## Chapter 2

# **Review of Literature**

In conducting the research on the development of science curriculum emphasizing on Science, Technology, Society and Environment Approach to enhance thinking skills and senses of responsibilities toward environment and society, the researcher reviewed the relating literature to be mentioned as follows:

- 1. Curriculum and Curriculum Development
- 2. The Basic Education Core Curriculum B.E. 2008, Learning Area of Science
- 3. Science Technology Society and Environment Approach
- 4. Problem-solving thinking skill
- 5. The Sense of responsibility
- 6. KWL- Search approach
- 7. Related Researches

#### 2.1 Curriculum and Curriculum Development

Tyler (1950: 79) defined the meaning of curriculum stating that ""...a curriculum is everything that students need to study under the plan and management of schools in order to achieve the goals of education.

Crow (1980: 250) said that a curriculum was an experience mass students had both in and out of schools to ensure their physical, social, intellectual and mental developments.

Oliva (1992: 8-9) clarified the meaning of curriculum by categorizing a curriculum into 3 types; 1) the curriculum designed by purposes, 2) the curriculum developed on the contexts, and 3) the curriculum based on strategies.

Thamrong Buasree (1999: 2) considered that a curriculum was the way of learning because learning achievement comes from proper processes or directions.

Chet Sirisawat (2007: 15) added more definition about curriculum summarizing that a curriculum was a designed plan detailing goals, the outline of content, activities, and the mass of experiences.

Kanat Thatthong (2009: 6) also gave more definition of curriculum. He said that a curriculum was the mass of experiences, or various kinds of knowledge to be taught for students both in and out of school in forms of activities, projects or plans.

The information discussed above can be concluded that a curriculum is a mass of experiences students receive both in and out of schools to develop their physical, intellectual, and mental potentials. A curriculum was designed with selected contents and proper processes, and it can be seen as subjects, activities, projects, and plans to support students to achieve the desired objectives.

#### 2.1.1 Curriculum Components

Curriculum components are the internal parts in a complete curriculum consisting of knowledge management, learning evaluation, improvement and development plan of curriculum. There are many scholars who mentioned about curriculum components.

Tyler (1990: 78) said that curriculum components included objectives determination, content selection, learning management, and curriculum evaluation.

Taba (1962: 9 -10) pointed that curriculum components consisted of its aims, objectives, content arrangement, use of curriculum, and curriculum evaluation.

Phob Laohaphaibool (1996: 47-48) summarized that curriculum components consisted of 4 main parts: 1) aims of curriculum, 2) content, 3) use of curriculum, 4) curriculum evaluation.

Kanat Thatthong (2009: 9-10) said that curriculum components included content, the use of curriculum, and curriculum evaluation.

From the definitions given above, it could be concluded that curriculum components are the aims of curriculum which direct curriculum progression, determination of content, the use of curriculum, and curriculum evaluation.

2.1.2 Types of Curriculum Organization

There are many types of curriculum given by many scholars. Below are some examples given discussed by Thamrong Buasree (1999: 187-188):

1) Subject Matter Curriculum: In this curriculum, each subject is generally taught in an isolated way, and they are selected based on their importance and requirements for learning such as secondary school curriculum or higher education curriculum. 2) Correlated Curriculum: This is a curriculum where recognize and establish relationships among the various subject areas or fields, for example, to correlate the Geography of South East Asia with the histories of Thailand, Lao PDR, or Cambodia.

3) Broad Fields Curriculum: The broad fields design combines two or more related subjects into a single broad field of study, for example, the combination of learning of science with mathematics (Amnart Chanpan, 1989: 93).

4) Core Curriculum: This curriculum focuses on subjects or societies. The focused subjects are, for example, science, or mathematics. When focusing on societies, the focus will be on the responsibilities in reserving nature or environment, or social problems concerning to housing problems and environment. In this light, citizen's responsibilities or understanding of economic systems could be focused. (Thamrong Buasree, 1999: 94)

5) Experience Curriculum: The Experience Curriculum mainly emphasizes on learning through activities or experiences, learning by doing holding student centered principle. (Amnart Chanpan, 1989: 94).

6) Competency – Based Curriculum: This type of curriculum highlights the development of skills, abilities, attitudes, and values that would be beneficial to students' lives. This curriculum results from Progressivism.

