opinions of teachers on the benefits of SMILE.

Important Observations:

Innovation in teaching and learning:

More than ninety five percent of the teachers are of the opinion that, Shared resources including online libraries and educational portals help them to be more innovative by sharing best practices and ways of explaining the subject matter through interesting analogies,
examples and applications. Multimedia presentations make learning interesting and engaging and students enjoy learning if the subject matter is explained through simple concepts in innovative ways by leveraging technology.

New ways of learning:

Ninety percent of the teachers agree that, tacibe learning with interactive simulations improves understanding of difficult concepts and stimulate creative thinking. Project based learning with simulation of experiments combined with application in real world helps students to find learning more relevant and meaningful. Assessment in blended learning environment where in online self-assessment supported by teachers in the form of lead questions, worked out examples and solutions improves confidence and satisfaction.
Learning Flexibility:

Eighty five percent of the teachers consider that, exploring the subject through educational portals and other online sources such as Wikipedia for doing projects facilitates learning to learn in students.

Learning to share and sharing to learn:

Ninety percent of the teachers consider that, Collaboration among schools in sharing best practices in teaching and content is important; and Virtual classrooms, which extend the reach of expert teachers and facilitates learning for wider audience is important.

5.10 Discussion of Results:

Simple and Motivating:

Teachers considered content structuring and sequencing to move from simple to increased levels of complexity as important as not even a single teacher disagreed on this. They also felt that students enjoy learning with simple, easy to understand visuals centered around a theme, animations and simulations which facilitate understanding of fundamental
concepts. Teachers also agreed with the opinion that students enjoy learning if teacher explains the subject matter through simple concepts and interesting facts related to the social context of the learner. Teachers based on their experience, would be in a position to evolve an appropriate learning model and be innovative with the assistance of shared resources such as digital libraries educational portal and multimedia content. Graphics that simulate applications in real life like projectiles and roller coasters are considered to be useful by teachers. They are motivating as they make learning interesting, relevant and meaningful. Quizzes along with worked out solutions and games helps in self-assessment, which helps them to identify areas of improvement and focus on them. This also enables students to assess their own understanding without any inhibitions and develop confidence. Teachers can then concentrate only on areas where students find difficulty in understanding and promote a student centric, personalized environment.

Interactive:

Teachers felt that graphics and interactive simulations facilitate learning by doing and hence are effective as students become active learners. Interactive simulations also help students to develop critical thinking by facilitating "What if?" conditions and experiments that are difficult to perform in a conventional laboratory. Abstract concepts like interference and polarizations can be explained in a better way and help students understand concepts and learn to apply those concepts. Simulations also can be developed to explain multiple concepts and observe the inter-relatedness, which is very important in problem solving, which requires ability to synthesize multiple concepts. Project based learning is considered to be one of the effective learning models and an interactive and collaborative networked
environment facilitates teachers as well as students to conceive and develop relevant and useful project ideas to address real life situations and problems.

**Learner centric:**

Flexibility in learning through access to varied but accredited content is also considered to be important by teachers who also agreed with the suggestion that educational portals and other online resources facilitates learning how to learn. Teachers agreed that there is no one right way of teaching and teachers could be facilitators, coaches and mentors in guiding the student and evolve a suitable learning model depending on the social context of the learner, content and the learner's aptitude. Teacher understands the student better and accordingly explains the subject matter with examples relevant to the social context of the learner. So teacher plays a central role in integrating their experience, knowledge and shared resources with technology to create and share the SMILE.

**Leveraging Technology to share the SMILE:**

Teacher can use the technology to develop media rich content or use the archives of e-learning materials to make learning interesting and engaging. Teachers agreed that shared resources including online libraries and educational portals help them to be more innovative in teaching and creating an engaging and enriching learning environment. Teachers can share the best practices and content in a networked e-learning environment. Virtual class rooms can be created using Edusat services with IP interactive terminals in schools, which extends the reach of expert teachers and facilitates learning opportunities to a large audience particularly in remote and rural areas where there is shortage of expert teachers in special
subjects. Collaborative learning through sharing of resources in a networked learning environment is essential to provide learning opportunities to every student. Simple, motivating and interactive environment created by leveraging technology makes learning a joyful experience with the active involvement of students in the learning process.

