DEVELOPMENT AND IMPLIMENTATION OF INTEGRATED STRATEGY TO INCULCATE PRODUCITVE THINKING AMONG ELEMENTARY SCHOOL STUDENTS

A
Synopsis
of the Thesis for the Degree of
Doctor of Philosophy
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1.1.0 INTRODUCTION

Time is witnessed of changes in our surrounding and our living style. We know that it all come to happen because of the thinking power of human brain but unfortunately this aspect of human endeavor is neglected in education system and it is restricted to mere cramming of written facts. Organization for Economic Co-operation and Development (OECD) (2018) has emphasized some of the skills that will be needed in the future viz. adaptability, creativity, curiosity, and open-mindedness. To attain such competencies the organizations framed 'The OECD learning framework, 2030' that recommends for construct; creativity, critical thinking, responsibility, resilience and collaboration to be successful.

World Bank (2011) stated that employers want skills beyond memory or knowledge level in their employees and therefore, this is the time to realize that education is not only reading, writing and arithmetic (3Rs) but also communication, team work, critical thinking, creativity, problem solving are the skills that are needed to be successful in life and at workplace as well. We need some human skills like creativity, originality and initiative, critical thinking, persuasion, resilience, flexibility, and complex problem solving skills to be successful and employed (World Economic Forum, 2018). 'The future of jobs, 2018' report of World Economic Forum, 2018 highlighted analytical thinking & innovation, creativity, originality & initiative, critical thinking & analysis, reasoning, problem solving & ideation and complex problem solving among the required skills for future. These skills are directly related to the higher order thinking ability of human being. Kothari commission (1964) also recommended reforms for institutions to give opportunities to the students to think, read, study and discuss. In the same line, National Curriculum Framework (NCF, 2005) and National Education Policy (NEP, 2020) also give importance to creative and critical thinking in teaching learning process. Looking into the required skills in the students several organizations, institutions and commissions in India and abroad talked about integration of thinking skill in teaching-learning process.

Unfortunately, our students are still not good at critical thinking, creative thinking, and problem solving and face difficulties in applying those skills (Velayati, N. et al., 2017 and Flores et al., 2012). Teachers also face difficulties in creative and critical thinking based instruction (Afifah and Retnawati, 2019). This gap in learning is need to be addressed to

inculcate higher order thinking skills in the students. It creates foundation for the present study.

1.2.0 EDUCATION IN 21st CENTURY

Education is the process that leads to the development of whole personality of an individual. It prepares individuals for their better future. Our students are living in the world which is full of challenges. We need to develop new competencies as required to face the new and challenging future. National Policy on Education (1992) stated that coming generation should have the ability to internalize new ideas constantly and creatively. In the same way, NCERT (2011) suggested core values for students including creative and critical thinking to be successful in all the areas of life in 21st century. Afifah & Ratnawati (2019) said 21st century having various complex challenges and our young generation should be trained for not only to earn money for a better life but also required various skills ranges from core subjects to innovation, information and communication technology skills to life skills, and most importantly higher order thinking skills. Partnership for 21st century skills (P21, 2009) provided 21st Century Curriculum and Instruction plan to harness 21st century skills in the students. It stressed on equal importance of core subjects and higher order thinking skills which paves the way for integrated approach of learning where students get opportunity to learn particular skill through core subjects. Schleicher (2007) highlighted the role of OECD's Programme for International Students Assessment (PISA) in assessing the competencies like capacity of young adults to access, manage, integrate and evaluate information, to think imaginatively, to hypothesise and discover, and to communicate their thoughts and ideas effectively. It is designed to test whether students are able to transfer what they have learned to the novel situation. It highlighted the equal importance of transfering skill along with content knowledge and highlighted the need of learning situation to transfer the knowledge in real time.

World Economic Forum, 2018 surveyed about the core competencies required in the future and results showed half of the candidates surveyed realized critical thinking and creativity are the most demanded skills along with complex problem solving. It means, in our education system there is a need to integrate creative thinking, critical thinking and problem solving skills which are the foundation for other competencies. The need of these higher order thinking skills prepared the foundation for the present study.

1.3.0 NEED OF THE STUDY

After achieving universal access to primary education, there is still something to achieve i.e. the quality education. Kothari Commission (1964-66) highlighted the role of dull and uninspiring school teaching behind failure in achieving quality education. Quality education conclave (2019) also highlighted the lack of quality education in India. NCERT (position paper, 2006) revealed that "our schools promote a regime of thought which discourages thinking and precludes new and surprising insight." By keeping in mind the present situation of educational outcomes, Sustainable Development Goal (SDG) by United Nations General Assembly (2015) calls for SDG4 i.e. quality education for all by 2030. Similarly, Vision, 2020 document by Prof. J. S. Rajput also put the light on promoting critical and independent thinking to achieve quality education (NCERT, 2000).

Mehrotra, S. (1995) highlighted the use of convergent thinking in the classroom by the teachers since their outcomes are objectively visible and they confirm to the expectation of the society. Therefore, teachers never go beyond the fact based conversation in the classroom which start from closed ended question and ended with an expected and most acceptable response. This is the picture of existing framework of discussion in the classroom and students cannot have situation to think upon in a different way other than the text book. This type of classroom discourse enable students with only retention skill which is not enough. Teachers also need to provide situations where students can transfer the knowledge and thereby giving emphasis on transfer and retention skill both.

Present study is an attempt in this direction by focusing on higher order thinking skills at one place as productive thinking. Productive thinking has its foundation in learner centered pedagogy where students are taught with learner centric techniques like classroom discussion, activity based method, audio-visual aids and ICT. Then students get opportunity to draw their creative potential collaboratively on situations related to their learned content and use their critical thinking power to find out the best possible answer or solution for the given task. We can say that productive thinking process creates opportunity for developing creative thinking and critical thinking at one place in terms of creative problem solving which is better known as productive thinking. It enables individuals to solve problem in a productive manner. Thereby, students develop their retention and transfer skill along with productive thinking, creative thinking and critical thinking skills.

1.4.0 PSYCHOLOGICAL FOUNDATIONS OF PRODUCTIVE THINKING

Productive thinking brings its essence from following psychological theories:

(1) Guilford's Structure of Intellect (SOI) model provides three dimensional structure of human intellect. This model presents different type of thinking abilities depending upon the combination of interrelated components. According to SOI model human intellect has three component viz. content, product and operation. Where content provide the input for the operational process to give a specific product. The model has 5 operations viz. cognition, memory, evaluation, convergent production and divergent production which interact with 5 content inputs (visual, auditory, symbolic, semantic and behavioral) to give variety of products (units, classes, relations, systems, transformation and implication).

Operation belongs to the thinking component of human intelligence. It decides how a person would act cognitively to do a task. It determines the cognitive activity involved while achieving the goal. Operations are responsible for nurturing cognitive abilities like creative thinking, critical thinking, logical reasoning, problem solving and evaluative thinking. Operation has following components responsible for following thinking abilities.

- **Cognition**: It is the ability to perceive and retrieve information from the memory whenever it is necessary for the particular task.

- **Memory**: It is the ability to store information by making some relation with different elements of past experiences.

- **Convergent production**: It is ability opposite to divergent production. It is unidirectional in nature and directed towards single correct answer.

- **Divergent production**: It is the ability to draw various ideas on a certain criteria by considering multiple dimensions of the task at hand. Therefore, it is multidimensional in cognitive processing.