7) Process Approach Curriculum: This curriculum can either focus on subjects or social problems. Learning by processes is the main feature of teaching and learning activities, problem solving, or researching processes for instance. The examples of the curriculum are science curriculum that requires observation, consideration, classification, and experiment.

8) Integrated Curriculum: This curriculum integrates contents from several subjects into one integrated whole content. The content is organized into groups for students to have continuous and valuable experiences for their lives.

Considering the curricular mentioned above, the designs of curriculum are different according to the aims and fundamental aspects.

The science curriculum that the researcher's created is the integration of contents of subjects in the same learning areas. Problem-solving skills, thinking skills, and scientific skills are emphasized in order to obtain experience mass both in and out of schools. Therefore, the science curriculum developed in this research is the mixture of many curricula, namely Subject Matter, Integrated, Competency – Based, and Process Approach Curricula. The curriculum aims to promote thinking and problem solving skills as well as the senses of responsibilities toward environment and society.

2.1.3 The characteristics of a preferable curriculum

From related literatures studied, the characteristics of preferable curriculum were discussed by many scholars as follows:

San Thambamrung (1997: 10), Thanaporn Loonla (2009: 6), Kanat Thatthong (2009: 20 -21) suggested a preferable curriculum;

1) be flexible,

2) work as a tool for achievement,

3) come from the participation of every concerning party,

4) have good implementation plans,

5) be implemented according to the aims of national education plan,

6) consider the philosophy of education, psychology, social and cultural aspects, science and technology,

7) be a broad curriculum

8) be consistent

9) promote the growth of knowledge, skills, attitudes, and

10) have an evaluation for curriculum improvement.

In conclusion, a preferable curriculum should be planned, flexible, and wide open with the emphasis on learners, social context, education philosophy, learners' natures, cultures, policies, and participation from all parties. Also, it should have the clear plan of learning management, curriculum evaluation to evaluate resources, as well as the changes of science, technologies, societies, and environment. All of these would meaningfully reflect the real life of humans.

### 2.2 The Basic Education Core Curriculum B.E. 2008, science.

The Ministry of Education (2008: 1-5) indicated that basic education commission had conducted research and studied problems in the Tenth National Economic and Social Development Plan (B.E. 2007-2011) in order to develop science curriculum based on the following information.

2.2.1 What is learned in science?

The learning area of science is aimed at enabling learners to learn this subject with emphasis on linking knowledge with processes, acquiring essential skills for investigation, building knowledge through investigative processes, seeking knowledge and solving various problems. Learners are allowed to participate in all stages of learning, with activities organized through diverse practical work suitable to their levels. The main content areas are prescribed as follows:

- 1) Living Things and Processes of Life
- 2) Life and the Environment
- 3) Substances and Properties of Substances
- 4) Forces and Motion
- 5) Energy
- 6) Change Process of the Earth
- 7) Astronomy and Space
- 8) Nature of Science and Technology

From these content areas, they share the same pattern and regulations, emphasizing that students will study science at all aspects. In this way, this would be beneficial for them both for their daily lives and for the virtues for societies.

#### 2.3 Science-Technology-Society and Environment Approach

Science and technology relationship can be seen in that technology can cause new possibilities while science promotes technological advances that support science. (Phob Laohaphaibool, 1996: 35-40)

2.3.1 The meaning of the concepts about science, technology and environment

The knowledge management for science, technologies, and environment means the integration of the concepts relating to science, technologies, and environment through various teaching activities such as working in small groups, discussion, problem solving activities, role play, making decision, criticism and argument with reasons (Aikenhead, 1988: 43; Erminia *et al.*, 2008: 941–960; Kim and Roth, 2008: 516–528; Yoruk *et al.*, 2009: 68- 84)

Aikenhead (1988: 8) said that the knowledge management for science, technologies, and environment not only considered the relationship among subjects but also enabled students to make the proper decision on problems about science, technologies, and environment.

Pedretti and Forbes (2000: 39-41) stated that the knowledge management for science, technologies, and environment was a process that bring about the understanding about science, technologies, and environment and integrate with each another. The main objective is to help students realize the importance of science development in daily life and to enhance daily life activities of people in the societies.