5.11 Perceptions of teachers on proposed strategic actions:

Figure 5.12 is a graphical depiction of the opinions of teachers on the proposed strategic actions. All teachers agreed that teacher will be at the heart of transformation in learning to facilitate every student to enjoy learning and achieve his/her potential. Teachers agreed with the strategic actions proposed such as access to accredited educational portals, networking of schools, blended learning with flexibility in curriculum and assessment and training for familiarity and usage of educational technologies and tools.

Access to educational portals and digital libraries of various organizations helps teachers to select appropriate learning objects and use them in developing their own content appropriate to the learning context by reassembling and modifying those learning modules in innovative ways.
Networking of schools help teachers to share best practices and learning modules enabling them to improve and be creative in new ways of teaching.

Training is required for teachers to use tools and technologies for developing their own content and participate in collaborative project based learning initiatives. Teachers will be in a position to host their content in school database servers, which can be accessed by students from home. Students can study the e-learning material available on school server, prepare notes, complete assignments and which also will be uploaded on to the school server. Student's interaction with teacher will be highly productive, as students have already prepared well on the subject before coming to the class. Teachers can spend more time on clarifying the doubts of students and encouraging students to learn through discussion and debate by synthesizing multiple perspectives from students with diverse backgrounds and ideas.

Flexibility in curriculum and assessment gives more freedom to students in choosing subjects of their interest to the required level of knowledge and helps teachers to explore new ways of teaching to meet diverse needs of students. Teachers also feel empowered with flexibility in curriculum and assessment as they have the flexibility to choose appropriate ways of teaching depending on the learner and the context. They can also integrate assessment with the learning process, as there is flexibility in assessment. So strategic actions proposed are considered by teachers to be useful in creating and sharing the SMILE and achieve the strategic objectives which helps us to extend learning opportunities to all where by every student achieves his/her full potential with smile.
5.12 Perceptions of teachers on strategic objectives related to benefits of strategy:

Questions addressed to teachers have been grouped under four strategic objectives we propose to achieve namely, enjoy learning, active learning, learning to learn and collaborative learning. Table 5.2 gives the list of the question numbers grouped under these strategic objectives.

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</tr>
<tr>
<td></td>
<td>Active Learning</td>
<td>Q 14_3; Q 15_3; Q 15_4; Q 16_3; Q 16_4</td>
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<tr>
<td></td>
<td>Learn to learn</td>
<td>Q 14_4</td>
</tr>
<tr>
<td></td>
<td>Collaborative Learning</td>
<td>Q 15_5; Q 16_5</td>
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Table 5.2
Figure 5.13 clearly represents the opinions of teachers on the conditions, which lead to the proposed strategic objective i.e., enjoy learning.

The charts given below displays the opinion of teachers, which shows that majority of teachers is in agreement on the following:

All the teachers opinioned that content structuring and sequencing to move from simple to increased levels of complexity is highly important and it makes the learning enjoyable.

Ninety nine percent of the teachers believe that students enjoy learning with a simple, easy to understand images, graphics, animations and simulations and also agree that students enjoy learning if teacher explains the subject matter through simple concepts and interesting facts related to social context of the learner. More than ninety eight percent of teachers felt that teaching with the aid of multimedia presentations makes learning interesting and engaging and also
believe that games that simulate applications in real life, which make learning interesting while being relevant and meaningful are useful. They also opinioned that shared resources including online libraries and educational portals help them to be more innovative. Ninety six percent of the teachers said that images and pictures centered around a theme along with animations to explain concepts are important.