- **Evaluation**: It is the ability to assess the information to ensure appropriateness and relevance of the information and thereby reaching at the conclusion.

The above discussed components make foundation for productive thinking process as well where all the operational components are emphasized while solving a problem productively. Patel, D. D. (1988) said that "in our present education system convergent production component is emphasized most and divergent production ability is somewhat ignored but it is important to bring imagination, novelty and newness in our education output." Productive thinking is the cognitive process which make use of operation components to solve problems

creatively. Productive thinking is the cognitive ability that make use of memory as foundation which is accessed by cognition for divergent production, convergent production, evaluation and other higher order thinking abilities.

(2)   Bloom (1956) proposed taxonomy of learning objectives and arranged different cognitive process in a hierarchical manner. He arranged cognitive processes in the following order; knowledge, comprehension, application, analysis, synthesis, and evaluation. Based on the complexity of the level, cognitive processes was categorized in two categories; lower order thinking level which include knowledge, comprehension and application and higher order thinking level which includes analysis, synthesis and evaluation.

Anderson & Krathwohl (2001) revised Bloom's taxonomy and arranged cognitive processes in the following order; remembering, understanding, analysing, applying, evaluating and creating. It was believed that for creating a new theory or drawing a conclusion an effective evaluation must be done first and therefore, creating or creative thinking is at the highest level and always supported by evaluative thinking (critical thinking). Bloom's taxonomy and it's revised edition provides scope for productive thinking. In the revised Bloom's taxonomy, place of creative thinking is at the highest level followed by critical thinking component i.e. evaluation. It can be said that when creative thinking is supported by evaluation or critical thinking, it will give novel result of higher value.

(3)   Creative thinking is one of the component of productive thinking. There are two different classes of theories that define creative thinking. Guilford and Torrance who looked creative thinking from the psychometric point of view which considers intelligence as the base of creativity whereas second theory is the confluence theory or investment theory (Sternberg, 2010) given by Sternberg who considered several other factors along with intelligence for creativity.
Guilford's structure of Intellect (SOI) Model talked about divergent production as one of the operations which is the base for creative thinking. In the divergent production operation Guilford talked about four sub-operations viz. originality, flexibility, fluency, and elaboration.

- Originality: It is the ability to generate new, original, and novel ideas.
- Fluency: It is the ability to generate as many ideas as possible.
- Flexibility: It is ability to generate ideas from different categories.
- Elaboration: It is the ability to add value to the idea by applying it in new situations.

By considering Guilford's work as the base and creativity as the cognitive ability Torrance also worked upon creativity and developed the test to evaluate creative thinking ability. He also considered fluency, flexibility, originality and elaboration as the components of creativity and developed a test of creativity to measure creative ability of an individual.

Sternberg et al. (1996) studied creativity as the result of combination of factors where intelligence is one of the factor. They developed a theory known as 'confluence theory of creativity'. According to this theory, creativity is the result of confluence of six components where threshold level of each component is required for the development of creative abilities. The six components are:

- Intellectual abilities
- Knowledge
- Style of thinking
- Personality
- Motivation
- Environment

For creativity, intellectual abilities comprise of synthetic ability, analytic ability and practical ability (Sternberg, 2010). Synthetic ability refers to a person's ability to think in a novel and interesting way. It is also considered as divergent thinking ability by which a person thinks in different way. Analytic ability refers to a person's ability to analyse and evaluate the ideas. It is the base for analytical thinking and evaluative thinking ability by which a person critically judge an idea. Practical ability refers to the ability to transform abstract ideas into real. It is the base for implementation aspect of creative thinking that makes creativity real and practical. Along with this, a threshold level of knowledge of a particular field is required to think in a creative way. It creates a foundation because creativity never comes in vacuum (without knowledge). Thinking style and some personality attributes that encourage a person to consider various directions to think upon and to remove the hurdles in the way are also inevitable which make a person self-efficient to think in a creative manner. The above discussed components could not give creative result in the absence of motivation and positive environment that helps a person to think freely and creatively.

From the discussion of the two theories of creative thinking it can be said that creative thinking ability is the higher cognitive ability that demands a minimum level of knowledge and an encouraging environment that act as an external motivation. It can be deduced from

the above discussion that divergent thinking ability is always supported by convergent thinking ability in a constructive manner. But it is also true that over emphasis on convergent thinking ability or critical thinking restrict creativity as well. Therefore, a balanced use of both thinking ability is needed. Productive thinking is a way of doing so. Which provide a balanced approach to make use of both the thinking ability in constructive way.

The above discussed theories helped the researcher to conceptualize productive thinking, its components and productive thinking as the process. The next section puts light on productive thinking and programmes developed by various researchers to develop productive thinking.

1.5.0 PRODUCTIVE THINKING

Productive thinking is the cognitive ability that has its definite place in education. The concept of productive thinking is not new rather Wertheimer (1945) was the first to define productive thinking as insight based reasoning. He classified thinking in two categories based on the way of thinking i.e. productive thinking and reproductive thinking. According to Wertheimer, reproductive thinking is associated with chained behavior or repetition and ultimately lead to the rote learning whereas productive thinking is an insight based logical reasoning.

Hurson (2011) wrote a book *think better* wherein he differentiated productive thinking and reproductive thinking with two Japanese words *kaizen* and *Tenkaizen*. Literal meaning of *Kaizen* is *good change* and *Tenkaizen* means *good revolution*. He described reproductive thinking as kaizen where person gives fixed response to a given stimulus every time. It will lead to rote repetition, conscious systematization, and continuous improvement whereas productive thinking is tenkaizen which leads to new ideas. According to him, productive thinking has two components viz. creative thinking and critical thinking. In productive thinking both the elements need to be separated because simultaneous use of both the elements will lead to no new product or idea. Hurson (2011) define productive thinking as "a process of suspending judgment to generate long list of ideas and then returning to those lists to make choices by judging the ideas against pre-established success criteria".

He gave ThinkX model to develop productive ideas particularly in the field of management and industries. This model is a six step process and can be described as:

(1) What's going on? : This is the first step to develop an understanding about the problem by asking questions about the problem.

(2) What's success? : This step involves criteria establishment on which creatively generated ideas would be test to achieve success.

(3) What's the question? : This step involves listing down the questions that you want to be solved about the problem to achieve the success.

(4) Generate answer: This step is to creatively address the questions that are asked in the phase 3 about the problem.

(5) Forge the solution: This step involves evaluation of the ideas generated in the phase 4 against the criteria established in phase 2. This phase is critical thinking phase which is for refining the generated ideas.

(6) Align resources: This step involves identification and relocation of the required resources to implement the ideas in real setting.

