DEVELOPING CRITICAL THINKING SKILLS AND DISPOSITIONS AMONG HIGHER EDUCATION STUDENTS IN THAILAND

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การพัฒนาทักษะและแนวโน้มในการคิดวิเคราะห์ของนิสิตนักศึกษาสถาบันอุดมศึกษาในประเทศไทย

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BY

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This research paper addresses the imperative task of fostering critical thinking skills and dispositions among higher education students in Thailand. The primary objective of this study was to identify essential critical thinking skills and dispositions through an extensive review of existing literature. Subsequently, an instrument was developed to assess the current levels of these skills and dispositions among students. To further enhance the critical thinking abilities of the students, a tailored intervention program was designed to empower students to create their own improvement strategies. The methodology involved rigorous data analysis and reduction techniques to distil essential skills and dispositions from the existing literature. The Item objective congruence and expert opinions were then integrated into the development of the assessment instrument. This instrument was administered to a sample of 400 bachelor's degree students from four distinct universities in Thailand. A focus group study was conducted to refine and tailor the intervention strategies. The key findings of this research demonstrated that the intervention had a profound and statistically significant impact on enhancing various critical thinking skills and dispositions, except for academic assertiveness. Moreover, a noteworthy correlation was identified between critical thinking skills and dispositions and the students' performance on standardized tests such as the IELTS and SAT EBRW scores. This study underscores the importance of nurturing critical thinking skills and dispositions among higher education students in Thailand, offering valuable insights into effective interventions for fostering these skills. The results also highlight the relevance of critical thinking abilities to standardized test scores, emphasizing their broader significance in the academic and professional realms.

Keyword : Critical thinking, Higher education, Skills, Dispositions, Assessment, Interventions, Thailand, Academic Assertiveness, IELTS, SAT EBRW Scores

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KEERTHI PRABHAKAR PADMARUDRAM SASIDHARAN THAMPI

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INTRODUCTION

"Reading furnishes the mind only with materials of knowledge; it is thinking that makes what we read ours." - John Locke.

This thesis attempts to develop critical thinking more in terms of dispositions rather than skills and to develop a pedagogy to improve argumentative skills, which can indirectly promote the dispositions of critical thinking among higher education students in Thailand, based on developmental research. Critical thinking skills and development may be one of the hottest topics of modern-day education. In a newly industrialised economy like Thailand, where the recent initiatives by the government to save the population from the middle-class income trap in the next five years, nurturing and enhancing a labour force which can critically think and appreciate is of utmost importance.

Background

Humankind has been through a plethora of milestones in the last few decades. The advancements of homo-sapiens as a civilisation in the previous few decades might be far beyond the imagination of the predecessors. The achievements in modern medicine, electronics, telecommunication, industrialisation, manufacturing, and everything, have made this generation so intricate that it might be time to redefine the role and purpose of Higher Education. With all these advancements and achievements, the skill requirements of society have also changed. Today information is everywhere. From an era where physical strength was of utmost importance, where sheer power would ensure a career in the Armed forces, today, to become a soldier in most of the modern era Armed Forces, the candidate needs a High School Certificate, have to go through an eligibility test where the math skills and language comprehension skills are tested. Suppose a candidate wishes to become a Commissioned Officer in the Royal Army of Thailand. In that case, the candidate has to undergo an ardent testing procedure where the person has to compete with thousands of fellowmen, where their skills are tested in

Math, Science, Language, Critical Thinking, Aptitude, and Leadership traits, to name a few. This profound change in 'requirements' applies to the Armed Forces and is relevant to almost every walk of life. modern era Armed Forces, the candidate needs a High School Certificate, have to go through an eligibility test where the math skills and language comprehension skills are tested. Suppose a candidate wishes to become a Commissioned Officer in the Royal Army of Thailand. In that case, the candidate has to undergo an ardent testing procedure where the person has to compete with thousands of fellowmen, where their skills are tested in Math, Science, Language, Critical Thinking, Aptitude, and Leadership traits, to name a few. This profound change in 'requirements' applies to the Armed Forces and is relevant to almost every walk of life. The differing demands of the employers that require their employees to think critically, innovate, find solutions, and communicate effectively (American Management Association, 2010) reflect on the formulation of policies in higher education institutions. Employers have clarity about the required skill set and what higher education institutions should teach prospective employees (Association of American Colleges and Universities, 2010).

Recent studies conducted in Thailand among higher education students show an alarming trend of falling critical thinking skills (Wanida, Ploysangwal, 2018), Mathematic skills, Scientific knowledge and reading skills (Program for International Student Assessment, 2011). The study by Dr Wanida Ploysangwal 2018 showed that the critical thinking skills among higher education students were way below average, with a mean score of 5.93 from a total of 15, with a standard deviation of 2.67. Rationalising one's judgements, interpretation, or analysing the arguments may be new to most students. The PISA reading test scores 2015 also reflected that the level of Thai students was below average (Ploysangwal, Wanida, 2018). The National Education Act for Thailand of 1999 clearly states in Section24, "In organising the learning process, the educational institutions and agencies concerned shall:

(2) Provide training in the thinking process, management, how to face various situations and application of knowledge for preventing and solving problems (3) Organise activities for learners to draw from authentic experience; drill in practical work for complete mastery; enable learners to think critically and acquire the reading habit and continuous thirst for knowledge." Even though the relevance of critical thinking and its development was always essential for the academic community in Thailand, previous studies (Ploysangwal, Wanida, 2018) indicate that the execution was not successful. When the critical reading and analysis test was conducted among major English students in Thailand, the higher education students in Thailand demonstrated a lack of reflection on their thought processes and critical analysis (Ploysangwal, Wanida, 2018).

These falling quality trends of critical thinking and Science-Mathematics skills are causing a massive mismatch in the Thai labour sector. The 'Salary Survey 2018' conducted by Robert Walters Inc., a specialist recruitment agency operating in 28 countries, found that the availability of jobs in the science/technical/IT is on the rise per global demands. In Thailand, Robert Walters Inc. observed a considerable talent scarcity, especially among IT professionals, project managers and ERP (Enterprise Resource Planning). The companies are forced to recruit foreign talents in these areas (Robert-Walters Salary Survey 2018 southeast Asia-greater-china.pdf). This lack of talent pool is to be read in-line with the study conducted by Dr Akkaya Senkrua in 2015 about the mismatch in the labour market of Thailand. The students turning away from Science and Math based topics are an all-time worse, with 60 per cent of college graduates holding a degree in social sciences. These graduates are overeducated (exceeding the required education to do their job) and getting paid way below compared to their educational qualification (Akkaya Senkrua, The mismatch in the Thai labour market: Over education, 2015). Creating an environment in the education sector where critical thinking is inspired and backed up by a curriculum that promotes higher-order thinking would be the key to creating an efficient, freethinking and capable workforce.

The experts highlighted the necessity of introducing critical thinking in the early stages of education (Facione, Peter A, Executive Summary, Delphi research, 1990). Yet, teaching critical thinking at schools in Thailand doesn't seem to be an easy task. In a culture where teachers are propagated as moral parents, as protectors whom the students should follow (Wallace, M; Cultural dilemma of the Thai teacher, 2003), cultural indoctrination may hinder the students from thinking critically. Even in higher education institutions, the cultural framework of Thailand contributes to academic authoritarianism (Thanosawan. P, 2018). Addressing the industry's demand and responding responsibly to the needs of society, it can be said that it is a 'herculean' responsibility of educators to address this at some stage of formal education. It could be more beneficial to address the critical thinking needs of the students as an institution rather than treating them as individuals. The primary questions that led to this research were;

1. The declining trend in critical thinking is evident, and as a researcher in higher education, how can this be addressed at the higher education level?