In essence, students enjoy learning in a simple, motivating and interactive learning environment with visuals centered around a theme and interesting facts, simple and easy to understand graphics, animations, games, simulations and applications in real life. Learning is made meaningful by referring to examples and real world applications relevant to the social context of the learner. Teachers with the help of shared learning modules and access to online libraries can be innovative in developing content, which is suitably structured and sequenced to move from simple to increased levels of complexity. So teachers can create and share SMILE in which students enjoy learning.
Figure 5.14 is a bar graph representation of the opinions of teachers on the conditions which lead to the proposed strategic objective i.e., active learning.

All the teachers concur that quizzes along with worked out solutions enable learners to assess their own understanding and thereby encouraging students to be actively involved in the learning process. Ninety eight percent of the teachers harmonize that interactive simulations help children to develop curiosity and critical thinking. Ninety percent of the teachers responded that interactive simulations to explain difficult concepts are useful. Seventy seven percent of teachers opinioned that simulation of experiments difficult to perform in lab are essential. Sixty eight percent of the teachers are aware that flexibility in learning through access to varied but accredited content from open source such as BBC is important.

In core teachers opinioned that quizzes with worked out solutions, projects and interactive simulations encourage students to participate actively in the learning process.
doing through projects and simulations is a teaching and learning strategy that engages students in complex, challenging, and sometimes, real life problems like purification of lakes and energy conservation. Teachers and students not only learn but also can contribute to creation of knowledge as well through new ideas and insights they gain while working on the project. Active learning facilitated by access to accredited and enriching content offers flexibility in learning and enables students to take responsibility for what and how they learn, achieving their personal goals as self-directed learners.

Figure 5.15 clearly depicts the opinions of teachers on the proposed strategic objective i.e., learn to learn.

Simulation of experiments difficult to perform in lab such as total internal reflection helps teachers to explain the concepts by modifying the parameters and demonstrate the effects of different variables and encourage students to explore and experiment to establish a cause and effect relationship. Teachers also agreed that interactive simulations help students to develop curiosity and critical thinking as learners can hypothesize to test their understanding, experiment, learn by mistakes and develop understanding of systems through knowledge of how different factors interact.
Exploring the subject matter through educational portals and other online sources is considered important by eighty six percent of the teachers who also agree that online learning, project based learning and flexibility in learning facilitates learning how to learn. Learning flexibility encourages students to be reflective and self-critical learners, to access tools which help them become more efficient and effective, to be able to transfer learning to learn skills from one context to the next; and to equip themselves to deal with new and unpredictable situations in the future. Teachers can facilitate and coach the students to work on challenging projects with which they are not very familiar so that they are trained to know what to do in order to acquire, analyse and use new information, and to process new data.

Figure 5.16 is a graphical representation of the opinions of teachers on the proposed strategic objective i.e., collaborative learning. Ninety seven percent of teachers consider collaboration among schools in sharing content and best practices in teaching is important. They are also in favor of shared resources including online libraries as they help them to be innovative and creative in teaching by synthesizing reusable learning objects in a way appropriate to the context and the preferred learning style of the student. Ninety percent of the teachers concur that the collaborative learning through virtual class rooms with video lectures from expert teachers where in large audience of students and teachers can be involved in synchronous interactive learning brings learners, teachers, and experts together.
to share ideas and good practice, contributing to new knowledge and learning. Collaborative learning achieves economies of scale through collective efforts in creating and sharing knowledge capital and extends learning opportunities to all with equity and equality.

5.13 Analysis of qualitative data from teachers:

Teachers were asked open-ended questions to seek their opinion on the following:

Q: Does technology help to enjoy teaching?
Q: Suggestions to improve the educational system?