Nuttawit Potjanatunti (2001: 277-228) explained about the meaning of STS Approach (Science Technology Society) saying that it means the teaching and learning management that enables students to be knowledgeable in subjects, and skilful in doing work through processes. Students should also have creative ideas and positive thinking toward science. They might be able to make decision on their own. STS Approach emphasizes on the real problem relating to science and technology.

Yager and Akcay (2008: 2) concluded that STS Approach according the objectives of the National Science Teacher Association (NSTA) in 1990 was the learning and teaching for science that focuses on real problems about science and technology. This would enable learners to analyse and apply the knowledge and processes in real situation.

From the information mentioned above, it can be concluded that Science-Technology-Society and Environment Approach is the integration of knowledge about science technology society and environment in positive and negative ways. It is a study of theories, principles, reasons, content about science, technology. All of these will bring about the searching, examining, analyzing process for the problem actually occurring. With this, it would provide the proper solution for problems based on the sense of responsibilities for society and environment.

2.3.2 The formats of Science Technology Society and Environment Approach

Science-Technology-Society and Environment Approach Bryant (1995 cited in Phatcha Phermphiphat, 2006: 24) said that Science-Technology-Society and Environment Approach consists of 6 steps namely: 1) wonder, 2) plan the working procedure, 3) investigate problems, 4) Reflect, 5) Share experiences and 6) act out.

Carin (1997: 27-28) proposed the format of activities based on Science Technology Society and Environment Approach using STS problem-solving model. The format consists of 5 steps that are 1) Searching for problems, 2) Solving problems, 3) Creating ideas, 4) Sharing experiences, and acting out.

Natthawit Potjanatunti (2005: 163-168) provided the 7 steps of Science-Technology-Society and Environment Approach including questioning, planning, exploring, reflecting, sharing experiences, extending knowledge, and acting.

From the earlier formats, the researcher come up with the approach called STSE Problem-Solving Model consisting of 6 steps, e.g., Searching for Problems, Problem-solving, Reflecting, Creating, Sharing Experiences, and Acting out.

#### 2.4 Problem-solving thinking skill

Problem solving skills are the important tool for learning and acquiring many skills (National Council of Teachers of Mathematics, 2000: 182) Therefore, students should be enhanced to develop the abilities to solve problems, which is one of the crucial skills for them. Polya (1957: 221) agreed with this statement saying that problem solving is a human behaviour to achieve the goal we set before hand for our prosperity.

2.4.1 The Meaning of Problem- Solving Skills

Problem-solving thinking skill is an advanced skill that is defined by many scholars as mentioned below:

Thissana Khammanee (2001: 149) defined the meaning of problemsolving skill saying that the skill consists of the process of thinking and solving problems in many steps starting from identifying problems, analysing causes of problems, searching for problem solutions, selecting the best solutions, solving problems, collecting data, and evaluating data.

Suwit Moolkham (2004: 15) gave the definition on problem-solving skill saying that it is the abilities of the brain in managing the imbalance occurring in our life. In the process, we need to adjust ourselves to the environment.

Jonassen (1997: 65-66) is another person who proposed the steps for problem-solving skill. The steps proposed are studying and analysing problems, searching and examining problems through various sources, theories, approaches. All these steps need to be implemented with careful operation that would lead to the management of information in selecting data, making decision.

2.4.2 The management processes to develop thinking skills for problem solving

Suwit Moolkham (2004: 20) proposed the process to solve problems starting from determining problems, forming hypothesis about causes of problems, planning to solve problems, collecting data, analyzing data and proving the hypothesis, and conclude the result.

Praphan Susaorat (2008: 146-149) provided the 6 steps of problem solving namely recognizing problems, collecting data or searching for the causes of problems, determining problems, finding the approach to solve problems, making conclusion and select the proper approach and solving problems.

Considering the steps mentioned, it can be concluded that the development of problem solving skills rely on the systematic processes properly planned. Hence, the researcher created the steps to solve problems consisting of 6 steps: 1) determining problems, 2) identifying causes of problems, 3) planning to solve problems, 4) solving problems, 5) collecting and analyzing data, and 6) evaluating and concluding the results.

