CHAPTER I

INTRODUCTION

1.1 Background

At present more than at any other periods on time axis human beings need to adopt themselves with the current world environment. Education is an important factor for the development of human beings. Today technology is an important factor for education. New practices and ways of learning have developed such as distance education. Technology offers a powerful learning tool that demands new skills and understandings of students, including multimedia literacy and provides new ways to engage students such as, through ‘classroom packing’. Technology is also being used in the instruction of students. The use of technologies such as programs and interactive capsules captures the attention of the students in the classroom environment. Technology is also being used in the assessment of students.

In the early period of Thai society, education management was controlled by the monarch and religion. Thai education was first reformed during the reign of King Rama V, Ministry of Education was created to supervise the development of education as a whole. The National Education Development Plan was set up to create equal opportunity in education and to improve and develop the quality of teaching and learning. Education in Thailand has developed from traditional education offered in the temple, the palace and the family between 1220 and 1868 to the foundation of formal education between 1868 and 1932.
The era of modernized education for national development began when Thailand became a constitutional monarchy in 1932. During the 1950s, the government became much more concerned with the development of education as a part of national reconstruction and modernization in the post-war period. Since the introduction of the first National Economic and Social Development Plan during 1961-1966, education has assumed a full functional role as an instrument for development in line with the National Scheme of Education and the National Education Development Plan.

The Constitution marked the beginning of the current development of Thailand’s national education in 1997. What prompted the change was the economic crisis in the region, which highlighted an urgent need to enhance people’s ability to keep up with the rapid changes associated with globalization in order to thrive in a very competitive global arena. At the same time, there was a need to ensure greater flexibility in service provision. A system, which would be more flexible in terms of curricula content, modes of delivery and educational management, was needed. (Ministry of Education, 2004)

The current for education is based on the Constitution and the National Education Act (1999), which provides the basic principles as well as challenging guidelines for the provision and development of the education system. The Constitution greatly increased the rights of Thai citizens to political participation ensuring the voice opinion on major topics. Thus, for the first time, Thai people, throughout the country, were invited to participate in discussion contributing to decision making on the national education direction. Subsequently, a National Education Plan was drawn up, concentrating on how to address poverty and find ways to improve the quality of life of Thai people by embracing issues of access, equity and quality in education. Education reform airs to prepare people to
pursue promising careers but also provides them with the ability to make rational judgments and choices, and to live in harmony with other members of society.

The new Constitution, promulgated contains several provisions relating directly to education, religion and culture and charging the State with responsibility for improving education in line with economic and social change. This means that the Government is committed to implementing, reviewing, and revising a continuous program of education reform in order to keep up with the pace of change. The Constitution also ensures the right of all Thai people to receive a quality, basic education for at least 12 years that the Basic Education covers 6 years of primary, 3 years of lower secondary and 3 years of upper secondary education.

In addition, the Tenth National Economic and Social Development Plan (2007-2011) emphasises the need to shift the focus of human development. It has become imperative for the Thai people to be endowed with desirable moral values, intelligence and sagacity. They should be able to enjoy full development in all respects—physical, intellectual, emotional and spiritual. They would thus be able to adjust themselves to unavoidable change, leading to a transformation to a firmly-founded knowledge-based society. The direction of such human capacity development would focus on providing children and youths with a firm foundation for attaining morality and public-mindedness, together with capacities, skills and basic knowledge essential to their future lives, leading to sustainability in national development (the National Economic and Social Development Board, 2007)\textsuperscript{D-10}. Such priorities are consistent with the policy of the Ministry of Education in guiding Thai children and youths towards the 21\textsuperscript{st} century. Emphases have been placed on morality, preference for Thai-ness, skills in analytical and creative thinking, technological know-how, capacity for
teamwork and ability to live in peace and harmony in the world community (Ministry of Education, 2008). 

Studies, monitoring and evaluation of application of the Basic Education Curriculum 2001, together with guiding principles of the Tenth National Economic and Social Development Plan for human capacity development, as well as priorities advocated by the Ministry of Education for youth development for the 21st century led to revision of this curriculum. Consequently, the Basic Education Core Curriculum 2008 was formulated for greater clarity and appropriateness. Improvement was made for presentation of objectives and process of implementing the curriculum at educational service area and school levels. Succinct vision, objectives, learners’ significant capacities and desirable characteristics, and learning standards and indicators have been presented, providing guidance for preparation of curriculum for teaching-learning activities at each educational level. Furthermore, the new curriculum has prescribed a structure of minimum time to be allotted to each subject area for each grade level. Schools are given opportunities to increase learning time allotment, depending on their readiness and priorities. Improvement has been made to the process of measuring and evaluating learners’ performance as well as criteria for graduation at each educational level. Adjustment has also been made for streamlining certification which correlates with learning standards, thus facilitating application of certifying documents.

The Basic Education Core Curriculum 2008 thus formulated will provide local communities and schools with a framework and orientation for preparing school curriculums. Teaching-learning activities organised for all Thai children and youths at basic education level are aimed at enhancing learners’ quality regarding essential knowledge and skills required for their lives in an ever-
changing society. They will thus be empowered to seek further knowledge for continuous lifelong self-development.

The learning standards and indicators prescribed in this document will enable agencies concerned at all levels to clearly visualise expected learning outcomes throughout the entire course of study. It will provide relevant local agencies and schools with confidence in their collaborative efforts to prepare school curriculums of higher quality and harmony. Learning measurement and evaluation will have greater clarity, thus eliminating the problem of inter-school transfer of learning outcomes. Therefore, curriculum development at all levels—from national to school levels—must exhibit the quality as prescribed in the learning standards and indicators. The core curriculum will provide a framework and direction for provision of education of all types, covering all target groups of learners receiving basic education.

The National Education Plan focuses on the integration of all aspects of the quality of life. It emphasizes human-centered development and an integrated and holistic scheme of education, religion, art and culture. In this regard, Thai people shall attain full development in terms of physical and spiritual health intellect, morality and intellect as well as desirable way of life that focuses on living in harmony with other people. The National Education Plan (2002-2016) represents major reform plans, bringing together the relevant prevision of the Constitution and the National Education Act. It is based on the policy aimed at transforming Thailand into a learning society leading to a knowledge-based economy with an equal access to lifelong learning and serving as a capital resource for income generation employment. The National Education Plan stipulates three objectives and eleven policy guidelines for implementation.
The first objective; of “all-round and balanced human development” will be attained through the policy guidelines;

1. Developing all people to have access to learning
2. Learning reform for the benefit of learners
3. Inculcating and strengthening morality, integrity, ethics, and desirable values and characteristics.