Analysis of opinion expressed by teachers in terms of limitations of technology-assisted learning, implementation of e-Learning and suggestions for improving the learning environment and educational system is given below:

Limitations expressed by Teachers:

Access to ICT:
- Lack of infrastructure in the school
- Lack of computers in the classroom
- Lack of adequate technical support
- Lack of Internet connectivity
- Low bandwidth

Limited number of computers is installed in the computer lab or library, which is not convenient for the teachers to utilize the computer as a teaching aid. Broadband internet access is not available in many schools as it is still considered expensive. Access is a serious
limitation in schools as internet access through low bandwidth is time consuming and students may lose interest.

Access to Content:

- Lack of relevant content in the form of CD’s
- Lack of teaching aids
- Lack of resources

Teachers are not having access to any type of audio-visual lessons in the form of presentations, CDs or audiocassettes.

Professional development and technical support:

- Lack of teacher training
- Lack of technical support

Due to lack of technical staff in the schools, the teachers are not getting any technical support if they face any problem with the technology usage. Teachers are looking for training and a collaborative learning environment.

Curriculum and assessment:

- Vast syllabus
- Irrelevant curriculum
- System of examination
Frequent changes of curriculum Teachers feel that the syllabus is too vast and irrelevant to be covered in the academic year. Because of it teachers find no time to implement innovative methods of teaching in the classroom. A frequent change of curriculum is another obstacle faced by teachers to re-purpose the content or resources.

Management:

- High student-teacher ratio.
- Burdening the teachers with administrative work
- Lack of encouragement.

The strength of the class is also a major barrier for the teachers to give individual attention and conduct interactive sessions. The teachers are burdened with the administrative work in most of the schools and they hardly find any time to improvise their teaching skills.

Suggestions by teachers:

- Improve Access to ICT by providing proper infrastructure including computers in the classroom with broadband internet access.
- Technical support and training in educational technologies related to multimedia, online learning, content authoring and management is required
- National curriculum at school level integrating all the streams (SSC, CBSE, ICSE), which facilitates child-centered learning is required. The curriculum should emphasize on project-based learning.
• Education should not be completely exam oriented and the system of examination has to be changed. Instead of assessing the memory power of students, the exams should measure the student's level of understanding and application of concepts.

5.14 Analysis of qualitative data from Principals:

Important attributes and requirements of an effective learning environment that facilitates children to enjoy learning:

- Motivated and competent faculty
- Infrastructure
- Teacher training
- Technological support
- Interactive
- Student-centric
- Multimedia
- Stress free
- Activity oriented
- Relevance to real life situation
- Emphasis on application
- Concept based learning
- Learning tools
- Optimum student-teacher ratio
- Balance between academic and co-curricular and extra curricular activities
- Wonderwhizkids portal is useful in enhancing the learning environment and motivates self-learning.
Challenges:

- Teachers hesitate to use technology. Teachers are in dire need of basic training for the use of technology and integration of technology in classroom teaching.
- Number of teachers is not commensurate with strength of the school, leading to high student teacher ratio. Teachers remain extremely occupied.
- Lack of funds is a major barrier to implement e-Learning or to provide teaching aids in the schools.
- Vast syllabus is another obstacle to implement the innovative ideas in teaching. Pattern of examinations is also a major obstacle in introducing blended learning.

Suggestions for improvement:

Training of teachers:

Teachers need to be trained and motivated to use the available resources and training in new skill sets is required for e-Learning. They should overcome technology shyness by regular training and frequent use of user-friendly software packages. Hence, external agencies need to be engaged in designing and producing e-Learning packages in consultation with educators. Basic training of the use of technology and integration of technology in classroom teaching is required.
Resources:

Funds and required resources should be made available. Teacher–student ratio to be improved to be commensurate with strength of school.

Reforms in the educational system:

The syllabus and pattern of examination should be reviewed. Acceptance by the parents and recognition by the affiliated boards is also required.

Collaboration:

Teachers should interact with each other and exchange the ideas to improvise their teaching skills.