2.4.3 Evaluation of Problem-Solving Abilities

Wassana Prawalpreuk (1995: 48) said that problem solving skill was an important process to awake students to act out. The technique suggested was the challenging test to find solution by oneself with authentic performance measurement. The test would emphasize on students' abilities in 4 areas; 1) the ability to understand problems, 2) strategies and process to solve problems, 3) communication using reasons in solving problems, and 4) the ability to solve problems.

Thissana Khammanee and Sirichai Karnjanwasree (2001: 169-179) mentioned about 2 ways to assess the thinking ability as follows:

1) The psychometrics assessment through standardized test

2) The assessment through real performance that can be measured by considering real life performance. Carin (1997: 383) suggested the use of rubrics as the tool for authentic assessment.

2.1) Standardized tests are divided into 2 types; e.g. the multiple choice test for general thinking skill, and the test for specific thinking ability.

2.2) The development of the test to evaluate thinking skill test can be in these procedure; 1) determine the objectives of the test, 2) determine the framework and operational definitions and terminologies, 3) create the layout of test, 4) create the test, 5) try out the test and 6) use the test in real context.

Considering the information mentioned about the evaluation of thinking skill to solve problems, the researcher suggests that evaluation should consist of the determination of real problems, problem solving process based on tasks, evaluation through science projects, as well as the evaluation using rubric scale.

#### 2.5 The sense of responsibility

2.5.1 The meaning of senses of responsibility

Cattell (1963: 128) said that the characteristics of people with high responsibilities were considered through the responsibilities in their duties, their diligence, and dignities. People without responsibilities were the ones who avoid rules or do anything for their own sake.

Brown and Cohn (1968: 58) stated that responsibilities were the reliable and creative acts of endeavor. The ones with responsibilities would be confident to improve himself or herself to faithfully achieve the goal set on time.

Good (1973: 20) added that the senses of responsibilities is a moral principle to control one's behaviours and desires.

With the meaning of senses of responsibilities discussed so far, we can see that senses of responsibilities are the characteristics of the people who carry out their duties with their desire of achievement in mind, complete work on time, and work with willingness along with moral principles and ethics in order to finally create qualified work.

2.5.2 The Significance of Senses of Responsibility

The chaotic societies are the culmination of the lack of 5 desired qualifications in people. The desire qualifications are senses of responsibility, consistency, self confidence, faithfulness, and self reliance (Sanya Sanyawiwat, 1981: 55-57). As one on the list, senses of responsibilities is a factor to reduce problems in society. In addition, the 11<sup>th</sup> national economic and social development plan, in the strategy 1, highlights that students have to disciplined, responsible, reliable, confident,

and can live in the society happily (Ministry of Education, 2010: 15). If a person possesses senses of responsibilities, he or she would complete all work on time, be praised and supported in working based on ethics and social rules. The person would not cause social problems, take part in establishing the advancement and security in society.

In conclusion, the senses of responsibility are a crucial because they promote the achievement of people carrying out duties or works. People with senses of responsibility are the qualified and confident ones in working for society or for their own sake. Generally, they would have the role in securing and developing societies.

2.5.4 Measurement of the Senses of Responsibility

The Ministry of Education (2009: 45) indicated that the measurement of desired qualifications in class room could be carried on by 1) determining the behaviors to be measured, 2) analyzing the behaviors, 3) selecting and using proper tools , and 4) determining scoring rubrics to evaluate feelings ranking from minimum to maximum levels (Ministry of Education, 2009: 67). The levels are ranked from 1) realization, 2) responses, 3) perception of values and 4) organization of values.

The popular measurement for evaluation for senses of responsibility is performance observation. There would be various tools such as rating scales, checking lists, anecdotal note, and self evaluation report.

2.5.5 Characteristics and Behaviors Indicating Senses of Responsibility.

Phichit Boonsarn (2007: 33) explained types of behaviors to show senses of responsibility consisting of, for example, self responsibility, social responsibility, diligence, faithfulness, use of the fullest ability when working, determination in learning, love of learning, and the ability to complete all work effectively.

Suthep Benchawilaikul (2007: 24) added more information giving some characteristics that indicated senses of responsibility including people being punctual, careful, determined, enthusiastic, working hard with full energy, dedicative and attentive to work, open minded to constructive criticism, and active to improve or better themselves for work.