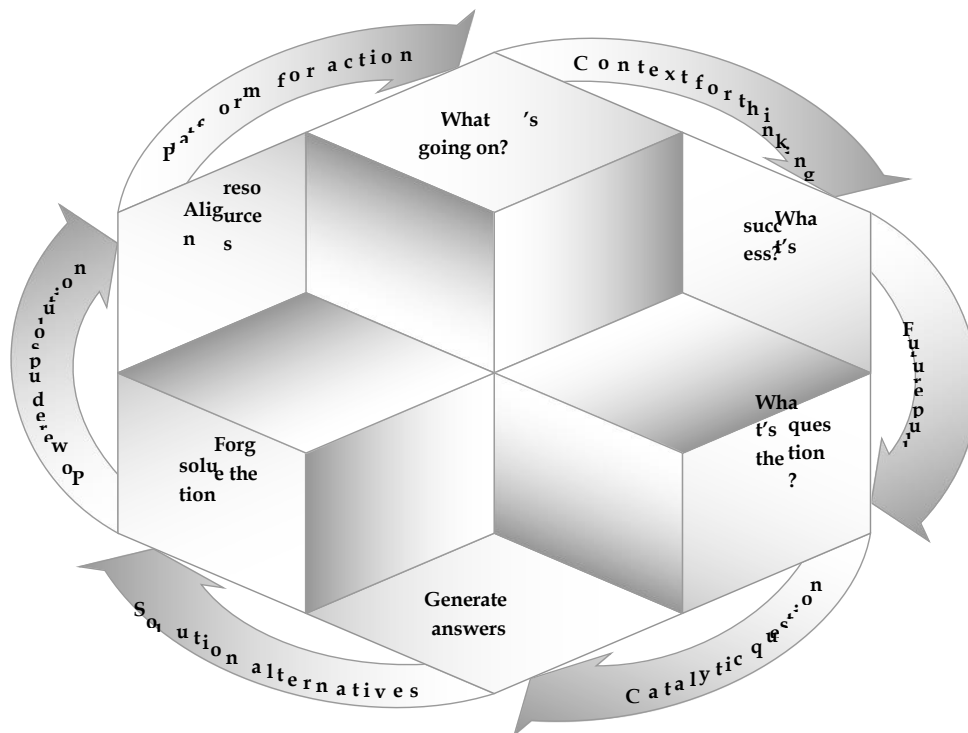The steps of Think X model can be represented by the following figure 1.1

Figure 1: ThinkX model

Newton (2017) described productive thinking as the skill of reasoning, understanding, creative thinking, evaluative thinking, decision making and wise thinking. She introduced "Model of productive thought" and can be explained by the figure 1.2.
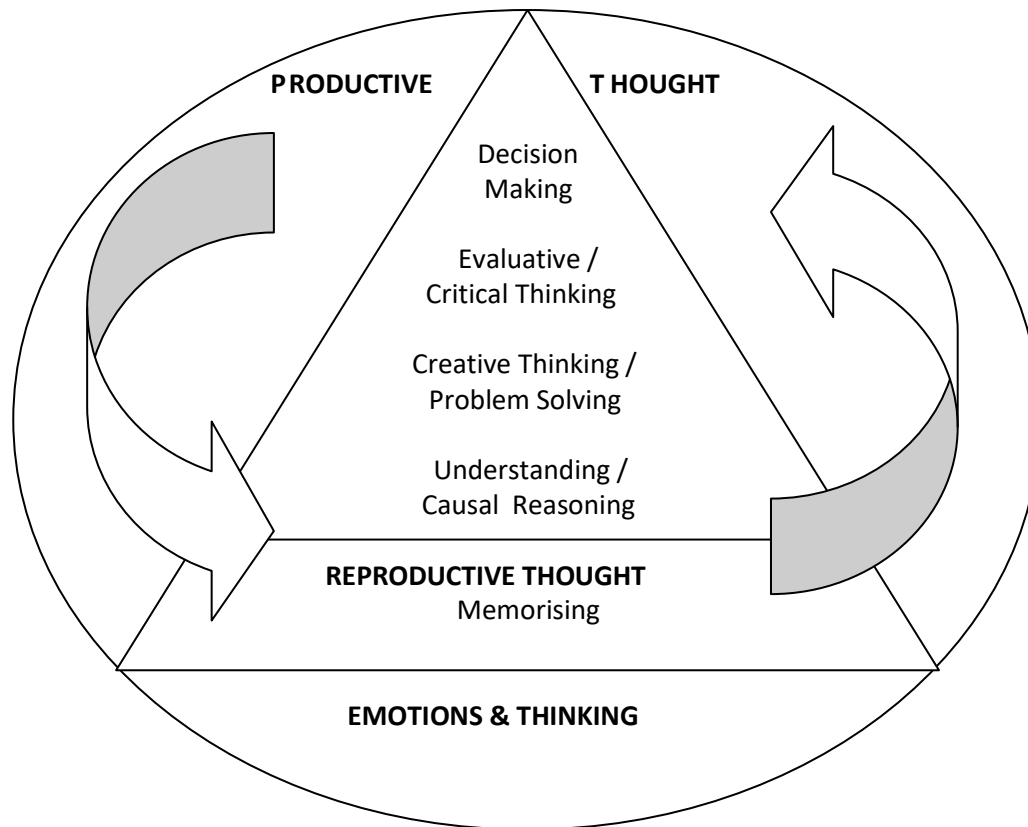

Figure 2: Model of productive thought

According to Newton (2017) productive thought has five components and can be described as follows:

(1) Memorizing: This component emphasizes the role of a knowledge foundation or facts in higher cognitive operations.

(2) Understanding and causal reasoning: This component helps to establish the relationship between existing knowledge or experience with the new ideas.

(3) Creative thinking and problem solving: It involves identification of problem, generation of ideas, and evaluation of ideas to select the best one.

(4) Evaluative and critical thinking: It is for improving the quality of ideas using constructive judgment.

(5) Decision making and wise thinking: It is the ability to make decision by looking multiple dimension of the situation and being impartial.

Gallagher and Aschner (1963) cited in (Aranda et al., 2020) considered productive thinking as the combination of creative and critical thinking skills where memory creates the base for higher cognitive activity. They arranged the components in the following order:

(1) Memory: It is the lowest level of thinking which involves repetition of facts and results into rote learning.
(2) Convergent thinking: It involves analysis and integration of information to give one result.
(3) Divergent thinking: It involves generation of ideas, alternatives, consider multiple perspectives and give various possibilities.
(4) Evaluative thinking: It involves making evaluative judgment to improve quality and making choices.

It means productive thinking involves memory, convergent thinking, divergent thinking and evaluative thinking.

Rusbult, C. (1997) explained productive thinking as combination of creative and critical thinking. He gave four elements of productive thinking: motivation, memory, creative thinking and critical thinking. He explained that productive thinking is the result of motivation, memory, creative and critical thinking. The basic principle of producitve thinking is to provide separate place to creative thinking and critical thinking to get productive result.

Birch & Rabinowitz (1951) defined productive thinking as not merely arriving at the solution of problem through direct application of previous learning rather in productive thinking past experiences are re-patterned and restructured to meet current demands.

Gallagher (cited in Hoffman & Hoffman, 1964) defines productive thinking as the result of the individual operation upon information from internal or external sources in order to change it into some different product. It involves problem solving, creative thinking, analytical thinking and logical reasoning dimensions.

It can be deduced from the above discussion that productive thinking is the combination of creative thinking and critical thinking where motivation and memory are the two components that provide support to the productive thinking process. Productive thinking needs a minimum knowledge level and a motivating environment in the background also which facilitates productive thinking process. As discussed by Hurson (2011) that productive thinking process requires separate place for creative and critical thinking because being

critical at creative phase may create hindrance for creativity. We need a constructive relation between both thinking rather than restrictive one. Therefore, it is necessary to overcome from fixed pattern of looking at things. Ready to change the perspective and considering multiple dimensions while addressing the problem open the door for creativity. Hence, we can say that productive thinking is the process where creative thinking and critical thinking are blended in such a way that produces a high-quality solution for problem.