The second objective; of “Building a society of morality, wisdom and learning” will be attained through the policy guideline:

5. Developing a learning society to create knowledge cognition the good behaviour and integrity of the people.
6. Promotion of research and development to increase the knowledge and learning of Thai people and Thai society
7. Creation, application and dissemination of knowledge and learning

The third objective; of “Development of social environment” will be attained through the policy guidelines:

8. Promotion and creation of social and cultural capital limitation
9. Limitation, decrease and elimination of structural problems for social justice
10. Development of technologies of education, and
11. Systematization of resources and investment for education, religion, art and culture.
It is hoped that the National Education Plan will (i) lead to a knowledge-based economy and society, (ii) promote continuous learning, (iii) involve all segments of society in designing and decision-making concerning public activities. It is also expected that the National Education Plan will empower their people so that they will be enabled to adjust to world trends and events while maintaining their Thai identity as well as to develop desirable characteristic including virtue, competency, happiness and self-reliance.

In the present times, the learning process as indicated in the National Education Act will be based on the principle that all learners are capable of learning and self-development and are regarded as being most important. The teaching-learning process will aim at enabling learners to develop at their own pace and to maximize their potential. At Basic Education Level to reform the learning process in the best interest of learners, considerable efforts have been made as follows: 1) Teachers are encouraged to develop their own teaching materials. In so doing, activities, experiments and hand-on experience will be emphasized along with the needs of learners and the community. Moreover, the teacher’s role will be that of a facilitator who assists learners to learn by themselves. 2) Various training activities were specially organized to provide teachers with the knowledge relating to the learning of learners; classroom research; and development of teachers’ bodies of knowledge and teaching methods in eight groups of subjects. Instruction manuals have also been provided to teachers for self-development. For development for science which is both the subject of knowledge and skills for students such development focuses on the ability of producers and users of educational technologies in their production and effectiveness and on the ability of learners for using these technologies to enhance their knowledge their of science subject.
In Thailand, The Promotion of Teaching Science and Technology (IPST) has been the organization that is responsible for introducing various teaching and learning methods to Thai science teachers. The IPST has developed the science curriculum and learning materials for helping all science teachers. The objectives are to promote and support students to learn with scientific processes and through students centered learning. After The National Education Act of 1999 was announced, all schools have their tasks on the development of school curriculum that will ultimately improve student’s critical thinking, skill based competence and student’s capabilities. The IPST has developed the national science stand, which has been used as a stand for local school science. The school science curriculum is developed based on the science stand, which consists of 8 substances: 1) Living things and living processes, 2) Life and environment, 3) Matters and properties of the matters, 4) Forces and motion, 5) Energy, 6) Processes that shapes the earth, 7) Astronomy and space, and 8) Nature of science and technology. These are included in the science Substance 1.1.1 to 1.1.7.

Scientific knowledge is very important for students who learn because it connects them with ‘life of the society’. The knowledge of science helps construct new ideas and intelligence of a variety of nature. Thus, the effect of the modern technological ideas is an important factor on the part of ‘research’ related to science. In order to become eligible genuine students, they must have a quest/thirst of deep knowledge, understand conceptual science and organize knowledge in an orderly manner. Students will benefit from thinking about science and their learning will become interactive. In this way, science will become the culture of the knowledge based society and there will be scientific literacy for all.
The Basic Education Curriculum is in charge of prescribing the core curriculum for basic education while basic education institutions are responsible for prescribing curricular substance. The basic education curriculum has, therefore, been prepared at national level and at institutional level. The curriculum for basic education at national level has been formulated covering 12 years of basic education (grade 1-12), this curriculum is divided into 4 stages, and each stage comprises 3 years. For grade IX students are at the lower secondary education level. This level covers the last stage of compulsory education or basic education. It focuses on allowing learners to explore their aptitude and interest, promoting development of individual personality, skills for critical and creative thinking, problem-solving, life skills and skills required to apply technologies as learning tools, social responsibility, and proper balance in regard to knowledge, virtue and pride in Thai-ness, which together provide a foundation for future livelihood or further education. The students at grade IX who learn through English program will be designated as English medium students. All subjects can be taught in English, except subjects like Thai language and Social studies. The groups of knowledge and skill as specified of the National Education Act have been included in this curriculum. The classification in eight groups of subject for grade IX students include (i) Thai language (ii) Mathematics (iii) Science (iv) Social Studies (v) Religion and Culture(vi) Health Education and Physical Education (vii) Career and Technology-Related Education and (viii) Foreign Language. In addition, they are required to pursue interests in co-curricular and extra-curricular activities that related to scouting and advice for further study. (Ministry of Education, 2008)

Science plays an important role in our present and future world communities, as it concerns all of us in our daily lives and livelihoods. Science also involves technologies, instruments, devices and various
products at our disposal, which facilitate our life and work. All these benefit from our scientific knowledge, which is combined with creativity as well as other disciplines. Science enables us to develop our thinking skill in various respects-logical, creative, analytical and critical. It also enables us to acquire essential investigative skills for seeking knowledge, and allows the ability for systematic problem-solving, and for verifiable decision-making based on diverse data and evidences. Science is essential to modern world, which is intrinsically a knowledge society. All of us therefore need to be provided with scientific knowledge so as to acquire knowledge and understanding of nature and man-made technologies that can be applied through logical, creative and moral approaches.

At basic education level on reform of the admission system, students studying in grade III, VI, and IX have been obliged to take the national tests organized by the Office of the Basic Education Commission (OBEC) since the academic year 2001. The national test is an evaluation to conduct in order to assess learners’ quality at national level, based on the learning standards prescribed in the Basic Education Core Curriculum. Educational institutions are required to arrange for assessment of all students in Grades III, VI, IX and XII. The evaluation results will provide relevant data for comparing educational quality at different levels, which will be useful for planning in order to raise the quality of education provided. The data obtained will also support decision-making at national policy level. The data from evaluation at the various levels mentioned above will be useful to educational institutions for checking, reviewing and developing learners’ quality. It is incumbent upon the educational institutions to establish a system for providing necessary care and assistance, remedial measures, and encouragement and support in order to allow learners to develop themselves to their highest potentiality. The data obtained from the
evaluation therefore will provide essential information to the educational institutions for providing timely assistance to learners, who are thus allowed to enjoy full development and learning achievement. They are required to take the national tests in following subjects (table).

**Table 1.1 Subjects Required in National Tests. (OBEC from 2001)**

<table>
<thead>
<tr>
<th>Levels of Education</th>
<th>Subjects Required</th>
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<tbody>
<tr>
<td>Grade III</td>
<td>Mathematics and Thai language</td>
</tr>
<tr>
<td>Grade VI</td>
<td>Mathematics, Thai language, Science and English</td>
</tr>
<tr>
<td>Grade IX</td>
<td>Mathematics, Thai language, <strong>Science</strong>, English and Social Science</td>
</tr>
</tbody>
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The recent advances in the field of science and technology and the wide application of the achievement of science in industry, agriculture, medicine, transport and communication as well as their uses in domestic life justify, more than ever, the utilitarian values of science. Science has opened innumerable avenues for pursuing different vocations. A student of science can study engineering and technology, medicine, agriculture or any similar subject and make his career in that profession. In addition, scientific activities have given rise to many varieties of crafts and allied services. Science, therefore, gives opportunities for career-making and pursuing professions and vocations.