5.15 Advanced Statistical Analysis:

Binary logistic regression models are widely used in applied research, as many outcome variables (dependent variables) will be binary or dichotomous (consisting of only two possible observations). In order to study the (i) relationship/influence of key elements of strategy and strategic actions on learning environment (SMILE), and (ii) relationship of learning environment (SMILE) on benefits of strategy, strategic objectives and (iii) relationship/influence of key elements of strategy and strategic actions on benefits of strategy/strategic objectives, binary logistic regression models were run on data collected from students and results were discussed/interpreted.
Binary logistic regression has been carried out using SPSS package by classifying the opinions expressed by students as “Agree” and “Disagree”. Agree and slightly agree are classified under “Agree”. Neither agree nor disagree, slightly disagree and disagree have been classified as “Disagree”. Similarly very important and important are classified under “Agree”. Can’t say, not important and not at all important are classified under “Disagree”. Highly useful and useful are classified under “Agree”. Can’t say, not useful and not at all useful are classified under “Disagree”.

After conducting binary logistic regression on SPSS package it has been found that 'Goodness of fit', which reflects the overall percentage of actual data that followed predicted values is high (75% - 95%) and hence this model is considered valid for analysis.

The questionnaires for students captured the stakeholders’ perceptions on learning environment (SMILE), benefits of Strategy, strategic objectives, strategic actions and key elements of strategy. The answers given by students to the questions on the above qualitative aspects were measured in a five-point scale. However, responses to each question indicated a skewed distribution. Therefore, all the variables with five-point scale were converted into dichotomous variables.

Opinion of students on the strategic objectives have been classified into binary data and considered as independent variables. The features of the learning environment proposed as the strategy namely Simple, Motivating, Interactive, Learner-centric and collaborative have been classified as independent variables. Further key elements of the strategy like content, technology, access and collaboration along with the proposed strategic actions also have been considered as independent variables. Then we have tried to find out the factors, which
have significant influence on the dependant variables, i.e., strategic objectives of the proposed strategy.

5.16 Students: Strategic objectives Vs SMILE:

Strategic objectives such as enjoy learning, learning to learn, active learning, collaborative learning are considered as dependent variables. The attributes of “SMILE” namely “simple", "motivating", "interactive", "learner centric" and "collaborative" are considered as independent variables. Several variables relating/corresponding to each of the strategic objectives like enjoy learning, active learning, learn to learn and collaborative learning are identified. Since each of the strategic objectives (eg, enjoy learning, etc) is measured through several related variables as benefits of the strategy, a combined score has been derived for each objective variable by adding individual scores of the variables (dichotomous) related to corresponding benefits of the strategy. Now the resultant strategic objective variables are non-dichotomous. In order to convert them into dichotomous variables, we compare the individual combined scores with their respective median scores. If combined score is less than median score, put score as ‘0’, otherwise ‘1’ (Please refer to Table 4.3 for more details). Once all strategic objective variables (enjoy learning, active learning, learn to learn and collaborative learning) are converted into dichotomous variables, we use advanced statistical tools (binary logistic regression) to study the relationship/influence of learning environment on strategic objective variables.
Hosmer and Lemeshow test for Goodness of fit

<table>
<thead>
<tr>
<th>Strategic Objectives</th>
<th>Chi-square</th>
<th>Df (Degree of freedom)</th>
<th>Sig (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoy Learning</td>
<td>4.415</td>
<td>5</td>
<td>0.491</td>
</tr>
<tr>
<td>Active Learning</td>
<td>2.292</td>
<td>4</td>
<td>0.682</td>
</tr>
<tr>
<td>Learn to Learn</td>
<td>2.753</td>
<td>5</td>
<td>0.738</td>
</tr>
<tr>
<td>Collaborative Learning</td>
<td>1.439</td>
<td>3</td>
<td>0.696</td>
</tr>
</tbody>
</table>

Table 5.3

After conducting binary logistic regression on SPSS package it has been found that 'Goodness of fit', which reflects the overall percentage of actual data that followed predicted values is high as the probability value (p value) for significance is very much greater than 0.05. So this model is having goodness of fit and hence considered valid for analysis.