2. Can the existing models of critical thinking and its dispositions reach Thai students, connect with their cultural inhibitions and inspire critical thinking?

3. Which more practical pedagogy addresses the lack of critical thinking skills? Should the focus be on improving every essential disposition of thinking or catalyse the fundamental understanding of thinking and it's importance among higher education students?

These primary questions acted as a rough guideline towards the research questions, methodologies and instruments required to answer the research questions. Various studies in the past have found a positive correlation between critical thinking skills and the GPA of the students and critical thinking skills and student learning. The insufficiency of curricula and assessment in critical thinking has been pointed out by experts in previous studies conducted in Thailand. Still, it's a crucial skill that equips the student to face an unfamiliar situation, and these critical thinking skills can be improved through targeted educational support. Despite the strong demand for instructional mediums for enhancing critical thinking in the classroom, there is an existing gap in

research. The gap may be more in considering critical thinking as a skill rather than a tendency the learner needs to develop. A pedagogy targeted at developing critical thinking as a tendency may have a lasting effect on the learner rather than learning it as a set of skills.

This thesis is not only for educators but also to make the student community aware of the importance of higher-order thinking. Generally, higher education students know or want to learn how to think, but this may not be the case in the 21st century. Motivation and the level of interest are of paramount importance in any learning process. But no matter the level of motivation, educators must be able to accelerate the process of higher-order thinking among higher education students. Every student may have a unique way of thinking, but this thesis tries to act as a pointer towards the primary objectives of critical thinking. Critical thinking is a goal-oriented / object-oriented activity (Halpern, 1998; Rudd, 2007); even an improved thought process is desirable. Critical thinking may not always involve taking action; sometimes, it is an intellectual task, a thought experiment or mere ruling out of adverse or undesirable activities, or changes one's perceptions. These may not be mutually exclusive results but a result of the overall understanding of critical thinking. This research is vital to make the students aware that critical thinking is not just a series of dispositions or skills. Still, it's the ability to bring higher-order thinking into daily activities.

Higher education has been under worldwide critical scrutiny for many years now. The incompetence of higher education as an institution in developing critical thinkers was a significant issue in the United States. The changing demographics and existing mismatches (quantitative and qualitative; quantitative because of an informal sector where a vast percentage of the population depends) can cause problems in a developing economy like Thailand. Qualitative is the horizontal mismatch due to over or under-education, and vertical mismatch is where a person works in an industry different from his field of study). These mismatches are reasons enough for Thai higher education to concentrate more on verticals like critical thinking skills and their development among the students. Thailand has already made the importance clear through the Basic

Education Curriculum (2008) by emphasising the importance of critical thinking as a stimulant towards knowledge creation. Higher education institutions should keep the momentum and adopt these concepts into the classroom.

Theoretical Framework

Critical thinking maybe one of the most researched topics in social science. Many theorists and social scientists contributed significantly to critical thinking and its sub-topics. In this research, the author considers Peter Facione, Robert Ennis, Jennifer Moon and Stephen Brookfield, and Richard Paul primarily. The works of other theorists and social scientists were also reviewed to understand the topic in-depth, but the works of Facione, Ennis, Moon, Brookfield and Paul are the driving force of this research. Facione and Ennis are among the pioneers who tried to bring clarity into the definition of critical thinking and recognised it as a specific set of skills and dispositions. They are also the designers behind two of the most widely accepted critical thinking assessments, the California Critical Thinking Skills Test (CCTST) and the Cornell Critical Thinking Test (CCTT). Brookfield is a critical pedagogue reiterating the importance of strategies like team teaching and critical modelling in educating learners. Moon is also a critical pedagogue who emphasises academic assertiveness and its role in shaping a critical thinker. Richard Paul is also a pedagogue who helps shape critical thinking in the modern world. He is also the author of notable titles like The Miniature Guide to Critical Thinking: Concepts & Tools, Critical Thinking: Tools for Taking Charge of Your Professional and Personal life, Critical Thinking: What Every Person Needs To Survive in a Rapidly Changing World, the Thinkers Guide for Conscientious Citizens to Detect Media Bias - Foundation for Critical Thinking, etc.

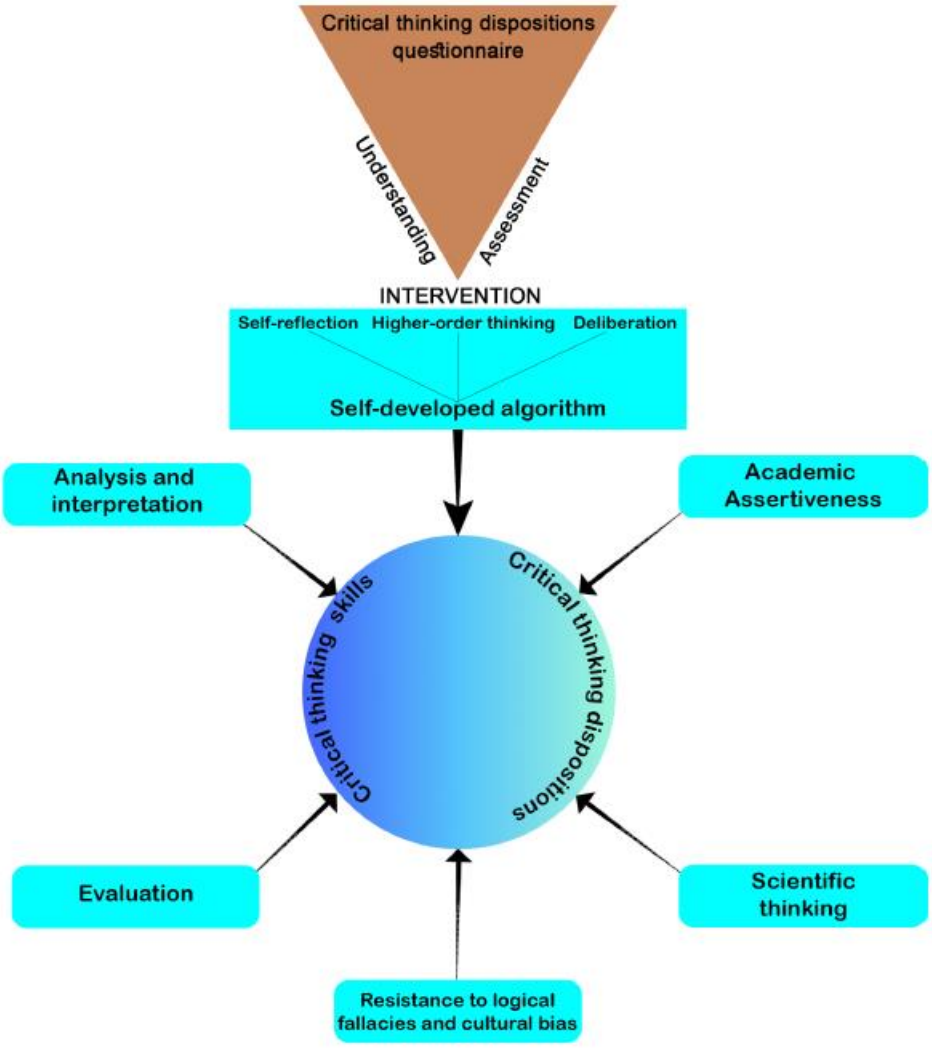

Figure 1: Theoretical Framework

Population and Research questions

The primary and most important purpose of this research is to promote argumentative skills to improve and promote critical thinking skills and dispositions among higher education students in Thailand. This research follows the research and development model with three stages, and different research questions are framed for different stages.