Grade IX students are at the lower secondary education level. This level covers the last stage of compulsory education. It focuses on allowing learners to explore their aptitude and interests, promoting development of individual
personality, skills for critical and creative thinking, problem-solving, life skills and skills required to apply technologies as learning tools, social responsibility, and proper balance in regard to knowledge, virtue and pride in Thai-ness, which together provide a foundation for future livelihood or further education. For the students at grade IX who learn in English program, English will be used as a medium to instruction. All subjects can be taught in English, except the subject like Thai Language and Social Studies which may be taught through the mother tongue.

For Science for grade IX, the topics of Biotechnology and Biodiversity are closely related to diversity of plant and animal. For grade IX course in Thailand, students are required to learn and understand progress and impact of biotechnology, diversity of plant and local animals, chromosome and genetic substance, process of genetics transfer, and application of biotechnology. Chirawat (2007) \textsuperscript{B-11} has attempted to study the science learning achievement resulted from the community resources for providing Biology learning activities on the topic of Biodiversity. The finding was that the students who were taught this topic had higher post-test scores than pre-test. And the other study abroad carried out by Saka and others (2006) \textsuperscript{C-47} is concerned with 175 Turkish students using drawings at different ages for the understanding of gene, DNA and chromosome concepts. Students from VIII, IX, XI grades and, science and biology student teachers were simply asked to draw the structure of gene, DNA and chromosome in a cell and also to give explanations about these three concepts. Differences in understanding between the age groups were found to be significant for the concepts of gene and DNA. None of the groups exhibit sound understanding and regardless of the age levels, students in all groups had alternative ideas about the three concepts investigated.
At the same times, the National Education Act B.E 2545 (1999) and amendments made in 2002 (Second National Education Act) at Chapter 9 Technologies for Education that; Section 65; Steps shall be taken for personnel development for both producers and users of technologies for education so that they shall have the knowledge, capabilities, and skills required for the production and utilization of appropriate, high-quality, and efficient technologies. Section 66; Learners shall have the right to develop their capabilities for utilization of technologies for education as soon as feasible so that they shall have sufficient knowledge and skills in using these technologies for acquiring knowledge themselves on a continual lifelong basis. Section 67; The State shall promote research and development; production and refinement of technologies for education; as well as following-up, checking, and evaluating their use to ensure cost-effective and appropriate application to the learning process of the Thai people.

The criteria and procedures for distribution of the Fund for the production, research and development of technologies for education shall be as prescribed in the ministerial. Section 69; The State shall establish a central unit responsible for proposing policies, plans, promotion and coordination of research, development and utilization of technologies for education, including matters relating to evaluation of the quality and effectiveness of the production and application of the technologies for education.

Utilization of technologies for education is crucial in proving the quality of teaching and learning. Technologies for education may be classified in terms of broadcasting media, printing media and non-traditional technologies including products and services that provide information using computer or the internet. The National Education Act of 1999 has paved the way for major action to be taken so as to promote the utilization of technologies for development of learning
and teaching and instructional materials and other technologies for education and development of educational personnel and learners. The development of knowledge, capabilities, and skills is essentially required for personnel and learners. Such development focuses on the ability of producers and user of technologies for education in the production and utilization of technologies that are appropriate, of high-quality, and efficient and suitable to the ability of learners using these technologies to acquire knowledge on a continual lifelong basis.

Technology in the field of education is almost necessary for teaching as well as for learning. Then, technology in instruction has been a point of debate for its effectiveness for several decades. However, there is considerable improvement in the technology for more and more application into instruction. First generation computer assisted instruction systems were developed in the late 1950s when computer technology was viewed as a vehicle for implementing the ultimate in programmed instruction. (Baker; 1978) C-3

1.2 Characteristics of Self-Instructional material

As a teacher, trainer, line manager, as a learner who used self-instructional material in open, distance or flexible learning contexts. In primary school it may have involved the teacher giving children a work-card in game. In secondary school the teacher may have provided directions to conduct an experiment, data to solve a problem or guidelines to undertake project work. In further education, teacher may have prepared materials to simulate fault diagnosis teaching. At its- simple teacher may have given leaner a technical report, blueprint circuit diagram or extract to study together with a series of
questions to answer. Self-instructional material is that there is no need to wait until there are enough learners to form a viable group. Indeed, it is possible with a single group to have several program of study being followed. These learners requiring additional or remedial help can have it provided at the same times as those who want additional practice or who wish to pursue their own special interests in an area.

Each individual can work at his or her own pace rather than at the pace of the group- or rather pace the teacher believes is the optimum that students do not study at regular speed. Depending on their interests, background, personal experience and other demands, students will complete their study of some material quickly; at other times it will take them longer. Self-instructional learning is private learning. Certainly, there is no “loss of face” possible because there is no one else around to witness your confusion. However, it does put great emphasis on the need for clear teaching, with every opportunity for learners to monitor their progress, check their learning and resolve their problems.

One of the main attractions of self-instructional material is that it is available at any time- when a learner wishes to study rather than according to some fixed timetable. Students not only study at different speeds, they also prefer to study at time convenient to themselves. The assumption that learners will study according to a regular, fixed schedule is myth. The belief that regular broadcast transmissions or tutorials would “pace” a student have been replaced by the realization the only assignment deadlines are likely to prompt study to a timetable. Indeed, we now realize that between such assignment deadline study is likely to be irregular for the majority of students. Students pace themselves according to their own schedule and completing demands.
A distinctive feature of self-instructional material is that it is available at any place; in students’ homes, when travelling, at the workplace or on holiday. The only limitation would be where some audio, video, practical work or computer-based materials are needed. However, at the present time and for the immediate future the majority of self-instruction material are likely to be based on printed and are thus portable, cheap and flexible. What is more, audio, video and other components are typically flagged in the text, allowing learners to arrange their study so that any necessary equipment or facilities are available when required.

Learners deserve the best teaching materials that teacher can provide; materials that are not adversely affected by the particular preference or idiosyncrasies. A feature of self-instructional material is that it enables all learners to receive the same teaching material. Furthermore, since the materials are available for scrutiny by others it is likely to be central- rather that the personal views of the author. In large institutions it is not unusual for a group of following the same syllabus or scheme of work. However, often an independent observer would be excused if they judged that two completely different courses were being taught. Indeed, even when one person is responsible for the teaching, and conducts duplicate classes, the difference between the presentations is likely to be significant.