1.6.0 COMPONENTS OF PRODUCTIVE THINKING

Productive thinking is the cognitive process that refine creative product with constructive evaluation by critical thinking. As Rusbult, C. (1997) explains productive thinking as combination of creative and critical thinking and Davis and Scott (1971) (cited in Patel, D. D., 1988) described productive thinking consisting in those convergent, divergent and evaluative operation. By considering different definitions and explanations given by researchers and psychologist it can be said that productive thinking is the blending of creative thinking and critical thinking to make use of positive components of both the elements. Therefore, elements of productive thinking are creative thinking and critical thinking.

1.6.1.0 CREATIVE THINKING

Creative thinking found its place at highest hierarchical order in Bloom's taxonomy. It is the ability to see an object, process or idea from new perspective. It is the ability to think something new and different. It can be identified in terms of process as well as product. Like Supratman (2013) considered creative thinking as the process to solve problem in not normal, unique, and various ways. Creative thinking has three components viz. fluency, flexibility, and originality (Supratman, 2013, Torrance, 1993 & Guilford, 1950 cited in Michael, F. 1995). It is not always that product or composition of creativity is completely new, it may happen that the product is previously unknown to the producer (Drevdahl, 1956 cited in Mangal, 2021, p. 307). In the same line, Stagner and Karwoski defined creativity as the production of totally or partially novel identity (Mangal, 2021, p. 307). Creativity is often associated with usefulness and appropriateness and ready to solve the purpose (Seifert K. and Sutton R., 2009). Creativity is also a way of looking and finding unexpected relation between two or more components of problem and reaching to a novel product (Shah, 1981). Ramalingam, P. (2013) defines creative thinking is the process of applying a person's mental

ability to discover something new, ability to relate and connect and capacity to develop new idea, concepts and processes.

0From the above discussion it can be said that creative thinking is the ability to consider multiple dimension of a process, object, or a person while arriving at novel product or deriving a novel conclusion. It is the potential which is present in every individual but a stimulating environment is needed to harness this potential.

1.6.2.0 CRITICAL THINKING

Critical thinking is one of the higher order thinking ability which has its root in reasoning but many people misinterpret it as negative judgment or restrictive judgment. The word critical is often associated with criticism but it is not like that. Critical thinking is the ability to analyze critically by considering each aspect before arriving at conclusion. It is an unbiased, objective and disciplined way of thinking where reasoning has its own place in background. Hurson (2011) described it as analytic, expensive and selective. As emphasized by Paul et al. (1989) critical thinking involves truth, open-mindedness, empathy, autonomy, rationality, and self-criticism. Barua & Chakrabarti (2017) defined it as a self-guided and self-disciplined thinking which attempts to reason at the highest level of quality in a fair-minded way.

Sternberg, et al. (2007) define critical thinking as thinking which is purposeful, reasoned and goal directed which involved in problem solving, formulating inferences and making decisions. Krishnan (2011) defines critical thinking as one of the higher order thinking skill which is pervasive and self-rectifying human phenomenon which constitute interpretation, analysis, evaluation and inference. Critical thinking is the essential element of problem solving and decision making (Tanujaya et al., 2017 and Seifert K. and Sutton R., 2009). We are living in the world of information but if a person is accepting the information without questioning or objectively looking at the source or without considering the authenticity of the information can never be a critical thinker (Patel, R., 2010, and Seifert K. & Sutton R., 2009).

By keeping in mind the above discussion on critical thinking it can be said that "critical thinking is a cognitive process that involve analysis, evaluation, interpretation, reflection and judgmental ability." An environment that provide sufficient opportunity to the students to analyse, evaluate and reflect upon can help students to develop critical thinking. It was also reported that it has been overlooked at the elementary and high school levels where the

primary focus is on rote learning of concepts rather than skilful application of ideas (Barua & Chakrabarti, 2017). Therefore, an attempt is needed to develop this skill in students.

1.7.0 PRODUCTIVE THINKING AT ELEMENTARY SCHOOL LEVEL

Piaget's cognitive development theory prepares foundation for productive thinking. Piaget gave the stages of cognitive development by relating it to chronological development of a child. The stages of cognitive development ranges from pre-operational stage to formal operational stage. It means the theory gave us an age group which is favourable for abstract thinking. Simatwa (2010) described some of the characteristics of this formal operational stage as follows:

- At this stage, chid shifts from the level of concrete operations to the final stage of formal operations.
- Child is capable of considering the ideas of others and the ideas of others and communicating with others.
- Pupils develop the ability to reason by hypotheses based on logic of all possible combinations.
- Pupil can deal with abstraction and mentally explore similar and differences because child is mastered in reversibility.

It is assumed that the learner can think in the prescribed way at the formal operational stage. The biological maturation is only one of the factor that allows a child to develop cognitively. But the importance of environmental effect can never be ignored. So, abstract thinking power needs biological maturation as well as environmental factors to foster it. And upper primary stage of elementary school education is best for training of creative thinking, critical thinking and productive thinking because students' curiosity is at its peak at this stage of cognitive development. If a conducive environment is provided at this age, then majority of students will shift from concrete operational stage to formal operational stage. In the school, the environment can be provided separately or in an integrated way through a subject. In the present study researcher selected science as the subject of teaching for productive thinking inculcation.

1.8.0 PRODUCTIVE THINKING IN SCIENCE EDUCATION

Science is not only the body of knowledge or a fixed set of facts rather it is a way of thinking which is regularly updated and challenged in the knowledge society by various scientific methods. It is the process aspect of human cognition by which life around us is regularly changing. Science creates a room for investigation, observation, hypothesis formation, verification, evaluation and finally a conclusion is drawn. It is the subject that opens the door for developing higher order thinking skills i.e. analysis, synthesis, and evaluation. Science is the subject to play with and enjoy it by experiencing the link between textbook and real life. But still in our society science is no more than a factual knowledge. This makes science one of the difficult subject and students use rote learning for getting marks without internalizing it. It was also realized and emphasized by National Policy on Education (POA, 1992) "that we need to improve and strengthen our science education that develop well defined abilities and value such as the spirit of inquiry, creativity, objectivity, the courage to question, and aesthetic sensibility." But unfortunately, school science teaching learning process is still at lower order thinking level as it is emphasized by National Curriculum Framework (2005) that in India science education does not develop competence like innovation skills.

To improve the present practices in science teaching we first need to understand and identify the key skills that could be imbibed with science as a subject. Keeping in view this objective NCERT (2015) suggested process skills of science which includes observation, pose question, searching various resources of learning, planning investigation, hypothesis formulation and testing, analyzing, interpreting data, critical thinking to consider and evaluate alternative explanations, reflecting on their own thinking. Based on process skills NCERT recommended expected learning outcomes for class VIII in science. One of the learning outcome is to exhibit creativity in designing, planning, making use of available resources, etc. but this outcome cannot be achieved by traditional classroom approach where teacher's voice dominates to control class and students speak occasionally or to give answer of the asked question in a most acceptable manner.

Teachers need to introduce process skills of science in learners while teaching the content rather than simply putting information before students. This type of atmosphere never encourage learners to relate science content with the real life phenomenon and they never think beyond the four walls of classroom. Therefore, it is necessary to introduce a strategy that foster higher order thinking ability in the students at one platform through science

learning. Productive thinking process opens the door for higher order thinking abilities (analysis, synthesis and evaluation) in science and ensure learners' participation in the knowledge construction. Along with this, it also helpful in developing creative abilities and critical thinking power of the learners in classroom while learning science.

1.9.0 IMPLICATION OF REVIEW OF RELATED LITERATURE

Researcher has made an attempt to review the literature available in the area of thinking in India and abroad. On the basis of this analysis of literature, the implication is drawn for the present study.