Strategic objectives Vs SMILE ((Variables of equation))

<table>
<thead>
<tr>
<th>Strategic Objectives</th>
<th>Attributes of Share the SMILE</th>
<th>Odd ratio EXP(B)</th>
<th>95% C.I. for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Enjoy Learning</td>
<td>Simple</td>
<td>2.815</td>
<td>1.970</td>
</tr>
<tr>
<td></td>
<td>Motivating</td>
<td>2.880</td>
<td>1.987</td>
</tr>
<tr>
<td></td>
<td>Interactive</td>
<td>3.087</td>
<td>2.135</td>
</tr>
<tr>
<td></td>
<td>Learner centric</td>
<td>1.774</td>
<td>1.339</td>
</tr>
<tr>
<td></td>
<td>Collaborative</td>
<td>2.042</td>
<td>1.551</td>
</tr>
<tr>
<td>Active Learning</td>
<td>Simple</td>
<td>1.899</td>
<td>1.312</td>
</tr>
<tr>
<td></td>
<td>Motivating</td>
<td>3.023</td>
<td>2.069</td>
</tr>
<tr>
<td></td>
<td>Interactive</td>
<td>3.142</td>
<td>2.146</td>
</tr>
<tr>
<td></td>
<td>Learner centric</td>
<td>2.612</td>
<td>1.987</td>
</tr>
<tr>
<td></td>
<td>Collaborative</td>
<td>2.832</td>
<td>2.167</td>
</tr>
<tr>
<td>Learn to Learn</td>
<td>Interactive</td>
<td>1.902</td>
<td>1.338</td>
</tr>
<tr>
<td></td>
<td>Learner centric</td>
<td>1.884</td>
<td>1.461</td>
</tr>
<tr>
<td></td>
<td>Collaborative</td>
<td>1.931</td>
<td>1.506</td>
</tr>
<tr>
<td>Collaborative Learning</td>
<td>Simple</td>
<td>1.659</td>
<td>1.168</td>
</tr>
<tr>
<td></td>
<td>Motivating</td>
<td>1.891</td>
<td>1.317</td>
</tr>
<tr>
<td></td>
<td>Interactive</td>
<td>3.027</td>
<td>2.135</td>
</tr>
<tr>
<td></td>
<td>Collaborative</td>
<td>1.936</td>
<td>1.498</td>
</tr>
</tbody>
</table>

Table 5.4
Significant Variables in the equation:

The binary logistic regression resulting from the analysis on SPSS package indicate that enjoy learning depends to a significant extent on attributes of the learning environment such as simple, motivating, interactive, learner centric and collaborative, the most significant factor being ‘interactive’ followed by ‘motivating’, ‘Simple’, ‘collaborative’ and ‘learner centric’. The odds ratio range in terms of lower and upper limits have been computed for 95% confidence level which are greater than 1.0 in all cases. The most significant factor is "Interactive" with odds ratio of 3.087 followed by "motivating" which is 2.880.

All facets of SMILE i.e., simple, motivating, interactive, learner-centric environment along with collaboration have significant influence on ‘Active learning” the most significant factor being “Interactive” followed by motivating, collaborative, learner centric and simple. The odds ratio range in terms of lower and upper limits have been computed for 95% confidence level which are greater than 1.0 in all cases. The most significant factor is "Interactive" with odds ratio of 3.142 followed by “motivating” which is 3.023.

It has been found from the logistic regression analysis on SPSS that collaborative, interactive and learner-centric environment has significant influence in achieving the objective “learning how to learn”. The odds ratio range in terms of lower and upper limits have been computed for 95% confidence level which are greater than 1.0 in all cases. The most significant factor is" Interactive " with odds ratio of 3.027 followed by "collaborative " which is 1.936.
From the above analysis on SPSS it is also understood that interactive, collaborative and motivating learning environment has significant influence in achieving the objective "collaborative learning". The odds ratio range in terms of lower and upper limits have been computed for 95% confidence level which are greater than 1.0 in all cases. The most significant factor is "collaborative" with odds ratio of 1.93 followed by "interactive" which is 1.902.