A dozen subject matter specialists, independently to design a particular package to satisfy an agreed aim and series of objectives to get a dozen different ways of doing it. Some would take longer than others to study; some would stress one element rather than others. The structure of the packages and sequence of elements would undoubtedly vary. Of course, in reality many teachers are only required to provide the briefest of outlines for a particular program of study. It is often merely a list of topics or lecture titles supplemented by two or three
sentences. What is more, a detailed description or overview of the course, let alone individual modules or study session, is typically provided in a paragraph in course publicity material. A distinctive feature of self-instruction material in course publicity material, and sequence is made explicitly. Preliminary document, often an introduction and guide, provides the general structure of the course, while preliminary page in each module indicates the structure and sequence of the teaching material—alternative ways through it. If the material is assembled by two or more authors, or they have the advice and assistance of other, they can devise a teaching strategy that reflects a consensus of the most effectiveness way to teach the topic.

In further education, the teacher is still widely held as an obvious method or conveying information. The problem is that the teacher does all the work—all the telling. The learners are reduced to the role of one who must merely comprehend, interpret and remember, often little opportunity is provided to ask questions, resolve misunderstandings or clarify idea. Unfortunately, many learners still appear to believe that this method has merit until given the opportunity to experience an alternative way of studying. A distinctive feature of self-instructional material is that individual learns by using ideas presented in the teaching material rather than merely being told about them. The provision of exercises, activities or self-assessment questions is the mechanism by which the key objectives associated with a teaching text are realized and students allowed practicing them. It is sobering to learn that when two modules of a course were compared by students, one containing activities and one in which none were present the majority of student said the absence of activities hindered their learning.

Knowledge of one’s performance, the appropriateness of one’s response to questions; confirmation of ideas and relationships or their refutations are at the
core of learning. All teachers would seek to provide feedback to students on their learning. Unfortunately, many lectures, seminars and even workplace forms of teaching fail to provide adequate feedback. A distinctive feature of self-instructional material is that learners receive continuous feedback to help them monitor their learning check on their performance as they progress through the teaching package.

Traditionally, the feedback is provided in periodic comments to learners in response to tests, quizzes or assignments. A critical factor is not merely the quality of the original questions and corresponding feedback, but the speed with which it is provided. If a considerable amount of time elapses between posing the problems, encouraging a response and providing feedback, its effectiveness is in doubt. Learner’s misunderstandings may have been reinforced or unnecessary confusion allowed to continue. Self-instructional material is designed to provide the feedback continuously-essentially via the self-assessment questions or activities integrated into the text, the CD-ROM or web pages, but also by the quality of the exposition. In many situations the feedback provided by teachers is designed to indicate the scope and depth of preferred responses; to indicate the quality expected of learners at a particular stage. (Fourie, 1999)

The main advantages of self-instructional materials are discussed. Self-instructional material motivates learners by enabling to improve intelligence, special abilities and calends, creativity, motivational and volitional orientation, personal styles and strategies, interests, values, attitudes, and all of human personality. Self-instructional material encourages the building of a suitable structure of human abilities; based on inter-correlations among many cognitive measurements. Analytical intelligence of reasoning, crystallized intelligence as in verbal and reading comprehension, visual and auditory perception, idea production, memory, and speed and time required for reaction are the various
abilities of learning performance which are intensively and extensively depend on the instructional design decisions and strategies. Self-instruction material moderates the correlation between general intelligence measures and achievement. Self-instructional material promotes ability development. Identifying cognitive component processes meta-cognitive skills. Meta-cognitive skills and strategies knowledge structures and performance sequence is attained through the self-instruction materials and strategies computerized instruction improves assessment measures of constituent processing abilities. It supports training ability improvements. Learning and problem-solving is possible under instruction conditions through the constituent processes, skill and strategies. Learners and thus motivated to improve on their own by the new educational technology like the self-instructional programs and this further leads to the promotion of the potentials of human development in respect of intelligence, knowledge content, skills and abilities and value-oriented behavior.

Students are enabled by the self-instructional materials to acquire knowledge independently on their own any place and at any time. Self-reliance in learning is the most desirable because what a learner learns on own is an effort of concentration. It is the “do-it-yourself” technique which opens up all the faculties of the learner with a keep desire to learn strong motivation and unwavering concentration for learning the contents and acquiring the skills through the maximum utilization of the energies and abilities. This program of self-instructional material arouses the learner’s curiosity involves the learner in interaction. Adjusting the pace of learning is essential as the learner masters the contents of the learning are according to own pace which is sometimes very slow and at times very fast. The understanding of the contents in vitally significant and therefore the variations in the pace of learning are required to absorbs the bits and chunks of the contents of the program of learning through self-
instruction. Self-instructional programs are characterized by the fact that these enable the learners to defy the constraints of time and space. Learners are in a position or to more forward, to remain in the same position or to move backward in accordance with the requirements of the attainment of proficiency in learning content and skills. Repeating the process as many times as necessary is also possible. There no restriction of time as movement and turns are totally dependent on the learners’ convenience. Self-instructional material thus enables learners to learn independently. Self-instructional materials and programs are helpful in acquiring knowledge independently through the strategy of self-help.

Self-instructional designs are quite relevant to cognitive as well as affective aptitudes in addition to the cognitive aptitudes. Cognitive aptitudes include motivational and volitional orientations as well as aspects of personal styles as action tendencies. Affective aptitudes refer to the vast domain of personality, temperament, attitudes, and values. Achievement motivation, intrinsic as well as extrinsic achievement, and development of interests are the results of self-instructional designs. Self-efficacy, self-concept, self-regulation, action control, effort investment and achievement through independence are the products of the self-instructional designs. These self-instructional programs illuminate the functioning of the primaries and individuality in learning is noticed in both structure and idiosyncrasy. Adapting to the self-instructional designs and evaluate these designs. Adaption has the two levels of macro adaption and of micro adaption which are major and minor adjustments of instructional procedure. Self-instruction materials are thus helpful in person situation interaction. That is the reason because of which the self-instructional programs are considered a valuable and on teaching and learning strategies.

Self-instructional material is used in various ways such as a work-card, directions, data or guidelines or in modern times a computer-assisted program.
Self-instructional learning is private learning that gives every opportunity for learners to monitor their progress, check their learning and resolve their problem. The two alterations of self-instructional material are that it is available at any time and at any place. The best teaching materials are used as input in the design of a package of self-instructional program. The teaching strategy is devised in such a manner that it reflects the most effectiveness way to teach the topic for which the self-instructional program is designed. The teacher doing all the telling conveying all the information is the situation in traditional set up which is avoided. The learners are not rendered to become passive listeners. The learners are not given any opportunity to ask questions, resolve doubts or misunderstandings or clarify ideas. The self-instructional program gives the individual an opportunity to use the ideas presented on his own independently according to his own convenience at his own pace at any time and at any place. Exercises, activities, self-assessment question and other devices in the self-instructional design mechanism by with the objectives of teaching are realized. The use of self-instructional programs gives the learner the knowledge of performance, confirmation of ideas and continuous feedback. This helps the learners to monitor their learning, check on their performance as they progress through the teaching package. Self-instructional materials and programs enable the learners to pursue their own studies thereby improving the quality of instructional material used, using the innovative educational technology and a format of systematic and effective tool of instruction to the learners. The learner is more actively engaged in learning and the teacher is more energetically involved in designing the self-instructional program. The learner learns on own and the teacher plays the role of a facilitator in the process of learning. Self-instructional design model is a simplified representation of reality of a theory. These models develop specific aspects of instruction and teaching. Cost-effectiveness, compression of time, easy to handle system and provision of
reinforcement and continuous feedback are the chief characteristics of the self-instructional material or design model which is in the format of a computer-assisted program. Availability at any time and at any place, flexibility in the pace, the privacy of learning according to the learner-friendly scenario is the other characteristics of self-instructional design model. It is flexible, extendable, handy, compact and convenient which highlight the effectiveness of the self-instructional design model. Preciseness of planned, organized and ordered sequences of instructional activities is effectively controlled in the practical effectiveness of self-instructional design models of computer-assisted programs. It is a constructive representative instructional system and therefore it is an effective organization model of systematic instruction being used most frequently in innovative educational programs.