Thinking skills can never be separated from learning. It has its own place in teaching learning process which cannot be ignored. Learning with simply repetition of the facts is the result of reproductive thinking or retention without developing the transferring skills. Various researchers tried to give emphasis on developing thinking skills by integrating it with content knowledge. This process has its roots in Bloom's taxonomy which gives learning objectives ranges from lower order thinking skills to the higher order thinking skills i.e. knowledge, comprehension, application, analysis, synthesis and evaluation. Saido, G. M. (2015) surveyed VII standard students and revealed 79.7% students are at lower order thinking level. One of the reason of this is teachers' difficulty in teaching, assessing and designing Higher Order Thinking Skills (HOTS) based material (Afifah & Retnawati, 2019). Chin, C. (2007) reflected on teachers' questioning and gave four types of questioning techniques viz. Socratic questioning, verbal jigsaw, semantic tapestry and framing and emphasized on teachers' role in asking questions that stimulate students' productive thinking. Hutchinson (1967) tried to study creative and productive thinking process in the classroom discourse and categorized students' responses in five categories viz. cognitive memory, convergent thinking, divergent thinking, evaluative thinking and routine responses after giving training through brainstorming. This study revealed the place of ideational fluency where criticism is not allowed and quantity precedes over quality in the process of developing productive thinking. Olton, R. M. et al. (1969) and Schuler & George (1974) used productive thinking programme developed by Covington, Crutchfield & Davies, (1966) to train the students and considered creative thinking and problem solving as the component of productive thinking. He highlighted active involvement of teacher for success of productive thinking programme. Patel, D. D. (1984) developed productive thinking programme to develop creative thinking in an integrated manner through Geography and concluded that it is better to develop thinking skills through the subject content rather than separately. This study emerge the idea of a

model where subject content is used to draw higher order thinking skills. Aranda, M. (2019) observed that at planning stage of a project students employ cognitive memory, divergent thinking and convergent thinking and at redesigning stage students used evaluative thinking to improve the initial design. While solving a problem creatively a person needs to shift the thinking process between creative and critical to refine the product.

Higher order thinking skills can be developed through all the subjects and science provides tremendous opportunity to bring different thinking skills while teaching. Nayar, P. P. (1971) identified six variables that predict achievement in science. Verbal reasoning ability, numerical ability, comprehension and interpretation, problem solving, critical thinking and spatial ability are the variables that are the part of learning in science.

Studies conducted in the area of creative thinking investigators developed the programme or took some standardized programme to develop particular type of thinking. CoRT thinking programme developed by DeBono was found effective in developing creative thinking among students (Patel, N., 2002 & Kachhia, 1990), SCAMPER was also found an effective techniques for developing creative potential (Gundogan, A., 2019 & Ozyaprak, M., 2015). Similarly, researchers used Synectic model to develop creative thinking where students used unusual analogies to draw their creative imagination (Paltasingh, S., 1998, Pandit, D., 2006, & Prashanth, M. S., 2006). Brainstorming is the technique where students get chance to work in the group and develop creative thinking by shared idea and understanding and it was also found very effective in developing creative thinking in generic as well as in integrated manner (Patel, R. P., 1988, Raj, H., 2016, George, K. M., 2016, & Pandit, D., 2006).

To implement the creativity programme in the classroom teachers need to be active, energetic, democratic and able to create favorable classroom climate where criticism has no place (Rajagopalan, S. A., 1988 and Gupta, A. K., 1977) as we know that teachers are continuously show their preferences and regards towards characteristics like; discipline, good grades, hard work, spirit of cooperation and neglect self-expression, imaginativeness, flexibility of ideas and non-conformity in the students (Haleem, N., 1984). Patel, J. Z. (1987), Gupta, P. K. (1985), Vora & Gira, C. (1984), Shah B. B. (1981), Amin, M. J. (1988), Krishnan, D. (2011), and Pandit, D. (2006) developed programme to develop creative thinking among students and found effective. All the studies help to establish a fact that if we create an enjoyable atmosphere in the classroom where teacher supports the students to draw their creative potential then it would be easy to develop creative learners in the classroom only.

Some of the researchers thought that intelligence as the prerequisite to be a creative and critical thinker (Kumari, S., 2014, Paltasingh, S., 1998, Gupta, P. K., 1985) and some others established that creativity is independent of intelligence (Brar, S. S., 1987 & Prashanth, M. S., 2006). It was also observed that creative thinking training also lead to better achievement (Passi, B. K., 1972, & Shah, B. B., 1981). Critical thinking involves abilities like inductive reasoning, analysis, inference, problem solving, evaluation, interpretation, self-regulation, open-mindedness, inquisitiveness, truth-seeking and explanation (Patel, D. M., 2011, Seeja, K.R., 2012, & Alghafri & Ismail, 2014). It is one of the 21st century skill and important component of achievement (Manjula, H. S, 2013, Siburian, et al., 2019 & Ramesh, K., 2015) but our students possess very low or average critical thinking skills and very negligible percentage of teachers used strategies to develop critical thinking skills in the classroom (Paily, M. U., 1999). To address this issue Meghani, A. M. (1999) & Patel, R. (2010) developed strategy based on Edward DeBono's CoRT thinking programme to develop critical thinking along with creativity. It is well evident that technology support enhance thinking skills as it provide way to explore upon the content. Manjula, H. S. (2013) used interactive multimedia packages and Joseph, M. S. (2018) used Andes intelligent tutoring for enhancing critical thinking skills among students. Researchers also used inquiry learning training (Ramesh, K., 2015), active learning strategy (Seeja, K. R., 2012) and critical thinking programme (Patel, D. M., 2011) to train the students for critical thinking. Studies conducted in the area of critical thinking reflects that students need to have a knowledge foundation that provide criteria to analyze, evaluate, draw inference, make judgment and interpret.

Studies conducted on creative problem solving shows involvement of creative and critical thinking potential to solve a problem creatively is important. Jain, S. C., (1982), Gill (1989), Kumari, U. M. C. (1993), and Thambi, T. (2018) developed creative problem solving ability in the students by various programmes where creative thinking and critical thinking have their own place in solving problem.

Review of literature related to thinking skills was conducted to develop an insight about the development of productive thinking among elementary school students. Total 51 researches were reviewed and most of the researches were conducted on programme to develop productive thinking, critical thinking, creative thinking and creative problem solving skills. Reviewed researches have following implications for the present research:

- A good number of studies had been conducted in the area of creative and critical thinking but there is lack of studies in the area of productive thinking particularly in India.

- Reviewed researches emerged the need of a model by which productive thinking can be developed through the shift in thinking at each step.
- There are very less number of studies where productive thinking is developed and assessed in an integrated manner.
- Teacher's role is very important in the process of development of thinking skills. Teachers need to be open-minded who always welcome multiple responses of a problem and encourage creativity.
- For the development of productive thinking it is very necessary to restrict criticism and give emphasis on ideational fluency at the stage of creativity.
- Critical thinking has its role in developing a clear understanding about the problem and improving the generated ideas on some criteria.
- A strategy that make a balance between all the components of productive thinking is required to train the students.
- Thinking skills can be taught in separated way or through the subject content as integrated strategy through a model.
- Enjoyable environment and thinking programme help learners to improve thinking skills along with mastery of subject content. If students are trained in such a way then they will be benefited by it.
- Researches suggested use of quasi experimental design of experimental study for the better result.