Noppadol Phawanawichien (1997: 70-71) proposed some characteristics of responsibility stating that, referring to 5 aspects, people would be responsible by considering that they:

- 1) realize the importance of their duties
- 2) carry on their duties willingly
- 3) carry on their work attentively
- 4) carry on their work continuously
- 5) accept the result of their acts

To sum up, senses of responsibilities are the qualifications to enable people to effectively work and achieve their goals of work. Also, having the senses of responsibilities, people would realize the importance of themselves, and be responsible for themselves and society. Based on these beliefs, the researcher designed measurement and evaluation in various forms based as real assessment, such as simulation of situations to make students reflect the ideas. The observation would be carried on using writing, and interviewing according to following 6 aspects, namely, 1) realize what is their duties, 2) work with willingness for the good of society and environment, 3)work attentively , 4) work continuously to achieve goals, 5) accept the results of their acts, and 6) operate to solve problems about society and environment.

#### 2.6 KWL-Search approach

KWL is a technique focusing on thinking skills where students consciously realize what they think and how their thinking skills work. They can monitor their thinking process and adjust or improve the way they think. Somsak Phuwiphadawan (2001: 75–77) said that KWL technique (Know-Want-Learned) was the learning process with the set objectives. Students would predict what to be learned and show their thoughts by writing. This would help students recognize, and analyze their knowledge systematically. It is the process of metacognition. There are 3 components as follows: 1) K is for "What you know". This session is to prepare the basic knowledge, 2) W is for "What you want to know". This session is to use questions to encourage students to think, and 3) L is for "What you have learned". In this session, students have to write the answer and ideas from what the research they do.

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#### **2.7 Related Researches**

#### 2.7.1 Domestic Researches

Phatcha Phemphiphat (2006) studied learning achievement and the use of science in the daily lives of Mathayom 2 students taught using Science, Technology, Society and Environment Approach. The objectives of the study were to 1) study learning achievement in food science subject, and 2) to study the ability to use knowledge relating to food science in daily life. The study tools included lesson plans focusing the topic of food with the issues of science, technology, and society. Learning achievement tests, and ability test about the use of science in daily life, and assessment forms to assess the knowledge of science to be used in daily life.

Somchit Sawathanaphaibool (2007) conducted the R&D research to study the development of science curriculum for students of grade level 4. The objectives of this study were to develop the science curriculum and to study the result of the curriculum used. The processes of curriculum development had 3 steps namely 1) studying background information to synthesize the principle of curriculum integration for curriculum development, 2) developing a science curriculum, and 3) using and improving the science curriculum.

2.7.2 International Researches

Aikenhead (1988) conducted the research dealing with science teaching and learning using Science, Technology, Society and Environment Approach. The objectives of this study were to develop the teaching and learning management employing STE- Approach, to provide 11 teaching techniques for science teachers. The techniques included open ended thinking issues, working in small groups, student centered activities, problem-solving activities, simulations, making decision activities, showing disagreement, arguments with reasons, course books, e-materials, local resources of knowledge.

Solomon (1993) used Science, Technology, and Society Approach to develop science and technology in order to support teaching and learning activities using STS. The researcher needed to prepare teachers, analyzed social situations relating to science, and technology, and to introduce the techniques used in STS such as use of games, simulations, role plays, small group discussion using issues of doing projects.

Rosario (2009) studied Science, Technology, Society and Environment Approach dealing with environmental science. The researcher used local cultures to teach students none-majoring in science. The objectives of the study were to promote learning achievement, environmental science self-efficacy, and support sociopolitical perspectives concerning science and environment in students. The study was an experimental research based on Solomon's Four Group Design to collect quantitative data. To collect qualitative data, the researcher employed observation and interview.

From all of the researches mentioned, the curriculum developments at different levels need to be systematically designed. Most of the curricula consist of 3 main processes; 1) studying for background information, 2) creating or developing the curriculum, and 3) evaluating and improving the curriculum. Regarding to teaching and learning that employ STSE approach, the curriculum emphasizes on learning by doing, learning through searching based on the decision making to enhance metacognition. There was the integration of knowledge and theories relating to science and technology aiming to be used in the real life situation both in and out of schools.

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