1.3 Self-Instructional computer-assisted program (SICAP) and its importance

Technological growth in our present era of globalization has spurred social and economic changes worldwide. The computer in particular, can be made to help the curricular need of children by acting as a tutor, as a tool and perhaps as a facilitator. The first application of computer in education came up with computer as tutor. In this mode, the computer program offers a learning experience to the child in one of the varieties of possible modes. It could be a drill and practice program, a simulation game or a statement of facts. In the tool model, a child is supposed to use the computer as a tool to create patterns, documents or anything that is possible with the computer system of the day.
Computer assisted programs are interactive and can illustrate a concept through attractive animation, sound, and demonstration. They allow students to progress at their own pace and to work individually or for problem solving in a group. It also can provide innovative and interactive ways of presenting material and therefore should be used as an adjunct to conventional teaching or as a means of “Self-Instruction” (Harold R.; 2003)

Self - Instructional computer – assisted program (SICAP) is an instructional media . Computer can be used for presentation in place of the instructor and the learners can study by themselves. It can be used to present through multimedia format to help the presentation of the content. Self - Instructional computer – assisted program (SICAP) is a technique that is more interesting because it shows the whole picture, sound and provides relationship between the lesson and the learner. It can create knowledge and can ensure positive attitude for learners who study by a self-instructional method of teaching and learning situation.

Self-instructional Computer-assisted program (SICAP) holds great potential for individual as well as group learning if properly developed in accordance with the needs of the learners. By such computer program one can learn at his own pace with immediate personalized feedback and knowledge of progress. The teachers design Self-instructional computer-assisted program (SICAP) based on the need of their students. It can be used effectively for teaching and providing information to the learners. Therefore, more such attempts should be undertaken for some other important subjects and topics as per the needs of the learners. The study has also implications for teachers and students for better planning of the teaching learning process.
The effectiveness of computer-assisted instruction has been growing recently. The effectiveness of computer-assisted program as compared to traditional instruction has been investigated for decades. Various studies have been conducted at different educational levels and in various areas of instruction. Numerous studies have investigated the effectiveness of computer-assisted instruction among different samples (Chang; 2002, Hacker and Suva; 1998, Hollingsworth and Hoover; 1991, Wong; 2001). Both methods have unique features but either one may be used to provide instruction for any particular learning experience. This raises the question of which is the more effective method for a better learning experience. One way to answer this question would be to compare the two methods by measuring the respective gains in learning. Hence, there have been numerous studies of the effectiveness of computerized instruction programs (Yaakub; 1998).

Self-Instructional Computer-assisted programs (SICAP) play an important role in teaching and learning of science concepts. They provide students and teachers with existing tools such as computer to conduct inquiry and to understand science that enables to acquire information through using computers in science, especially for learning scientific concepts of secondary education. The teaching tools prepared by institutions specializing in such applications could also be used in virtual media. By using such teaching tools, students could learn the subject matter in a better way, as they are provided with a variety of knowledge. As a result, they are expected to find out if the application of computer-assisted programs affects the students’ achievement.

In the field of science education there have developed many computer-assisted programs at the level of the secondary schools. For example, (Demircioglu H. and Geban, 1996) compared CAI with the traditional teaching method on grade VI students in science classes. The students of the
The experimental group were taught with CAI in addition to the traditional teaching method. The students of the control group were taught through problem solving. The topics were static electricity, electrical transmission, electrical wires and Ohm’s laws. The science achievement rates of the two groups were compared through a t-test and the group that was taught through CAI was found to be more successful. In a similar study, (Chun-Yen Chang, 2000) compared CAI with the traditional teaching method on grades X learning of earth science in Taiwan. Experimental group students learned earth science concepts through the CAI, whereas comparison group students were taught by a traditional approach. The results include students in the experimental group had higher achievement scores than had done students in the comparison group.

Structure of Self-instructional computer assisted program (SICAP) for teaching and learning of cognitive skills the four component instructional design model is used. In the beginning of the 1980s, Gange’s and Briggs (1979) distinguished different categories and subcategories of goals and stated that special instructional conditions are required with correspond with the conditions of learning specified for the category innovated. To meet the increasing need for instructional guidelines for the training of cognitive skills the four component instructional design model has been developed. This model is rooted in recent cognitive psychological theories. These include learning by doing in contrast with the conventional learning by being told, information processing through declarative knowledge, and controlled and automated processing. These make use of roll automation for recurrent skills and schema acquisition for non-recurrent skills, information presentation through restricted encoding and analogy as the process for knowledge-based transfer. The self-instructional computer assisted program (SICAP) design that should be employed to produce effective training program for cognitive skills. The first set is of principled skill
decomposition. Task hierarchies are built to decompose the cognitive skill in the constituent skill. These skills are classified into either recurrent skills or non-recurrent skills. The second set is of the analysis of constituent skills and related knowledge. The third set is of the selection of instructional methods. The fourth set is of the compositing of the training strategy.

The resources of self-instructional computer assisted program (SICAP) are related to the contents of the topics to be learnt by the learners. The contents of the program are presented in the core curriculum designed for grade IX learners. The contents of the units to be learnt by the learners on their own through self-instructional computer-assisted program. The resources of the SICAP are duly presented in the format which has introduction, content presentation, and technique and evaluation process. The two pillars in which SICAP rests are the content units and the method of presentation and technique. Both of these are appropriately, precisely and relevantly used in the present SICAP. The resources of SICAP are thus dependent on the inputs from the different strategies of instructional model of systematic design.