Stage 1 – Exploratory Research: The research population comprises approximately 400000 students attending various higher education institutions in Thailand. A sample size of 400 students was used to collect data in the exploratory research phase. The most common four-region system, used in administrative and statistical contexts of Thailand and as a general cultural grouping, includes the western and eastern regions within the central region while grouping some provinces in the northern region. The standard four-region system is also the regional system most commonly used by the national media and government administration when discussing regional events. It divides the country into the following regions: Northern Thailand, Northeastern Thailand, Central Thailand and Southern Thailand. The researcher uses the QS World University Ranking system data, where 8 Thai universities have found their place in the 2020 ranking list. One university from each of these regions mentioned above, which appears in the QS ranking list, will be considered for collecting data using the instrument developed by the researcher.

Stage 2 – Design and Developmental Research: A focus group comprising five-seven subject matter experts will be approached to collect data in the second stage. The data collected from these experts will be vital in deciding activities, topics for discussions and methods which comprises the pedagogy for developing argumentative skills.

Stage 3 – Efficacy research: A sample size of 30 students from an international program will be considered for the efficacy research. These students will be given the test developed by the researcher before the lesson and tested again after the lesson schedule. The discussions and participation of students will also be observed to monitor significant changes in attitude and thinking.

Research questions

Stage 1 – Exploratory Research

Question 1: Can the higher education students in Thailand display their abilities in analysis and interpretation, evaluation, academic assertiveness, resistance to logical fallacies and cultural bias, and scientific thinking?

Sub-question 1.1: Is there a significant difference between critical thinking dispositions of higher education students in Thailand based on their institution affiliation, Year of study, Gender, or stream of study?

Question 2: Is there a correlation between critical thinking dispositions and English language skills among higher education students in international programs?

Stage 2 – Design and Development research

Question 3: How to develop a practical and viable pedagogy to improve critical thinking dispositions among higher education students in Thailand?

Sub-question 3.1: Based on the results from Exploratory research, which areas need more attention while developing critical thinking dispositions?

Stage 3 – Efficacy research

Question 4: Is there a significant improvement in critical thinking dispositions among higher education students in Thailand after the intervention based on a self-developed algorithm developed through this research?

Significance and Definitions

Significance

In the 21st century, the economy is driven by innovation and the development of products and services rather than the manufacturing of material goods. The K-12 education structure has not adequately addressed the changes in economic structure and information technology. In Thailand, a noticeable number of students who graduated from high school are still not ready for higher education institutions. Despite being open to assimilating technologies into everyday educational activities, K-12 institutions still struggle to prepare students for 21st-century skills. Critical thinking skills are crucial in today's economy for preparing students to become active collaborators and informed global thinkers. Innovation demands a workforce that can think critically and communicate effectively within and between organisations.

Critical thinking is not easy to understand; it may be one of the epistemologically broadest concepts that have ever been adapted into a classroom. From Socrates to Plato, Facione to Ennis, Lipman to Moon, every theorist and social

scientist have contributed their fair share of knowledge to this concept. The most challenging part of this research was identifying those essential skills and dispositions that can lay the foundation for building capable critical thinkers as a product of higher education. The primary document which acted as a guide in identifying the skills and dispositions for this research and designing a questionnaire is the Model for the National Assessment of Higher Order Thinking, published by Richard Paul and Gerald M. Nosich, published in 1993. In this document, the authors suggest the twenty-one criterion be met while designing an assessment of critical thinking. Even though this document was vital in developing the questionnaire to assess the abilities of critical thinking in higher education students, two questions raised some dilemmas.

Is it fair to expect active higher-order/critical thinking skills from students who were never exposed to the concept?

Isn't it more relevant to stress the students' critical thinking dispositions rather than expecting well-formed skills?

In an attempt to answer these questions, five-term items were identified from the list of critical thinking skills and dispositions suggested by prominent theorists and social scientists. The rationale and arguments supporting each selected item and the definitions in the 'Definitions' section have been provided. The author argues that these skills and dispositions can lay the foundation for practical critical thinking. These skills and dispositions can also prepare the learners for a comprehensive understanding of the complex skills of critical thinking. Paul and Nosich (1993) also criticised the existing assessment tools and reiterated the importance of clarity in defining critical thinking. The document has been reviewed in detail in the literature review.

Why argumentative skills?

The author assumes an initial position that argumentative skills can develop the dispositions and skills required for students' critical thinking or higher-order thinking skills. To successfully represent themselves in an argument, the students must employ critical thinking skills without even realising that they are engaging in a higher-order thinking process. The tendency to involve higher-order thinking is more important than

recognising and learning it as a skill. Employing a known skill is a choice, while tendencies are hardly a choice. Critical thinking or higher-order thinking must be developed as a tendency to work effectively in a post-truth society. The thinker must be able to apply their critical thinking skills to every piece of data that passes through them, weigh the quality of the data and accept it as information only if it satisfies the thinking criteria. If the thinker identifies critical thinking as another skill they acquired from school, the whole process can be monotonous. But, if the thinker tends to apply critical thinking in everyday life, the whole process will act as a habit. This habit can be developed into new horizons, where the thinker can inspire others with their methodology.

While engaging themselves in a debate/discussion, the learners have to employ skills like analysing, interpreting and evaluating the arguments that they face. At this stage, the educator can help them how to employ these skills effectively and whether they should consider the argument as a valid one. The educator can also help the learners identify the logical fallacies and cultural biases hidden in the argument. Thus the students will develop the tendency to employ these skills when they are face-to-face with data and more extended exposure to situations; it becomes a cognitive disposition.

For example, many people consider physical exercise, like running, strenuous and monotonous. The physical education teacher is trying to improve the overall physical fitness of her class. She understands that the students are not keen on running or monotonous activities. So, she decides to create a soccer league competition within her classroom. She divides them into three teams, instructs them about the game's basic rules, regularly draws up a schedule and conducts a tournament. The students are getting regular exercise as part of the regular soccer games. At the end of each game, the teacher would give them feedback on how the students can improve the game, who should run more, how they can defend and tackle better, etc. More students get involved in the tournament, some students rose to the situation, some display some natural talent in soccer, some get inspired, they analyse the games about what went wrong, different students get assigned different roles, and even the students who were left behind would at least know the rules of the game.

Similarly, thinking can be a monotonous activity for many students. But, when employed as part of a competitive and challenging activity like debating, argumentative skills get shaped as a disposition without the student realising its monotony. An activity that will assign a role to every student can ensure maximum student participation.

Definitions

Critical thinking skills: The ability to interpret, analyse, evaluate, infer, explain, and self-regulate the thought process is generally understood as critical thinking skills.

Critical thinking dispositions: The observable tendencies of behavioural traits, affective inclination or mental habits to apply critical thinking in daily life or any situation that demands critical thinking can be called critical thinking dispositions.

Analysis and Interpretation: Analyse and interpretation is the ability or skill to identify the actual inferential relationship between statements, arguments or questions and decode the significance of those relationships.