5.17 Students: Strategic actions required to create SMILE:

The binary logistic regression of the opinion of students was carried out by considering the attributes of "SMILE" namely "simple", "motivating", "interactive" and "learner centric" as dependent variables with strategic actions as independent variables. Key elements of the strategy are included in the strategic actions.

Hosmer and Lemeshow test for Goodness of fit

<table>
<thead>
<tr>
<th>Attributes of Share the SMILE</th>
<th>Chi-square</th>
<th>df (Degree of Freedom)</th>
<th>Sig (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>2.619</td>
<td>3</td>
<td>0.454</td>
</tr>
<tr>
<td>Motivating</td>
<td>4.918</td>
<td>3</td>
<td>0.178</td>
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<tr>
<td>Interactive</td>
<td>2.725</td>
<td>3</td>
<td>0.436</td>
</tr>
<tr>
<td>Learner centric</td>
<td>3.229</td>
<td>3</td>
<td>0.358</td>
</tr>
</tbody>
</table>

Table 5.5

After conducting binary logistic regression on SPSS package it has been found that 'Goodness of fit', which reflects the overall percentage of actual data that followed predicted values is high (75% - 95%) as per the classification table. Further the probability value (p
value) for significance is very much greater than 0.05 and hence this model is having
goodness of fit and hence considered valid for analysis.

Strategic actions required to create SMILE (Variables of equation):

<table>
<thead>
<tr>
<th>Attributes of share the SMILE</th>
<th>Strategic actions, Key elements of Strategy</th>
<th>Odds Ratio EXP(B)</th>
<th>95% C.I. for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>Key elements of the strategy:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to ICT (Q. 14.1)</td>
<td>1.665</td>
<td>1.076</td>
</tr>
<tr>
<td></td>
<td>Strategic Actions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Portals with open access (Q. 15.2)</td>
<td>2.037</td>
<td>1.333</td>
</tr>
<tr>
<td></td>
<td>Centre for Excellence in educational</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>technologies (Q15.5)</td>
<td>1.787</td>
<td>1.191</td>
</tr>
<tr>
<td>Motivating</td>
<td>Key elements of the strategy:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to ICT (Q. 14.1)</td>
<td>1.792</td>
<td>1.143</td>
</tr>
<tr>
<td></td>
<td>Technology (Q. 14.3)</td>
<td>2.071</td>
<td>1.335</td>
</tr>
<tr>
<td></td>
<td>Strategic Actions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Portals with open access (Q. 15.2)</td>
<td>1.644</td>
<td>1.048</td>
</tr>
<tr>
<td></td>
<td>Centre for Excellence in educational</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>technologies (Q. 15.5)</td>
<td>3.243</td>
<td>2.186</td>
</tr>
<tr>
<td>Interactive</td>
<td>Key elements of the strategy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology (Q. 14.3)</td>
<td>2.569</td>
<td>1.682</td>
</tr>
<tr>
<td></td>
<td>Collaboration (Q. 14.4)</td>
<td>2.272</td>
<td>1.556</td>
</tr>
<tr>
<td></td>
<td>Teacher (Q. 15.1)</td>
<td>2.101</td>
<td>1.135</td>
</tr>
<tr>
<td></td>
<td>Strategic Actions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blended Learning with flexible curriculum</td>
<td>1.823</td>
<td>1.216</td>
</tr>
<tr>
<td></td>
<td>and assessment (Q. 15.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Centre for Excellence in educational</td>
<td>1.607</td>
<td>1.041</td>
</tr>
<tr>
<td></td>
<td>technologies (Q. 15.5)</td>
<td></td>
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<tr>
<td>Learner</td>
<td>centric</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Key elements of the strategy:</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Technology (Q. 14.3)</td>
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<td>1.211</td>
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<td></td>
<td>Collaboration (Q. 14.4)</td>
<td>1.604</td>
<td>1.193</td>
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<td></td>
<td>Strategic Actions:</td>
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<tr>
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<td>Portals with open access (Q. 15.2)</td>
<td>1.698</td>
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<td>Networking Educational Institutes with</td>
<td>1.532</td>
<td>1.120</td>
</tr>
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<td>shared resources (Q. 15.3)</td>
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<td></td>
<td>Blended Learning with flexible curriculum</td>
<td>1.672</td>
<td>1.238</td>
</tr>
<tr>
<td></td>
<td>and assessment (Q. 15.4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.6
Significant Variables in the equation:

The binary logistic regression of data collected from students on SPSS package regarding strategic actions and key elements required to create and share SMILE indicate the following: Analysis of data collected from students regarding key elements of the strategy and strategic actions suggest that strategic actions such as educational portals with open access and center for excellence in educational technologies have significant influence in creating a learning environment which is "simple". SPSS analysis includes computation of the odds ratio range in terms of lower and upper limits for 95% confidence level which are found to be greater than 1.0 in all cases. The most significant factor is "Educational Portals with open access" with odds ratio of 2.037 followed by "Center for excellence in educational technologies" which is 1.787. Educational Portals with open access are extremely valuable and training for familiarity with computers, internet and other tools like Google and Wikipedia is important for improved learning. Access to accredited, enriching content is important to enjoy learning. In their opinion all these factors have significant influence on making the learning environment simple.

Strategic actions such as Center for excellence in educational technologies and open access to educational portals, Key elements of the strategy namely technology and access to ICT have significant influence in creating a "Motivating" learning environment. The odds ratio range in terms of lower and upper limits have been computed for 95% confidence level which are greater than 1.0 in all cases. The most significant factor is "Center for excellence in educational technologies" with odds ratio of 3.243 followed by "Technology", which is 2.071. Technology which make learning more joyful, interactive and collaborative, Educational
portals with accredited and appropriate content and access to ICT play a significant role in motivating them to learn.

It has been found from the logistic regression analysis on SPSS that Strategic actions such as Blended learning with flexible curriculum and assessment and Center for excellence in educational technologies and Key elements of the strategy such as Technology, Collaboration and Teacher have significant influence in creating an “Interactive” environment. The odds ratio range in terms of lower and upper limits have been computed for 95% confidence level which are greater than 1.0 in all cases. The most significant factor is “Technology” with odds ratio of 2.569 followed by “Collaboration” which is 2.272. Technology, which makes learning more joyful, interactive and collaborative; learning together and sharing of knowledge through chat, discussion forums have more influence in making the learning environment interactive. Teacher’s role in making learning a joyful experience, flexibility in learning if classroom learning is combined with online learning and training for familiarity with computers, internet and other tools like Google and Wikipedia to improved learning also lead to Interactive learning environment.

From the above analysis on SPSS it is also understood that Strategic actions such as Educational portals with open access, Blended Learning with flexible curriculum and assessment and Networking of educational institutions with shared resources and Key elements of the strategy such as Technology and Collaboration have significant influence in creating a “Learner centric” environment. The odds ratio range in terms of lower and upper limits have been computed for 95% confidence level which are greater than 1.0 in all cases. The most significant factor is “Technology” with odds ratio of 1.729 followed by “Portals with open access” which is 1.698. Educational Portals with open access, flexibility in learning by
combining classroom learning with online learning, learning together and sharing of knowledge through chat and discussion forums and networking of schools to share content and experience of teachers play a predominant role in providing the learner-centric environment. Technology enables us to create an interactive, learner-centric environment. Strategic actions such as networking of educational institutions, blended learning and training on technologies have significant influence on achieving the interactive and learner-centric environment.