It is imperative to find out the purpose for which self-instructional computer assisted program (SICAP) is to be used. SICAP is an instructional design model in which a set of instructions is compiled in order to achieve an instructional goal. It puts its focus on converting a goal statement into nine set instructions that is effectively applied for full implementation. The first task in SICAP is to determine what is the learners must be able to do when they have completed the instructional procedure. The instructional goal may be derived from a needs assessment, from practical experience with learning difficulties, from a job analysis and from the requirement for new instructional strategy, the present SICAP has determined the understanding of higher level concepts in the topics of Biotechnology and Biodiversity as its instructional goal. The next step
is that of identification of the steps required to perform the goal. A skills analysis is necessary to identify the skills that must be learned in support of the major steps. This analysis identifies all the skills required for learning the instructional goal and shows the relationship among the skills. In the present SICAP, the first few frames have determined both the instructional goal and have identified the skills required for achieving the same. Before beginning the instruction, it is necessary to identify the entry behaviour and characteristics of the learners. The specific skills already mastered by the learners and their specific characteristics as learner are important to determined the design of instructional activities. In the present context, the entry behaviour of the learners is determined by conducting a pre-test for learners which is presented in the three frames from frame eight to frame ten. Based on the instructional analysis and the statements of entry behaviour, specific descriptions of what learners will be able to do at the end of the instruction are written. These statements of objective include the behaviour to be learned, the conditions under which they will be performed and the criteria that must be met. In the present SICAP the statement of objectives is duly made. It is essential to develop criterion based assessments which in the present program is noticed in the last nine frames of assessments. The first five steps related to instructional goal, instructional analysis, entry behaviour, performance objective and context bound assessment program for the step of the development of the instructional strategy. The strategy includes sections on pre-instructional activities, presentation of information. The strategy is based on the content to be taught and on the interactive instruction. The next step is the development of instructional materials depending on the availability of relevant materials and the resources to support development activities. After the completion of a draft of the instruction, it is necessary to design and conduct the formative evaluation. It is necessary to attempt a re-examination of the validity of the instructional analysis and to incorporate changes to make it a more effective instructional tool.
The summative evaluation will find out the effectiveness of instruction. The present SICAP has been developed using all these steps to produce a tool of effective instruction. This shows how the SICAP satisfies the criteria of an effective instructional strategy in the present context of educational technology.

1.4 The current scene

In the present educational system, various types and methods of learning are offered to learners regardless of their economic social and cultural backgrounds. Access to all types and levels of education as well as the transfer of learning outcome and validation of experience have made lifelong learning possible for all Thai people and thus help transform Thailand into a learning society. The Curriculum for Basic Education has been formulated. Covering 12 years of basic education (Grades 1-12); this curriculum is divided into four stages. Each stage comprises 3 years.

Most importantly, Science as a classified subject in the group of subject of knowledge and skills as specified by the National Education Act has been included in this curriculum. It is necessary to improve teaching and learning processes for Thai people to develop scientific skills and attitudes. Soitlum (2001) C-50 states that Thailand does not value science education and relies mainly on the memorization of material from text-books rather than requiring students to develop their own ideas. As a result, students have found the study of science boring. The teaching and learning of science in Thai school should be improved in terms of content, knowledge and scientific processes.

Furthermore, science knowledge is the source of a great deal of technological development, and vice versa. Technology plays a great role in the
continual search for more knowledge. **It is possible to acquire information through using computer in science for grade IX students from secondary school that are English medium schools. Computers can support the improvement of students’ achievement.**

Self-instructional computer assisted program (SICAP) is developed in the present study for instructing the grade IX learners in the higher level concepts of the topics of Biotechnology and Biodiversity which are included in the Core Curriculum of secondary school in Thailand. The relevant information in the units on Biotechnology and Biodiversity are presented through the computer program. The information is appropriately and precisely decomposed and then presented. Biotechnology and Biodiversity are defined as technology based on biology. Most of the frames contain illustrative material with visual graphic presentation as diagrams, pictures, and others. The gradual dissemination of information is deliberately made as a part of the instructional strategy. The present SICAP makes the learner learn on their own. This is part of the do-it-yourself strategy. The do-it-yourself strategy is learn-it-yourself process. The learner can get acquainted with the instructional material as many times as he desires. The possibility of revising the understanding of the information through a number of resists to the frame reinforces the instructional material. It is process of read it for yourself, see it for yourself and then understand it for yourself. Constant revision continuous instruction and never-ending practice enable the learner to know the vital significance of the concepts of science. The learner is assisted in learning on their own. The importance of SICAP for the grade IX learners lies in the fact that it is an instructional tool that enables learners to learn on their own. It is indeed a tool of instructing oneself on one’s own at one’s own pace with the facility of self-instruction without the limitations of time and place.
Each learner has the capacity to learn. Teaching by telling by stuffing information does not help a learner as the learner in this process remains a passive listener practical and actual involvement in the process of learning makes the learner actively motivated and the process of self-instructional makes him curious to know strong motivation, unwavering concentration, awakened curiosity and interactive involvement make the learners of grade IX to grasp the concepts related to Biotechnology and Biodiversity. The internal psychological process act like the blooming of a flower and the learner’s mind is filled with the grains of knowledge through the self-instructional strategy. The use of computer technology is quite relevant for the grade IX learners. The self-instructional computer assisted program plays its role in making the learner search on own. This search for knowledge by the learner on his own leads him to the path of self-discovery of knowledge and the navigator is the learner himself. The teacher as the facilitator designs the self-instructional material and enables the learner to swim through the bits of information to make a catch. The learner is enabled to become on achiever in the self-instructional strategy of computer assisted programs. SICAP is thus significant for improvement for achievement and for understanding concepts.

1.5 Rationale for the study

In education, and much of higher education, the teaching through felling by the teacher is still widely held as an obvious method of conveying information. The problem is that the teacher does all the work—all the telling. The learner is reduced to the role of one who must merely comprehend, interpret and remember; often little opportunity is provided to ask question, resolve misunderstanding or clarify ideas. Unfortunately, many learners still appear to
believe that this method has merit until they are given the opportunity to experience a different method of studying.

In traditional method of teaching the teacher teaches through lecture method. The teacher makes use of a blackboard and chalk to support his teaching. No additional material is provided to the students. This method is also known as chalk and talk method of teaching. In it the teacher plays the important role of giving lecture and explaining and students play less active role. The traditional method in teaching science consists of three steps. The first step is discussion in which the students discuss about learning objectives, issues or the problems. The second step is experimentation in which the students carry out the experiments as explained in the practical handbook. The third step is conclusion in which the students discuss the results and give answers to the provided question and express their deep understanding of science through various passages.

Self-instructional method is a teaching strategy which allows a student to pursue a learning objective through a prepared, self-contained sequence of instructional activities at his own pace. It provides the student with alternative learning objective sequences of instructional activities from which he selects a path in which he is most comfortable. Hence, self- instructional computer-assisted program (SICAP) is that in which the individual learners learn by using ideas presented in the teaching authored programs of computer. The provision of exercises, activities or self-assessment questions is the authoring in the programs through which the key objectives associated with a teaching text are realized and students are allowed to get more practice in the area concerned. The subject matter is revealed to the student in a self-instructional approach which the computer-assisted program guides to learn.
Duchastel and Whitehead (1980)\textsuperscript{A-9} It is sobering to learn that when two modules of a course were compared by students, one containing activities and one in which none were present, the majority of students said the absence of activities hindered the learning. Its advantages to the teachers are that teachers are in a position to give more time to work with individual students for assisting them on a one-by-one or small group basis and concentration motivating the learners. It also to supplement lesson or to provide remedial work and can use this tool to create more flexible school schedules. In addition to this, the student passes an evaluation satisfactorily. The students may advance to higher level concepts in a shorter span of time.