Evaluation: Evaluation is the skill or ability to judge the credibility of a claim, argument or evidence. The ability to evaluate is also vital in identifying the underlying conflict of interest.

Academic Assertiveness: Academic assertiveness is a disposition to express one's position or opinion, to give due consideration to an argument and accept it if it is credible, and to seek clarity if required.

Resistance to logical fallacies and cultural bias: The ability to think beyond one's acquired sympathy towards common errors in reasoning and to think aside from the common phenomenon of judging and interpreting by standards inherent to one's culture can be depicted as resistance to logical fallacies and cultural bias.

Scientific thinking: The tendency to weigh every claim, assumption, argument and judgement using scientific or research methods is depicted as scientific thinking.

Why these variables?

Analysis and Interpretation

Critical thinking dispositions encompass the attitudes, habits of mind and intellectual character traits that foster critical thinking. Scholars have proposed various frameworks to identify and assess these dispositions. For instance, the Paul-Elder framework highlights critical elements such as intellectual humility, courage, empathy, and integrity (Paul & Elder, 2007). These dispositions can be cultivated through intentional efforts and targeted interventions. Analysis and interpretation are mandatory in critical thinking. These skills are on almost every critical thinking expert's list (Facione, Ennis, Moon, etc.). The author believes these two, analysis and interpretation, are not exclusive. Why analyse if not for interpretation? Interpretation is impossible without analysis. Facione expresses 'analysis' as the ability to identify the intended and actual inferential relationship among statements and 'interpretation' as the ability to comprehend and express the meaning or significance of the data (Facione, Peter. A, Critical thinking: What it is and why it counts, 1992). Ennis thinks that an ideal critical thinker can analyse arguments, ask and answer clarification questions, identify or formulate questions, and interpret logical terminology and intended meanings. While Facione and the experts project 'Analysis' and 'Interpretation' as two primary skills in their list of six, Ennis finds a wide range of possibilities for these skills under different headings (Ennis, R., A Logical basis for measuring critical thinking skills; 1985). Due to these processes, Moon observes 'Analysis' and 'Interpretation' is applicable in critical thinking.

The results of successful analysis and interpretation will reflect in a helpful review and development of an argument, practical evaluation of an object, review of an incident and also displaying a critical habit of engagement with the world (Moon, Jennifer, Critical thinking – An Exploration of theory and practice; 2007). In a Joint Special Operations Forces Senior Enlisted Academy briefing, Measured Reasons LLC reiterates the importance of analysing and interpreting in identifying critical elements of an environment. The critical thinking skills map to leadership decision-making considers

analysis and interpretation as a primary skill in recognising the critical premises of a situation (Facione, Peter. A, Critical thinking: What it is and why it counts, update 2015). Analysis and interpretation are integral components of critical thinking that allow students to break down complex information into manageable parts and derive meaning from it. Facione (1990) highlights the importance of these dispositions, emphasising their role in promoting thorough examination and understanding of concepts. By engaging in analysis and interpretation, students can develop a deeper comprehension of the subject matter, identify underlying assumptions, and discern the significance of different perspectives. If the educator throws these words around (analyse and interpret) at the learners, the understanding the learners gain may be extensive and lack clarity. In terms of argumentation, these words will gain more clarity as a tool to analyse and interpret the arguments the learners face and use.

Evaluation

Practical analysis and interpretation of a situation eventually lead to a successful evaluation. Evaluation is the ability to assess the credibility of a claim, argument, or other representations and the logical strength of inferential relationships among statements (Facione, Peter. A, Critical thinking: What it is and why it counts, 1992). The ability to judge the credibility of the source, evaluate reports, judge deductions in arguments, identify unstated assumptions and judge definitions has been pointed out by Ennis to promote the importance of evaluation in critical thinking (Ennis, R., A Logical basis for measuring critical thinking skills; 1985). For learners to think critically, efficient evaluation of the object is vital. Evaluation demands clarity in the representation of one's thinking, the conception of the nature of knowledge and the ability to identify the difference between personal view and societal view (Moon, Jennifer, Critical thinking – An Exploration of theory and practice; 2007, p135). In argumentative skills, evaluation plays an essential role in evaluating the arguments learners face and the credibility of their arguments. The ability to critically evaluate information is essential in higher education. Ennis (1989) emphasises that students must go beyond passively accepting information and learning to assess its validity, reliability,

and relevance. By fostering the disposition of evaluation, students can distinguish between credible and biased sources, identify logical inconsistencies, and form well-reasoned arguments. This skill is particularly crucial in an era of vast information availability, where evaluating sources is essential in avoiding misinformation and making informed decisions. Evaluation is not only a skill but also a disposition. The monotony behind analysing, interpreting and evaluating arguments can lead to overlooking and ignoring the premises of the arguments. A competitive atmosphere can inspire the learners to ignore the monotony. Repetitive use of evaluation skills can help the learners to develop evaluation as a disposition.

Academic Assertiveness

The term academic assertiveness was coined by Jennifer Moon (2007). Academic assertiveness refers to the ability to express ideas confidently, engage in intellectual debates, and challenge prevailing assumptions. Moon (2008) argues that fostering academic assertiveness encourages students to think independently, question authority, and participate actively in their educational journey. This disposition empowers students to articulate their thoughts effectively, contribute to discussions, and challenge ideas constructively. Academic assertiveness is valuable not only in the educational context but also in professional settings, where individuals must advocate for their ideas and navigate complex problem-solving scenarios. Academic assertiveness is more of a disposition than a skill. It may not be taught, but it can be developed. According to Moon, academic assertiveness in a group of orientations enables the learner to manage challenges in learning and critical thinking. Briefly, it includes the tendency to express an opinion without hesitation, willingness to accept and seek challenges, accepting if wrong and orientation to correct, willingness to listen to the viewpoints of others and academic integrity. Academic assertiveness is helpful for a learner in critical thinking and various spheres like academic, professional, social and career lives (Moon, Jennifer, Critical thinking – An Exploration of theory and practice; 2007). Ennis points out the importance of holding a position and even changing that position gracefully if the evidence and reasons demand in his list of critical thinking

dispositions. Ennis recommends that learners be aware of the quality of their thinking as a skill (Ennis, R., A Logical basis for measuring critical thinking skills; 1985). The experts pointed out during the Delphi research towards creating a consensus on critical thinking that the willingness to reconsider one's views and position where honest reflection suggests a change is a strong disposition for a critical thinker. The experts also suggest the need for self-confidence in their reasoning abilities in the Delphi research (Facione, Peter. A, Critical thinking: What it is and why it counts, 1992).

Is academic assertiveness a skill that can be taught? Certain aspects of critical thinking are affected by personal characteristics (Moon, 2007). Higher education students in Thailand may have cultural barriers that inhibit them from exhibiting academic assertiveness. While engaging in debates and similar activities, the learner is exposed to situations where academic assertiveness is essential and how it benefits the learner. Learners who are thinkers and do a retrospective of their performance will recognise the advantages of academic assertiveness in their daily life.

Resistance to logical fallacies and cultural bias

The critical thinker should be resistant to logical fallacies and cultural bias. The cultural bias also includes cultural indoctrination the thinker went through. Ennis points out the importance of identifying fallacy and fallacy labels in discussions and presentations in the list of critical thinking skills and dispositions (Ennis, R., A Logical basis for measuring critical thinking skills; 1985). Moon gives adequate importance to 'taking into account of own biases' for the active development of an argument. The willingness to question and challenge existing ideas is essential to the critical habit of engagement with society (Moon, Jennifer, Critical thinking – An Exploration of theory and practice; 2007). Cultural biases and logical fallacies can hinder objective and rational thinking. Brookfield (1987) emphasises the importance of developing a disposition of resistance to such biases and fallacies. By acknowledging the potential influence of cultural biases, students can strive for impartiality and avoid making hasty judgments based on preconceived notions.