Reviewed studies made it clear that thinking skills can be developed through various thinking training programmes. There were total 51 studies reviewed out of which 6 studies were conducted in the area of productive thinking, 39 studies were conducted in the area of critical thinking and creative thinking, 2 studies on higher order thinking skills and 4 on creative problem solving skills. But investigator come across very less number of studies on productive thinking and found no tool to measure productive thinking for elementary school students. Hence, this study will address the need of development of model for productive thinking in elementary education through science as the subject. For this, a tool will be developed through which effectiveness of model would be assessed.

1.10.0 RATIONALE OF THE STUDY

Innovation is the best gift of human cognition on the earth. Each and every second we enjoy and feel the essence of innovations but what power is standing behind this cognitive ability

that direct all the mental processing. Here comes the role of thinking ability that makes human being superpower and make superior to other animals. We are living in the 21st century where several thinking skills are expected from our students to address the challenges of the changing scenario. Creative thinking, critical thinking, collaboration and communication are 4 C's that are required to bring our students beyond 3 R's i.e. reading, writing and arithmetic. It is needed to develop classroom atmosphere that will lead to prepare our students for 21st century. Siburian et al. (2019) highlighted the role of educators, researchers, and curriculum developers to integrate the above discussed skills in the teaching-learning process. In the same line New Education Policy (NEP, 2020) framed one of the guiding principle on creativity and critical thinking to encourage logical decision making and innovation at institutional level and stated that we need to reduce curriculum content to enhance such thinking skills.

Thinking skill is innate in every human being but the ability to think in a particular way is acquired. According to Piaget's cognitive development theory, biological maturation leads to cognitive maturation also. But Kuhn et.al (1997) argued that "maturation establishes the basis only but a special environment is required to attain this stage." Therefore, it is inevitable to create environment that stimulate development of cognitive ability. Unfortunately, our school system is getting failed in creating environment that stimulate cognitive development and thinking process. It was well reported that our school practices focused on rote learning and very less focus is given to higher order thinking skill. Presently, most of the schools are preparing their students for getting very high score in examinations by getting the subject matter may be by cramming and for this, schools provide very little scope for thinking critically and divergently in the existing teaching-learning process. It creates no scope for novelty, originality and innovations (Pany, S., 2014).

Productive thinking is a way of integrating higher order thinking skills in the teaching-learning process. As Davis & Scott (1971) (cited in Patel, D. D., 1988) defines productive thinking as the ability that include creative and critical thinking dimensions of cognitive ability. It consist of divergent, convergent and evaluative operation where by the individual drew upon available past and present acts, ideas, association and observation in order to bring forth new facts, ideas and conclusion. It is the ability that bring learner beyond mechanical application of previously learnt behavior in every new situation and make ready to see the new situation from a different perspective. It creates scope for novelty in the teaching-learning process in the classroom and creates scope for thinking beyond memory level.

As we know that creative thinking and critical thinking are two components of productive thinking and need to separate in the productive thinking process. But our past experience may become the hindrance and obstacle which blocks creative endeavor and reduces it to stereotyped and fruitless essays channelized through reproductive thinking (Birch & Rabinowitz, 1951) but critical thinking can be fruitful also when it is acted on correct place like Gallagher (cited in Hoffman & Hoffman, 1964) highlighted the role of critical thinking component which enables the individual to select the most appropriate solution out of number of solutions for the particular problem. Barua & Chakrabarti (2017) highlighted the importance of critical thinking in promoting creativity by saying critical thinking plays a crucial role in evaluating new ideas, selecting the best ones and modifying them if necessary. It can be said that productive thinking is the skill to imbibe knowledge with creative thinking and critical thinking to give productive results followed by high motivation and no criticism. So, we need a model by which this can be done and positive components of both thinking skills can be used at one place.

In India, researches were conducted over various thinking skills like; creative thinking, critical thinking, reflective thinking, evaluative thinking, problem solving and many more. But investigator could find only one research in India and very few researches in abroad on productive thinking development. This study will focus on developing a model for teaching through productive thinking and strategy by which students can be trained through various steps of productive thinking process. This teaching model will also guide teachers about their role in the process, classroom atmosphere and role of the students. In each step, different strategy can be combined to strengthen knowledge foundation, creative potential and make use of critical thinking to refine creative potential.

Productive thinking can be developed through separated from school subjects or in an integrated manner with all school subjects like science, mathematics, language, social sciences, etc. The nature of science is such, that require the process skills like observation, pose question, searching various resources of learning, planning, investigation, hypothesis formulation and testing, analyzing, interpreting data, critical thinking to consider and evaluate alternative explanations, reflecting on their own thinking, etc. (NCERT, 2015). It was reported that present science teaching is over burdened by factual knowledge where a little room for discussion and creative and critical thinking process which are the heart of science education. So, in this study, science is taken as the subject through which productive thinking

development can be done in an integrated manner because science provides tremendous opportunity for the higher order thinking skills.

Upper primary stage of elementary school education is the foundation for secondary and higher secondary level as well as for future. According to Piaget (1952) this is the stage where students' cognitive mechanism shift from concrete operational stage to formal operational stage. At this level, students are able to consider abstract ideas and manipulate them also (Simatwa, 2010). Researches shown that this is the stage where students' creative potential is its peak therefore, in this study upper primary stage is taken for the productive thinking development.

To implement this in the classroom role of a teacher is inevitable. George, S. (1974) emphasized active role of teacher in the classroom for the effective implementation of the productive thinking program. Teacher need to be active, vibrant, ready to model creative behavior, and very importantly a constant motivator who is away from destructive criticism and who can channelize creative thoughts on the correct track.

Thinking operations determine the way of doing things and the perspective of looking things. A person needs enough time to change the way of looking at things and it cannot be done immediately in some days. A person who use reproductive thinking everywhere to solve problems he/she cannot change the way of solving problem in the training of some days. Therefore, in this study students will be taught through productive thinking the whole academic year.

1.11.0 STATEMENT OF THE PROBLEM

Development and Implementation of an Integrated Strategy to Inculcate Productive Thinking among Elementary School Students.

1.12.0 OBJECTIVES

1. To develop an integrated strategy in the form of a model to inculcate productive thinking among elementary school students.
2. To implement the developed model to inculcate productive thinking among elementary school students.
3. To study the effectiveness of the developed model in terms of productive thinking of the students.
4. To study the effectiveness of developed model in terms of the reaction of students.

1.13.0 HYPOTHESIS

The following null hypothesis will be tested at 0.05 level of significance.

H$_0$1: There will be no significant difference between the mean scores of productive thinking of the experimental and the control groups.

1.14.0 EXPLANATION OF THE TERMS

Integrated strategy: Integrated strategy interweave the subject content with the skills to be developed**.** It is the strategy that involve the activities which contain opportunities for students to learn about the skills through the teaching of content.

1.15.0 OPERATIONAL DEFINITION OF THE TERMS

Productive thinking: Productive thinking will be the score obtained by the students in the productive thinking scale developed by the researcher by considering the components of productive thinking.

Effectiveness: Effectiveness of the learning strategy is considered in terms of the significance of difference between the post-test scores of the experimental and control groups where the two groups are matched.

Effectiveness in terms of reaction: Effectiveness of the integrated strategy shall be evaluated in terms of the reaction the students towards the developed model on a reaction scale developed by the investigator.