In case of students of who learn through self-instructional method by computer-assisted program, these students can move as slowly as they like through a program. If the students want to repeat some task material again, the students can do so as many times as the students choose. The student also can skip over a topic if information is already known, making the learning process more effective with self-instruction using computer-assisted program. The students can decide what they want to learn and in what order. The students have different learning styles and use different learning strategies.

The studies by (Ford and Chen, 2001)\textsuperscript{C-18} has shown that when the students can learn in a way that suits them, improvements in the effectiveness of the learning process normally ensue. Others (Meskill and Mosop 1997)\textsuperscript{C-35} report that computer programs encourage learning as they provide a stimulating environment and promote enthusiasm. Computers may help the reticent student who is afraid to make mistakes in a classroom situation through the self-Instructional method.
Application of Self-instructional computer assisted program (SICAP) that people in different times and under different cultures have developed different patterns of learning and teaching. In the 1970s and 1980s, it was accepted that specific prerequisites of learners and specific requirement of the competencies that should evolve require specific instructional settings with the help of the systematization of instructional planning and decisions, it has become possible and meaningful to develop routines for a computer program. Interactive learning is an essential characteristic of the planned system of self-instructional computer assisted program (SICAP). Besides this action-oriented concept, that program development is guided by the assurance that people have different styles of learning and operating. The computer assisted instructional program follows the activity method, exploration and field experience approach, individualized learning and personalized programmed instruction. The programmed help in the context of the selection of instructional models has to deal with the aspects like the average pre-knowledge of the learners, their experience with different forms of instruction, the capability for self-directed learning, the conformity between learning environment and aspirated practice and the availability of the media and other resources. In the present, SICAP the requirements of specific learners in specific learning environment are taken into account. The specific learners are the grade IX learners in secondary schools in Thailand. The specific learning environment is the instructional strategy to be prepared for the learning of the higher level concepts in the topics of science such as Biotechnology and Biodiversity. The application of SICAP is both compact and meaningful as it proves to be a convenient instructional tool for self-learning based on recent psychological, educational perspectives and it makes use of the innovative educational technology of computer programming.
An essential aid for learners and for science education for learners of grade IX in English medium secondary schools in Thailand, SICAP is essential for the following reasons;

1. SICAP is an inter-active self-instructional program. Any learners who has the skill of operating computers can avail of this program

2. SICAP offers objective sequences of informative input along with different learning activities and illustrative audio-visual supplements. A learner is not told and stuffed with informative details but learners on his own by getting involved in activities which the learner performs on his own.

3. SICAP is useful for the learners as it allows the learners to move in the manner in which it is convenient for the learner to move. The flexibility and adjustability of the pace of learning, slow when required and fast when the learner so desired. The movement of the learner according to this own speed of learning is significant advantage of SICAP.

4. SICAP offers the learner an opportunity to select his own learning styles, his own learning materials and his own learning strategies. This elasticity of learning process is a strong reason because of which learners opt for SICAP

5. Learners became self-motivated to learn, eagerly curious to know the facts, energetically enthusiastic to understand to concepts through the operation of SICAP for self-learning. SICAP is proved to be an effective instructional tool that uses innovative educational technology. These grounds support its efficiency and effectiveness for learners.
SICAP is essential for science education on account of the following reason:

1. SICAP makes use of the decomposition of information, Bit by bit, piece by piece, chunk by chunk, the objective sequence of informative input is presented in SICAP. This makes the digestion of the scientific information possible and smooth. The slow and controlled release of information is a feature of SICAP. This is the reason which makes SICAP essential for science education.

2. SICAP presents the contents of the learning units in a simple language and in a direct clear exposition. The simplicity, the lucidity and the preciseness of the presentation of learning material makes the facts and concepts of science easier for learning by the self-instructional learners.

3. SICAP contains illustrative figures, pictures, charts, exercises, self-assessment queries and other audio-visual supplements to the informative text frames. This helps in creating an impact of concreteness and the concepts become easy for understanding mentally as well as graphically. This feature makes SICAP as essential learning tool.

4. SICAP is a do-it-yourself mechanism. It encourages the curious desire to understand the mysteries of the universe. This self-help device makes SICAP an essential instructional strategy for science education.

5. SICAP is a concrete objective presentation of facts and concepts of science. Self-motivated learners consider it as essential equipment in science education.

Benefits of SICAP for learners and for science education each teacher and planner courses knows the manifold problems one has to face in preparing
teaching units. An important in this process is “How does one ensure that the learner has the possibility during instruction to learn what he or she should be able to or wants to know?” to meet this goal the learner should be able to learn during instruction what he or she has to perform in an assessment. Therefore, the subject matter offered by instruction should be content valid to the educational goal as well as the items in the test. The four stages of an instructional design model SICAP are (1) Determination of instructional goal (2) Diagnosis of the state of the learner in correspondence to the instructional goal and the instructional tasks, (3) Instruction to the learner with suitable realizations through the instructional tasks that combines both the content and behavioral components and (4) Assessment of success through formative and summative evaluation.

The present SICAP is a useful representation of instructional tasks and instructional goals. This usefulness refers to the functions related to the teaching and learning process, the instructional design procedure and the revision of the procedure of learning and instruction. The benefits of the SICAP for learners and for science education are listed below;

1. The SICAP offers a precise description of the content component through the sequence of objective statements.
2. The SICAP offers a precise description of the action or behavioral component through the sequence of operations
3. The SICAP uses facilitating representations by presenting the tasks in a manner in which it becomes easier to handle the tasks and solve the problems
4. The SICAP offers an instructional design that imparts the instructional objectives using a representational method that uses all the three levels of course objectives of lessons and detailed specific sub-topics.
5. The SICAP offers a guarantee of validity with regard to the instructional objective. The parallel validity for teaching on the one hand and testing on the other is tested by the SICAP.

6. The realization of the knowledge transfer through the representational method is another benefit of the SICAP.

7. The SICAP offers an instructional task analysis to facilitate instructional decisions concerning how to teach through identification of suitable task characteristics.

8. The benefit of SICAP offers the method of representation of instructional tasks which is sufficiently generalized in nature as the process demands an easy format of representation of facts and concepts.

9. The SICAP is beneficial to learners and for science education in general on account of its easy communicability

10. The SICAP has the advantage of a step by step reconstruction that is systematically rule guided

11. The other benefit of SICAP is its practicability as it is an applied procedure which is useful for a concrete situation offering nine field of application for practical implementation.