Furthermore, recognising and understanding logical fallacies enables students to identify flawed arguments and engage in more effective critical discourse. The ability to self-examination under the self-regulation skill suggested by the experts of the Delphi method is a pointer towards assessing own biases and thought process. Examining views on a sensitive subject based on the possible influences of personal biases or interests has been given as an example of self-examination, as cited by Facione (Facione, Peter. A, Critical thinking: What it is and why it counts, update 2015). Two of the most projected dispositions of critical thinking, open-mindedness (Bailin et al., 1999; Ennis, 1985; Facione 1990, 2000; Halpern, 1998) and fairmindedness (Bailin et al., 1999; Facione, 1990) are results of the willingness to correct own biases.

The decision to question their own biases needs an external catalyst. But the question is, 'Can the educator always act as a catalyst?' The educator may not always have such an influence over the learners. But, activities, including peer groups, can profoundly impact learners' thinking. Engaging in debate and discussions with peer groups can result in deeper cognitive engagement oneself, which can lead to curiosity. Curiosity and the willingness to know can lead to higher-order thinking.

Scientific thinking

Scientific thinking is a disposition that cultivates a systematic and evidence-based approach to understanding the world. Moon (2008) emphasises that higher education students should develop this disposition to use logical reasoning, generate hypotheses, conduct research, and critically evaluate findings. By embracing scientific thinking, students can adopt a structured and empirical approach to problem-solving, make informed decisions based on evidence, and develop a deeper understanding of their study subjects. Scientific thinking is the ability to think based on the science content and the reasoning process that validates the field of science; for example, induction, deduction, experimental design, causal reasoning, concept formation, and hypothesis testing. The author argues that critical thinking is scientific thinking, where human emotions are assimilated. In this context, scientific thinking helps to validate the claims, processes, arguments, reasons, and statements the thinker comes across.

The reasoning process of scientific thinking finds a predominant place in the lists of Ennis, Facione, and Moon (Ennis, 1985; Facione, 1992; Moon, 2007). Scientific thinking will not be tested at an expert level among higher education students. Still, it is to be seen that after 12 years of school education, which includes basic science, how oriented are the students at testing claims or arguments based on scientific thinking?

Research hypothesis

The hypothesis states that after going through a program that nurtures critical thinking dispositions in the classroom, there is a significant improvement among higher education students in critical thinking skills and dispositions, especially in terms of analysis and interpretation, evaluation, academic assertiveness, resistance to logical fallacies and cultural bias and scientific thinking.

CHAPTER 2
LITERATURE REVIEW

Higher Education in Thailand

Education was only about imparting knowledge in every known civilisation times. In ancient Egypt, education was limited to the wealthy and elites. More than ninety per cent of the population had no access to education. The Indian Sub-continent relied on the Pre-Hindu scriptures known as Vedas for their formal education. This education was also limited to certain classes in the society who were considered superior to the others (Gupta, Amita, Going to sent in South Asia, 2007). One of the earliest known centres of Hindu and Buddhist learning is known to have existed in the sub-continent during the 5th century BC at a site called Taxila, where Vedas and some medical knowledge were imparted (Hartmut Scharfe, Education in Ancient India, 2002). The Shang dynasty in China had separate schools for the children of aristocrats and non-specialists. The children of aristocrats were taught in government schools, where they learned politics, literature, arts, archery etc.

Education was private in Greek civilisation except for the Kingdom of Sparta. But the Spartan public education system was designed to create warriors and soldiers for the service of the empire (Coulson Joseph, Market education - The unknown history, 1991). Education was understood as a tool for creating labourers for thousands of years since the invention of agriculture. The rise of the bourgeoisie class and the industrial era exploited al labour, later limited by legislation in England in 1883. In contrast, private schools trained the children of ordinary men in farming and handicraft (Lin, Education in Post-Mao China, 1993). The profound religions advocated the need for compulsory education, but they had the agenda of religious indoctrination (Peter Gray, Brief History of Education, Psychology Today). It is a matter of curiosity to note that some prominent universities in the world, which are symbols of academic excellence, were established as religious schools to train priests and clergy (Eg: the University of Oxford and the University of Cambridge). The 'Age of Enlightenment' had a massive influence on the education system of modern times.

John Locke and Rousseau reiterated the importance of shaping young minds at an early stage. The 'Age of Enlightenment ideas paved the way for creating various sub-domains in natural sciences like chemistry, anatomy, and pharmacology (Eddy, Mathew Daniel, The language of Mineralogy, 2008). The demand and availability of books increased due to the rise in literacy, which also resulted in cultural and intellectual exchange.

The nature of education has undergone a drastic change since the invention of information technology. Globalisation, internationalisation, economies based and built on knowledge, diversity among students, accessibility to higher education and e manifold of subject-knowledge domains were a few of the repercussions of information technology (Siaw Wee Chen, 2014).

King Rama V (five) established the first modern school in Thailand in 1871. with teachers and timetables to impart education to the sons of the royalty and noble;-; Twenty-six years later, Queen Sribajarindra initiated the admission of girls into the school system, which resulted in the first government school for girls in 1901 (Ministry of Education, Thailand website). King Rama VI (Six) merged the Royal Pages School and the College of Medicine to set up the first university of Thailand, Chulalongkorn University (CU History, CU website). Since then, the public and private sectors have managed 170 higher education institutions in Thailand.

Thailand is one of the few countries in the Asian region that has never been under foreign rule; the policies, methods and pedagogy of the Thai education system were more indigenously developed. Modernisation started in the 19th century, and the Thai education system was mainly shaped based on the US education model (WENR, Education in Thailand, 2018).

The Challenges

Political instability: Thailand is known as the 'Land of Smiles'. But, the political instabilities have been expensive on the country's education sector and economy. Thailand is a country which has seen the highest number of military coups in recent times; this shows the profound socio-political disparity between the traditional political establishment and the urban class of the country (WENR, Education in Thailand, 2018).

An ageing population: The ageing population is part of the major crisis faced by higher education institutions in Thailand. It causes a considerable shortage in the student population, thereby threatening the economically viable existence of many Thai higher education institutions. Some experts think that increasing competition from western universities and decreasing demand for education will lead to the disbanding of a much higher lack of skilled labour and the studies that revealed the previously mentioned findings in this document. The World Bank survey results showed that 83.5 per cent of the labour force in Thailand is unskilled (as cited by The Nation, Kaitanan Ruankaew). The survey ranks Thailand as the lowest among the ASEAN countries, and the result was the same in the percentage of people suitable for the job they are doing at 38.8 per cent.

Lack of motivation: The rising trend of lack of motivation to pursue higher education is a recent but pressing issue faced by the Thai higher education industry. As reported in 2015, the number of applicants in the Thai Central Admission System (TCAS) was way below almost two-thirds compared to the total number of available seats. The elite of the institutions known for their academic excellence is downsizing their departments and programs (WENP-Education in Thailand, 2018).