1.16.0 DELIMITATION OF THE STUDY

The present study is delimited to VIII standard (2019-2020) of two English medium CBSE schools of Vadodara city. It is also delimited to the teaching of science for the ease of the researcher.

1.17.0 RESEARCH DESIGN OF THE PRESENT STUDY

Research design is the blue print for any research which depends upon the objective of the research. As the present study is an experimental study where randomization is not possible to choose the sample, quasi-experimental design is followed in the present study. As discussed by Gribbons & Herman (1996) quasi-experimental design is employed when random assignments is not possible. Pretest-posttest non-equivalent group design is chosen for the present study. This design is used when experimental and control groups are assembled groups as intact classes (Best & Kahn, 2014). To avoid the threat of testing to

internal experimental validity, experimental and control groups are matched their pretest scores at the start of the experiment. The research design can be represented as follow.

$$O_1 \quad X \quad O_2$$

$$O_3 \quad C \quad O_4$$

Where, O_1 and O_3 are pretest,

O_2 and O_4 are posttest

X represents experiment group

C represents control group

The present study follows quasi-experimental pretest-posttest non-equivalent group design where at the start of the study both the intact groups were pretested and on the basis of pretest score groups are matched. Experimental group was taught science subject by the researcher with developed strategy for one academic session while control group was taught by traditional classroom method by their regular teachers. At the end of the study both the groups undergo productive thinking test as posttest. Analysis and result of the data is used to see the effectiveness of developed strategy on the development of productive thinking among students.

1.18.0 POPULATION OF THE STUDY

Population of the present study include all the students of class VIII studying in English medium schools affiliated to CBSE (Central Board of Secondary Education) in Gujarat state in the session 2019-2020. As per the CBSE annual report (2018-2019) there were total 471 schools in the Gujarat state affiliated to CBSE. So all the students studying in class VIII (2019-2020) in those schools comprise the population for the present study.

1.19.0 SAMPLE OF THE STUDY

As per the research design used in the present study, sample was selected using purposive sampling procedure. Two Kendriya Vidyalayas were selected from Vadodara city for the study. Permission was granted from Kendriya Vidyalaya, Regional Office, Gandhinagar for the experiment. As the permission granted, Kendriya Vidyalaya no. 4, ONGC, Makarpura was selected as experimental school and Kendriya Vidyalaya no. 3, Airforce Station, Makarpura was selected as control school. One section of standard VIII from each school

were selected as the class for the sample for the experimental and control group. Before starting the experiment, students of both the sample classes were made equivalent on the basis of their pretest score. Originally there were 45 students in experimental group and 59 students in control group. After matching, the equivalent group consist of 26 students each for experimental and control group and those 52 students constituted as the sample for the present study.

1.20.0 TOOLS FOR DATA COLLECTION

- Productive thinking scale: Productive thinking scale was developed to collect the data. This scale was used as pre-test to equate the groups and also as post-test to study the effectiveness of developed integrated strategy in the form of a model.
- Reaction scale: A Likert type five point rating scale was also developed to get the students' reaction towards strategy.

1.21.0 DEVELOPMENT OF INTEGRATED STRATEGY

In the present study to achieve the defined objectives, a strategy in the form of a model was developed. It was developed by keeping in mind the specified places of different thinking skill in productive thinking process. Therefore, a teaching model which can directs the teacher to separate the thinking process in a productive thinking process was needed. With this aim, a model of productive thinking (FIESI) is developed which provide opportunity to think specifically at different phases of this model. Then, suitable techniques directed towards specific thinking skill are selected and integrated with the FIESI model. The integrated strategy which was developed by using integration of thinking techniques with productive thinking model (FIESI) was used to teach science in an integrated manner where students learn productive thinking skills through science subject content. FIESI model can be represented by following figure 3:
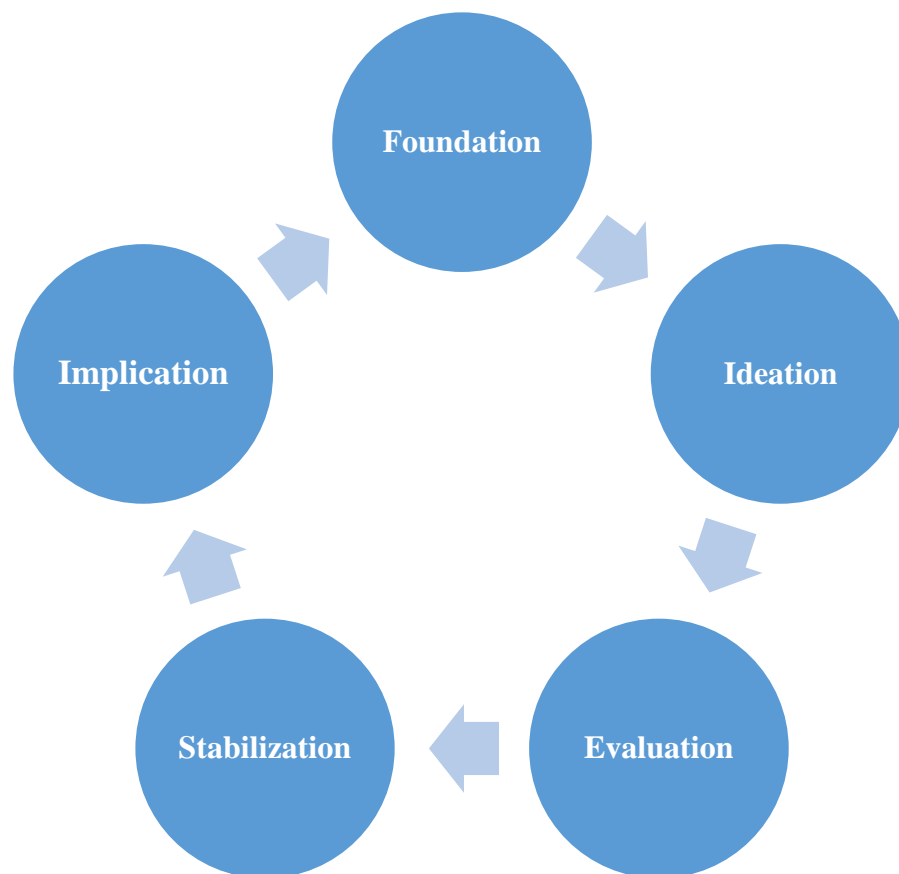
Figure 3: Productive thinking model (FIESI)

Different techniques used in FIESI model while teaching are as follow.

a) **Activity based learning**

Activity based learning is a technique to engage learners meaningfully in the cognitive task. This technique provides a platform for the students to explore the phenomenon by themselves. It involves engagement of all the senses that ensure learning. It provides opportunity for learning by doing and thereby students engaged meaningfully and enjoy learning process.

b) **Open ended questioning**

Open ended questions are helpful to break the cognitive equilibrium of the students and provoke them to think beyond the text given in the textbook. It creates space for discussion where students learn to accept ambiguity.

c) **ICT**

Information and Communication Technology (ICT) is known for addressing the diverse needs of the learners. It is also useful to connect classroom with the real life

setting. In the present study, it was used to motivate the students towards thinking differently and to ignite the spark of creativity in the students.

d) **Brainstorming**

It is a good technique to create a promising and creative idea for the problem. It can be conducted in the group as well as individually. In the brainstorming session a problem is put to work upon in front of the groups. A specific time is given to brainstorm within the group. When a long list of ideas is ready, leader invites the secretary to present the ideas before the class and then suggestions and critical evaluation are welcomed to improve the solution.

e) **SCAMPER**

It is the technique of generating divergent ideas and widely used as a creative thinking technique. SCAMPER is an acronym in which each letter represent different mode of generating idea like; Substitute, Combine, Adapt/Adjust, Modify, Put to another use, Eliminate, and Rearrange/Reuse.

f) **Concept map**

It is a good technique to summarize the concept as well as to retain the concept in mind for long time. It is because information in the concept maps are presented in some patterns and represent the relationship between the components in an effective way.

g) **Evaluation**

This is the convergent thinking or critical thinking component. Evaluation could be done by presenting the long list of ideas in front of panel to get critical judgment and suggestion to improve the ideas. The purpose of this technique is to select best promising idea out of a long list of ideas to solve the problem at hand.