12. The SICAP is helpful in the construction of content structure, action structure and helps to formulate a comprehensive instructional design model.

These benefits are equally applicable to the learners as well as science education in the given context of learning and teaching of the concepts in Biotechnology and Biodiversity in secondary schools in Thailand
1.6 Statement of the Problem

“Development of Self-Instructional Computer – Assisted program (SICAP) on Science of Grade IX and its Effectiveness in Thailand”

1.7 Operational definitions of key terms

(i) **Self-Instructional Computer – Assisted program (SICAP):** means an instruction media prepared in the format of a computer program which will be used to support the teachers who are teaching higher level concepts from Biotechnology and Biodiversity topics from science for Grade IX using different computer program (i.e. printed material, word, power point etc)

(ii) **Effectiveness:** It is the indicator to evaluate the standardized achievement criteria test of secondary school students for teaching science including Biotechnology and Biodiversity topics for grade IX. By two strategies i.e. traditional system and Self-Instructional computer assisted program (SICAP). Then, comparing them to judge the indication in the form to effectiveness

(iii) **Science:** It is referred as the core subject taught in the secondary school in Thai educational system. This science subject includes Biotechnology and Biodiversity topics

(iv) **Grade IX:** In Thailand the secondary school system starts from grade VII to grade XII. But, it is divided into pre-secondary school grade from VII to IX and post-secondary school grade from X to XII Thus, grade 9th is extremely important for any students of Thailand
1.8 Objectives of the study

1. To find out the higher level concepts from Biotechnology and Biodiversity topics from science for grade IX.
2. To analyze the higher level concepts from Biotechnology and Biodiversity topics from science for grade IX.
3. To develop Self-instructional computer – assisted program (SICAP) for students based on Biotechnology and Biodiversity topics of science grade IX.
4. To test the effectiveness of Self-instructional computer – assisted program (SICAP).

1.9 Research Hypothesis

There is significant difference in the mean achievement scores obtained teaching of science by using Self-Instructional Computer – Assisted program (SICAP) instead of traditional method for grade nine students

1.10 Null Hypothesis

There is no significant difference in the mean achievement scores obtained teaching of science by using Self-Instructional Computer – Assisted program (SICAP) instead of traditional method for grade nine students
1.11 Assumptions of the study

1. Teachers and students know how to operate computers.
2. Teachers use different teaching methods for teaching science.
3. Teachers use different innovative techniques for teaching science.
4. Students use computer and internet for work and references.

1.12. Scope and Limitations

1.12.1 Scope

This research is useful for all secondary English medium schools teachers, students of Grade IX in Thailand.

1.12.2 Limitations

1. The effectiveness of Self Instructional Computer Assisted program (SICAP) was based on total involvement of selected schools in Thailand.
2. The effectiveness of Self Instructional Computer Assisted program (SICAP) was based on response given by students to pre and post tests.
3. The researcher had no control on socio-economic status of Thailand and psychological factors.
1.13 Delimitations of the study

The present study is mainly confined to science in secondary English medium for grade IX students in Thailand. The researcher was made development self-instructional computer assisted program (SICAP). Hence, the study has the following scope and limitations:

1. The students of Grade IX at Benchamratrungrunsarit II School from English medium with computer facility were population from study in Thailand.
2. This study was limited to the schools following content of science by the basic Education Core Curriculum A.D 2008 in Thailand.
3. The sample was delimited to one English medium School.
4. 345 students selected for survey and interview and 100 students selected for experiment (experimental group of 50 and control group 50 students.) of Grad IX student.
5. This study was limited to Biotechnology and Biodiversity topics from science subject of grade IX in sub-matter topics: (I) Biotechnology; (i) Genetic engineering, (ii) A genetically Modified Organisms GMOs, (iii) Cloning, (iv) Deoxyribonucleic acid DNA, (v) Benefits of Biotechnology, (vi) Public opinion on Biotechnology, (II) Biodiversity; (i) Definition of Biodiversity, (ii) Classification of Animal, (ii) Classification of Plants

1.14 Significance of the study

The principal outcomes from the study comprised of the science learning using self-instructional computer-assisted program (SICAP) appropriated for the students of grade IX who learn through English medium. The basic knowledge for further study depends on using of self-instructional computer-assisted
program (SICAP). The approach was a student centered learning activities oriented strategy. One more thing, this research study is an attempt to provide a meaningful and practical instructional strategy for grade IX students in Thailand.

Science gives opportunity for creative thinking and constructive imagination. Further, science is a subject where idea can be experimented upon and verified. The learner develops the habits of searching for the truth. These qualities affect the pattern of behaviour of the learner. The significant aspect of science is that whatever the student learns has immediate application in the world around him. This is educationally very sound. In society, there will always be problem to be solved. One of the very useful outcomes of learning science is development of problem-solving skill. If properly cultivated through the teaching and learning of science, the students can apply this aims of modern education is to provide means for utilization of leisure especially in the industrialized societies.

However, Self-instructional computer assisted program (SICAP) in Science created by the researcher. A distinctive feature of self-instructional computer assisted program (SICAP) is that individual learns by using ideas presented in the teaching computer program rather than merely being told about them. The provision of exercises, activities or self-assessment questions is the mechanism by which the key objectives associated with a teaching text are realized and students allowed practicing them. It is sobering to learn that when two modules of a course were compared by students, one containing activities and one in which none were present the majority of student said the absence of activities hindered their learning.
The importance of Self-Instructional Computer Assisted program (SICAP) to education as following:

1. It helps learners in board areas quickly and have teachers spend more time with learns.
2. It can respond a multiple intelligence of learners. It gives learners freedom to seek for knowledge and have them responsible for themselves and society. It also provides autonomous learning due to one’s ability need, and interest.
3. It has education on scientific theory accepted to be one of the ways to develop in many fields of study. It provides the system of thinking, experimenting, problem-solving, and seeking for new knowledge.
4. It empowers the education management. One of the most important things in teaching and educational management is medium. Thus, using medium in education can confirm that the educational management will be more effective.
5. It can broaden learners’ vision to the world outside the classroom. It helps decrease gap between school and society. Learners can see the real-world situations via the Internet.
6. It creates the equality in education. It opens up the opportunities to everyone to acquire knowledge in formal, non-formal, informal, and special education. Moreover, it serves individuals’ need, interest, and ability of seeking knowledge.

In this study, the researcher would like to reveal the importance of the self- instructional computer – assisted program (SICAP) in teaching science for secondary schools grade IX especially for the students of grade IX for Benchamaratrungsarit II School of Thailand. Self- instructional computer – assisted program (SICAP) can be the most suitable supplement for learning and
teaching through the use of media efficiently in terms of learner achievement, interests and reactions. The students for grade IX in Thailand would be able to better handle self-instruction in the case of science subject as number of studies of science attainment illustrated. Then, the students would have resources that are to be used for practice. The instruction can increase understanding of content and can equip them to learn to the full to the capacity.