Cultural indoctrination: Many experts and critics have accused the Thai education system of culturally influencing youth to maintain the status quo. The indoctrination can deprive the learners of their critical ability to think, and almost every Thai government has failed to educate the youth (Grachangnetra, Songkran, Bangkok Post; 2015). After the coup d'état of 1933, there was an attempt by the Military leaders to

effect regional dominance of the central Thai culture. This aggressive take over was later known as Thaification, which targeted the Lao, ethnic Chinese, ethnic Malay Muslims, hill tribes, Indian and Vietnamese, both culturally and geographically (Ivanoff, Jacques, The Cultural Roots of Violence in Malay Southern Thailand: Comparative Mythology; Soul of Rice; 2010). A set of policies were implemented in the school, which resulted in saluting the flag twice a day and recognising the King as the father of the nation. The intended side effect was to cut-off all other loyalties other than to the Thai State, resulting from the fear of Lao dominance in the Isan (North-Eastern) region (Reyland, William, Sons of Isan; 2009). In 2018, the Thai government started a Thai-Niyom campaign, translated as 'Thai-ism', to re-introduce the idea of Thai exceptionalism. It draws its twelve core ideas from earlier cultural mandates. Several academics came forward to criticise this as nothing but state propaganda (Phataranawik, Phatarawadee, Special Report: How the misused junta culture to boost 'Thai-ism'; The Nation; 2018) (Wangkiat, Paritta, History doesn't repeat rhymes; Bangkok Post; 2018).

Lack of critical thinking: The lack of critical thinking skills among higher education students has been pointed out at the beginning of this paper. The first of the objectives stated in the list by the Office of Education Council in Thailand states that "All Thais will have the knowledge, critical thinking ability and a thirst for knowledge in science and technology as well as social and human sciences" and "The majority of the Thai people will behave following the traditional way of life." When accompanied by the traditional Thai culture, critical thinking is discouraged while conformity and conservativeness are encouraged (as cited by Sumter, Dirk, Does Thailand have to choose between obedience and critical thinking?; The Nation, 2018). While researchers like Ploysangwal cites a lack of language skills and non-familiarity with critical and analytical questions as the reason for the lack of critical thinking skills, they ignore addressing the lack of a critical thinking atmosphere in the education sector.

Many other social, economic and political challenges act as hindrances towards Thailand's growth and development in its educational system. Still, many such reasons are beyond the scope of this research. This research primarily attempts to

redefine critical thinking to promote critical thinking through developing argumentative skills among higher education students in the country.

Critical thinking – A historical background

The earliest documentation about Critical thinking exists from the teachings of Socrates, described by Plato, where he questioned the reliability of "Authority". As per Plato, Socrates demonstrated that people with power and influence could be confused, biased and irrational. Socrates reiterated the importance of asking questions, probing into evidence and criticism. An entire school of thought has been developed based on the teachings of Socrates, known as Socratic Questioning. The `Socratic questioning' has a very intimate connection with critical thinking because the art of questioning is mandatory for the excellence of thought. Socrates projected the necessity for accepting knowledge and ignorance and probing through what one may know. Socrates explained that the goal of reflective thinking must be about the steps of action required to solve the problem (Costa, 2001). The 'Socratic questioning' method brings an edge to critical thinking. It inspires interest, in-depth thinking and focus. According to Socrates, critical thinking is a tool that can help students fill the knowledge gaps (Sofos,1999).

The Philosophical Approach

Thinkers like Plato and modem-day experts like Lipman (1991) take a philosophical angle at defining critical thinking and critical thinker. For them, a critical thinker is an ideal hypothetical thinker with the qualities of a critical thinker. The actions of the hypothetical thinker don't matter in the philosophical approach. This philosophical approach profoundly influences the American Philosophical Association's consensus on defining a critical thinker (Lai, 2011). The supporters of the philosophical approach consider the critical thinker a standard-bearer of thinking, adequacy and accuracy (Bailin, 2002). The ideal critical thinker in the philosophical approach is reflective and reasonable (Ennis, 1985), the skilful and responsible thinker who provides good judgement (Lipman, 1988), the thinker whose thoughts will meet high standards of accuracy and adequacy (Bailin et al., 1999) and disciplined and possess clarity about a domain of thinking (Paul, 1992).

The cognitive psychological approach

The cognitive psychological approach gauges critical thinking as a set of skills the critical thinker could possess and utilise (Sternberg, 1986). This approach makes critical thinking quantifiable skills compared to the philosophical approach, where thoughts cannot be measured. Bloom's taxonomy (1956) tries to create a more hierarchical educational approach towards critical thinking, but Bloom has been critiqued for the limitations of dispositions and lack of clarity (Lai, 2011).

Edward Glaser defines Critical thinking as analysing facts to form a judgement. For Glaser, critical thinking is a process with three elements, attitude, knowledge and application. Attitude is about being disposed of to contemplate problems from previous experiences. Knowledge is understanding the methods of logical enquiry and reasoning. Application is the ability to apply knowledge.

Critical thinking can be a voluntary, self-directed and self-induced way of thinking. Critical thinking is a continuous search for alternative rational possibilities. It is also essential to evaluate these possibilities based on their practicality, how they will improve the current problem, the possible outcomes, advantages, disadvantages, and a proper course of action.

The deliberate attempt to interpret, analyse, evaluate and infer one's judgements and the ability to explain these judgements based on evidence methodologically, conceptually and contextualise are essential in critical thinking (Facione, Peter A., 2011). A purposeful commitment to using reason in formulating ideas and beliefs leads to critical thinking (Mulnix, J. W.,2010). Ennis (1985) believes that critical thinking provides better clarity than the higher-order thinking skills put forward by Bloom. According to Ennis, Higher-order thinking does little to help develop education, teaching or curriculum. But it is helpful as a reminder that reminds the student and teacher community about the higher task and thinking skills. Ennis also argues that the terms in Bloom's taxonomy are too vague and do not provide any assessment criteria (Ennis, R.H., 1985).

The Pedagogical approach

The definitions may be influenced by the pedagogical methods used by the teachers. The writers and theorists in the pedagogical approach are more concerned about how to guide the learners into critical thinking. They may not be concerned about the process of 'critical thinking' as an entity. According to Jennifer Moon, Brookfield (1987) strongly argue against forcing the students/learners to think against the assumptions they have been living under. According to Brookfield, this may cause massive resistance from the learners. Instead, he advocates 'inspiring the process.' Meyers (1986) also recommends a similar engagement process and enabling learners. Lipman (1991) suggests teaching philosophical approaches early to inspire critical thinking in the future. A more recent example quoted by Jennifer Moon (2007) is of Kaasball (1998), where the approaches included reducing teaching materials and inspiring more preparation by teachers to improvise interaction in the classroom. This study showed improvement in learning and problem-solving skills among computer students. The approach of Bernstein (1995) also proposes the need for educators to recognise a model of critical thinking to which they should adhere because the model can support the learning process. Bernstein promotes the teacher's need to explicit the model she adheres to, which should work as a guideline for learners throughout the learning process.