1.22.0 IMPLEMENTATION OF INTEGRATED STRATEGY

In the present study, Standard VIII students of experimental group was taught by developed model by investigator for one academic year 2019-2020. Investigator selected topics that can be taught through developed model and accordingly lesson plans were developed for teaching. In the present study cognitive lesson plan for each chapter is prepared by investigator by using FIESI model of productive thinking. Investigator changed classroom seating arrangement for group activities. Investigator taught all the chapters of science subject and act as a subject teacher. So along with focusing on thinking skills students are also prepared for their regular school test and maintain their notebooks.

The syntax of FIESI model has five phases viz. Foundation, Ideation, Evaluation, Stabilization, and Implication. Therefore, teaching starts with creating knowledge foundation in the classroom. Investigator first created knowledge foundation for each chapter by using child centred techniques like activity, demonstration, discussion, use of technology, and many more that help students to create knowledge. Then a situation was put to be solved in front of the students and students had to think divergently in the groups. Here brainstorming and SCAMPER techniques were used. Then the list of ideas were evaluated and best promising ideas were selected that can solve the purpose. The selected idea was then implied to some real life situation to connect classroom learning with real life settings.

1.23.0 DATA COLLECTION

As the present study was experimental study following quasi-experimental pre-test post-test control group design, data were collected in two phases.

1. Administration of pretest

    At the start of the session 2019-2020, investigator established a rapport with the students. When students get comfortable in the new class productive thinking scale was administered as pretest over the experimental and control group students.

2. Administration of posttest

    After the completion of syllabus, the same productive thinking scale was administered as post-test on both the groups to study the effectiveness of developed strategy.

3. Administration of reaction scale

    A Likert type five point reaction scale was administered on experimental group at the end of the experimentation. Students have to tick the preferred rating against five ratings viz. strongly agree, agree, average, disagree and strongly disagree for each statement.

1.24.0 DATA ANALYSIS

Data analysis was done using quantitative statistical techniques. Posttest data of productive thinking scale was analyzed using mean, standard deviation, Mann-Whitney U test, and chi-square analysis and reaction scale was analyzed using percentage, frequency and intensity index.

1.25.0 FINDINGS

Following findings are derived from analysis and interpretation of the collected data.

1. The developed model was found effective in inculcating productive thinking among elementary school students.
2. The developed model in the form of model was found effective in terms of mean score of productive thinking in productive thinking scale. Students taught through developed model performed better on productive thinking scale as compared to students who were taught through traditional classroom teaching.
3. The developed model was found effective significantly in terms of thinking pattern of elementary school students as more number of students from experimental group responded towards productive thinking as compared to control group.
4. The developed model was found effective in terms of reaction of the students towards developed strategy. Students taught through developed integrated strategy showed their positively agreed response towards strategy, FIESI model and techniques used.

1.26.0 IMPLICATION OF PRESENT STUDY

The findings of present study revealed the effectiveness of developed integrated strategy in the form of a model in inculcating productive thinking among elementary school students. It is also found that productive thinking model (FIESI) is effective in inculcating creative thinking, critical thinking, and problem solving skills. It can be said that present developed model is effective in developing higher order thinking skills which is the need of the hour. The need of 21st century skills are emphasized by many educational documents. Present study opens the door for development of 21st century skills.

In the traditional classroom, students hardly get chance to think beyond textbook and they always think in a more acceptable way. It leads to rote learning that is associated with reproductive thinking only. But to train the students to think in a creative and productive way we need to change existing classroom situation. Productive thinking model (FIESI) is a teaching model that helps teacher to create motivating environment in the classroom where students are encouraged to think differently. It helps teachers to create creative situations to think upon. In present study, VIII standard students are taught science through the developed model. Similarly this model could be implemented to other levels of school education and through other subjects also. It is a mean to harness creative potential in students. It is the time to give equal emphasis on productive thinking skills along with the basic knowledge level and accordingly we need to reframe our educational objectives at all levels to prepare our

students for challenging future. National Educational Policy, 2020 also highlighted the importance of creative thinking and critical thinking in education. In future, the most demanding skill will be creative problem solving which is popularly known as productive thinking. So in order to prepare our students we need to introduce thinking components in classroom teaching. Teaching through FIESI model can solve the purpose and foster productive thinking through critical thinking, creative thinking, and problem solving skills in a sequence.

1.27.0 SUGGESTIONS FOR FUTURE STUDIES

The present study is delimited to teaching of science to VIII standard CBSE school students of Vadodara city. Investigator implemented the developed strategy in Kendriya Vidyalaya and found effective in inculcating productive thinking among VIII standard students. The similar study could be conducted in the following area in future.

1. The FIESI model could be implemented through other subjects also.
2. It could also be implemented at secondary, higher secondary and higher education levels of education.
3. The effectiveness of FIESI model could be studied in terms of achievement of the students.
4. It could also be studied in relation to variables like, learning style, thinking style, higher order thinking skills, and other cognitive abilities.
5. The similar study could be conducted by using different techniques in productive thinking model FIESI.
6. The present status of productive thinking level among students could also be studied.
7. The effectiveness of FIESI model could be studied in developing 21st century skills among students.

1.28.0 CONCLUSION

We are living in 21st century that demand some specific skills. Thinking skills are having its place in 21st century skills. To prepare our students for complex future we need to give stress upon skills like creative thinking, critical thinking, and problem solving. By combining these three cognitive skill we will have productive thinking. It can be said that productive thinking is a creative problem solving that use critical thinking and creative thinking in a sequence in order to arrive at the solution of the problem. These demanding competencies should be the

part of regular classroom teaching learning practices but somehow these skills are neglected in the classroom and stress on knowledge and memory only is well reported. It leads to rote learning and fixed set of responses from students. It ignores thinking power of our students. This is the typical pattern of traditional classroom environment. It could be changed to inculcate thinking skills among students through productive thinking. Present study is an attempt in this direction in which a model is developed to inculcate productive thinking among elementary school students. In the integrated strategy a teaching model is developed which is named as productive thinking model (FIESI). Science is the subject with the process skills that opens the door for productive thinking. Standard VIII students of experimental group are taught science through the developed model using different techniques for academic year 2019-20. It was found effective in inculcating productive thinking among students in terms of productive thinking score. It was also found effective in terms of reaction of experimental group students. The developed model allows students to make use of creative thinking and critical thinking simultaneously. Students are encouraged and motivated to think in a specific way in order to arrive at productive idea. The findings suggested that developed strategy is effective in developing creative thinking, critical thinking, and problem solving along with productive thinking. The present study has an implication in preparing our students for the demanding cognitive skills. The developed FIESI model could help the teachers to inculcate productive thinking and other higher order thinking skills through science as well as through other subjects also.

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