Jenniffer Moon (Critical Thinking - An Exploration of Theory and Practice, 2007) tries to give different examples for defining critical thinking based on an educational approach and the differences in these definitions.

a) Critical thinking is an ability to perceive the information derived from various sources, analyse this information with creativity and logic, challenge this information and reach conclusions which can be justified. Knowledge is generally constructed, and meanings differ in different contexts.

b) Critical thinking is questioning and demanding justification for the theory or idea.

c) Critical thinking is developing arguments, disassembling the existing ideas and analysing each component. It is the understanding that different solutions can exist for the same problem, and different methods can reach the same solution.

d) It is a multi-dimensional thinking process considering the breadth, depth and time related to the problem. One should be able to consider the thought and approach of the other person. Objectivity is the game's name, and the ego-centric approach should be avoided.

e) Critical thinking may not be above empathy, culture and history. It is analysing the situation based on the facts and evidence, but cultural sensitivity is to be considered while reaching conclusions.

f) Critical thinking is a self-reflection of one's situation or activity. It is almost self-criticism. And then the same can also be applied to other people's work considering factors like their background, biases or vested interests.

g) Strategic thinking about an exam or a subject can also be called critical thinking as long as the person analyses and justifies it to understand it in detail.

h) Critical thinking is meaningful and thoughtful considerations which may differ from common sense and social constructs.

i) Critical thinking may not bring favourable results to oneself as long as the analysis of the subject is unbiased.

j) Critical thinking is also an understanding of how to use one's evaluation skills in different situations.

k) Critical thinking is approaching a problem from an objective, analytical and contrasting point of view.

l) Critical thinking is an attempt to understand a subject, apply in-depth thinking, appreciate it, analyse its strength and weaknesses and then develop a point of view on it.

m) It applies in-depth thinking on an issue without allowing conventional limits, social constructs or boundaries to constrain the conclusion of a solution or analysis.

n) Critical thinking is analysing the material and identifying its limitations and strengths.

o) It is the close examination of the available evidence which may or may not support the argument. Critical thinking is following the contradictions purposefully to analyse the validity, reliability and durability for justifying one's conclusions.

p) Critical thinking is the analysis of past experiences to help resolve the present situation.

q) Sometimes, it is helpful to analyse the contrary. For example, critical thinking is analysing what is not critical thinking and learning from due process.

r) Critical thinking is asking questions backed up with reliable evidence. It is a learning process to understand why something works the way it works and process through the problem.

s) Critical thinking is engaging functional analysis rather than relying on one's instincts. It is helpful if the analysis is done from various perspectives and is well structured.

t) The well-structured evaluation of available authors, journals, and articles; comparison of different ideas; questioning practice using theory; is also part of critical thinking.

u) In universities or higher education institutions, an in-depth thought process may be considered critical thinking. Analysis can be promoted instead of description, and evaluation should be inspired instead of personal views. It is like a river running through a subject, whereas the evidence joins this river like tributaries.

There are some similarities and differences in these definitions. But the fundamental question Jennifer Moon (2007) is trying to address is how the educator would define critical thinking to a learner in a brief answer. Even when providing a satisfactory definition for critical thinking is necessary, it is not easy to develop a concise, precise and brief definition.

The Delphi research – an attempt to define

Discussing or defining critical thinking and dispositions cannot be complete without a discourse on 'Delphi Research'. The ***Delphi method*** is a structured, systematic, interactive forecasting method that relies on a panel of experts (Brown, 1968). A group of experts came together to work towards reaching a consensus on essential critical thinking dispositions required for educational instructions and assessment. A panel of scholars, educators, and pioneers in analytical thinking theory, a total of 46 experts, were gathered under the funding of the United States Education Department. Using the qualitative research method, known as the Delphi method, the panellists made recommendations on cognitive skill dimensions of critical thinking, the dispositional dimensions of critical thinking, and specific recommendations on critical thinking instruction and assessment, including the development of a critical thinking curriculum (Facione, Peter A, 1990). The experts have "contended that effective and meaningful education requires comprehensive curricular, pedagogical and assessment strategies at all levels of education be coordinated to foster in students those cognitive skills and habits of inquiry associated with critical thinking" (Facione, Peter A, A statement of expert consensus, 1990). The consensus statement also reiterates critical thinking as a liberating educational force and a powerful resource in one's personal and civic life.

Critical thinking and sub-classification of dispositions can be done in numerous ways; therefore, the experts caution that the consensus should not be considered x, necessarily excluding others. While interpreting each sub-classifications, the experts were trying to create 'arbitrary differentiation' so that every sub-skills would become 'conceptually discrete' from each other thinking (Facione, Peter A, A statement of expert consensus, 1990). The following table, Table 1.1, depicts the lists published due to the Delphi research (Facione, Peter A, Table 3, A statement of expert consensus, 1990). Critical thinking should not be limited to academic subjects but also subjects with moral, ethical, and public policy dimensions (Facione, Peter A, A statement of consensus, 1990).

Critical thinking is engaging in an activity, process or procedure like any other skill. Critical thinking skills help the student do the right thing at the right time, possess the correct set of procedures, and know when to apply those procedures (Facione, Peter A, Executive Summary, Delphi research, 1990). If the assessments need to be effective, assessments should be frequent and explicit about reassuring the worth of students and the goals of the instructor (Facione, Peter A, A statement of expert consensus, 1990). In the Delphi research, the experts went beyond approaches to everyday life to insist that critical thinkers can be identified in how they approach specific problems or questions. The experts were divided ire opinion, where a minority preferred to think that a robust critical thinker should have a sense of doing 'good'. But, most experts held an opposing thought, suggesting that critical thinking has nothing to do with cultural, religious, ethical, political or any orthodoxies (Facione, Peter A, Critical Thinking - What it is and why it counts, 2011).

Interpretation

Interpretation in critical thinking:- The ability to comprehend and express the importance of various situations; these can be experiences, events, data, information, procedures or anything that can be contextualised, including beliefs and biases (Facione, Peter A, Executive Summary, Delphi research, 1990). Interpretation is evaluating various possible meanings and assigning the one relevant to the problem. Interpretation is further -divided into categorisation, significance and meaning. Categorisation is about identifying a situation or problem's distinctive characteristics without prejudice. Categorisation makes the case more understandable and classifiable. Decoding the significance explicit the need to ask questions and clarifies the purpose. Clarifying the meaning through careful analysis of words to avoid vagueness and ambiguity leads to intelligent design (Facione, Peter A, Executive Summary, Delphi research, 1990).

Analysis

Analysis in critical thinking:- Recognising and identifying the significant relation between statements, concepts, questions or anything that represents the problem. Examining ideas is crucial to defining terms, comparative analysis of different theories, and identifying the objectives. Detecting arguments from given descriptions or representations will clarify thoughts at this stage (Facione, Peter A, Executive Summary, Delphi research, 1990). Facione also adds the possibility of identifying the similarities and inconsistencies in two approaches to the solution of a problem, identifying the central claim made in a newspaper editorial and analysing the various reasons provided by the editor for the same, and identifying the unstated assumptions made in various situations (Facione, Peter A, Critical thinking – What it is and why it counts, 1992).

Evaluation

Evaluation in critical thinking: It is the ability to assess the consequential, relationship or logical strength of the problem-in-hand (Facione, Peter A, Executive Summary, Delphi research, 1990). It is also the ability to assess the credibility of the statements or arguments or any other representations and to assess the logical basis of the inferential relationships among the representations. Some examples experts provide, as per Facione, identify the factors that make a person credible as an authority or witness depending on the event (Facione, Peter A, Executive Summary, Delphi research, 1990).

Inference

Inference in critical thinking: The skill required to identify the elements that will lead to drawing meaningful conclusions can generally be identified as inference. It can be building meaning from differing arguments and securing logical items from them. The inference is followed by subskills like querying evidence to recognise those elements that need to be supported by logically explainable evidence and finding those key elements that can lead to the recognition of such evidence. Conjecturing alternatives is to find alternative approaches to the problem by evaluating the indications available (Facione, Peter A, Executive Summary, Delphi research, 1990). Foreseeing the

impact of the position taken in a situation or constructing the meaning from assessing the situation are some examples of inference.

Explanation

Explanation in critical thinking: The ability to comprehend and represent based on one's reasoning is called explanation. It is about how well one can justify own reasons and conclusions based on valid evidence (Facione, Peter A, Executive Summary, Delphi research, 1990). Critical thinkers need to explain the reasons behind their judgement or position. This ability provides the listener to understand the bigger picture behind the conclusion of the critical thinker. The ability to describe the methodology, present arguments and justification of the methodology are two subskills of 'Explanation'.

Self-regulation

Self-regulation in critical thinking is the conscious and deliberate monitoring and regulation of one's cognitive process. Self-examination is where the individual should assess their limitations and bias, and self-correction is the ability to rectify the same (Facione, Peter A, Executive Summary, Delphi research, 1990).

The Stage Theory – Richard Paul and Linda Elder

The 'Critical thinking development - Stage theory' was put forward by Richard Paul and Linda Elder, stating that there are different stages a learner passes through as he masters the ability to think critically. Educators must know these stages to provide the required help at each stage (Paul and Elder, 1996).

Stage one: The unreflective thinker: These learners have absolutely no idea what thinking is and how important it is in their lives. Their ability to be metacognitive is poor. They don't recognise concepts or assumptions and are illogical about their opinions or decisions. They may have acquired some thinking skills but are inconsistent, and the learner always falls back on his biases and prejudices. Some of these learners may gain educational qualifications but are not open to new methods or ideas or can't be committed to finding a solution.

Stage two: The Challenged thinker: These learners know the importance of thinking. They may have a general understanding of reasoning (concepts, assumptions, consequences, implications, purpose, etc.) and the need to assess their thinking. Their knowledge is very superficial. Even though they understand the importance of deliberate effort, logic may puzzle them. At this stage, the challenged thinker may consider himself a critical thinker, but his ability to apply these skills is inconsistent, making improvisation difficult.

Stage three: The Beginning thinker: These are learners eager to apply their thinking skills in every area of their life. They can make a deliberate effort to address their reasoning or problem-solving skills. They can understand and identify when their emotions overtake their logic and can think reflectively upon such occasions. They continually assess their thinking, but their inability to provide a systematic approach to their ideology makes them slightly inconsistent. They are open to criticism even though they are sporadic at self-monitoring.

Stage four: The Practicing thinker: These learners understand or know where they can go wrong. They have just begun thinking systematically, but they clearly understand the importance of reasoning and how to assess their thinking. They have realised the necessity to question their ego-centric assumptions. They also understand the self-deceptive properties of cognitive biases and deliberately attempt to challenge their beliefs and preconceived notions. The insight into their thinking is still limited.

Stage Five: The Advanced thinker: Learners with a well-established thinking system that they know is advantageous to them. They have deeper insights (metacognition), and they actively analyse, assess and evaluate their thinking process. The consistency may still be limited, but they are .eager to establish themselves as a bias-less thinker. They can quickly reflect on themselves when they make mistakes and are non-hesitant in correcting themselves. They have identified the link between thoughts, needs, desires and feelings and deliberately attempt to be intellectually fair.

Stage Six: The Accomplished thinker: These learners have an excellent framework to assess and monitor their thinking process continually. Constant structure analysis is needed to find room for improvement, and the metacognition process is well-developed. They know their thinking skills well, clearly understand them, always address them and avoid logical fallacies. They can make the right decisions by sincerely analysing reason, logic, relevance, accuracy and evidence. They display high intellectual abilities like intellectual humility, empathy, and fairness. They have complete control and understanding over the connections between logic, desire and emotions and continually seek out alternatives as problem solvers.

Model for assessment of higher-order thinking

The Center for Critical Thinking and Moral Critique and the Foundation for Critical Thinking are two non-profit organisations working towards educational reform to establish critical thinking as the foundation for education. The organisation's motto is to establish critical thinking values in society to get to the root of problems and develop sustainable solutions to those problems. Richard Paul, one of the prominent critical thinking pedagogues, heads the Foundation for Critical Thinking. According to Paul, the National Council for Excellence in Critical Thinking Instruction defines critical thinking 'as a disciplined process of skilful conceptualisation, application, analysation, synthesis or evaluation of the gathered information, generated by observation, experience, reflection, reason or communication as a guide to action and construction of belief.'

Twenty-one criteria suggested by Paul and Nosich

Paul and Nosich suggest 21 essential questions to assess the substantiative concept of critical thinking.

Criterion 1: Is it possible to test the information processing skills of an individual? One of the essential skills of critical thinking is the ability to process the available information.

Criterion 2: Is it possible to test skills and abilities that apply to various subjects, contexts, situations and academic levels? Critical thinking encompasses proficiency in assessing the elements of thought in all levels of reasoning – identifying

the purpose, problem or the question, assumptions, concepts, empirical backgrounds, reaching conclusions, implications and objections from alternative viewpoints. It should be flexible enough to be used in any subject or context to be figured out and should be able to adapt to any academic level.

Criterion 3: Can it be adapted to essential differences in subject domains? Subject domains differ from each other because of the purposes of such subjects. Therefore they seek different pieces of evidence, reasons, questions and concepts. Critical thinking must be able to underline the standard structural features of different subject domains.

Criterion 4: Is it possible to adapt to the pace of change in subject domains and still find its ground in intellectual history? It is clear enough that critical thinking skills are implicit in rational development and critique of the ideas of intellectual history. The development of new disciplines results from asking questions, following new purposes, new conceptualisation, framing new assumptions, finding new directions, etc. It is evident how a new discipline can find its ground in intellectual standards that transform the academic field.

Criterion 5: Is it helpful in improving instruction? It is essential to understand that critical thinking is not explicit or independent of other objectives of education. Instead, it is a formative goal which can enhance the quality of every other goal intended to achieve through education. For example, critical thinking skills can help students to read, write, speak and listen more effectively because of their well-formed thought processes; the enhanced expertise in the content results from the ability to reason. Critical thinking demands a variety of historical, scientific and mathematical thinking. The intellectual empowerment catalysed by critical thinking leads to self-confidence and developing skills, abilities and dispositions like humility, discipline and perseverance, which are crucial to success in life.

Criterion 6: Is it clear enough to establish the interconnectedness of knowledge and abilities, why the expertise in one discipline is not independent of the knowledge from another discipline, and also sensitive towards the need for

interdisciplinary integration? In critical thinking, the questions from one domain or field are logically similar to those from another. Identifying the need to ask questions using the logical parallels of different domains would be a justified starting point to establish the interconnectedness.

Criterion 7: Is assessing the skills essential to being a responsible decision-maker at the workplace adequate? Critical thinking skills are of high importance in one's career. Critical thinking enhances the learning process, where thought acts as an instrument of learning. The job descriptions are evolving and becoming more 'intellectual', which requires the individual to define specific purposes and goals, analyse and seek out relevant data, consider alternate approaches and possibilities, question assumptions, evolve thinking based on the continuous flow of information, etc. In conclusion, the workplace demands critical thinking.

Criterion 8: Can it inspire clarity in concepts, well-thought, reasonable goals, criteria, and standards? Critical thinking is crucial in generating clear concepts in testing and setting reasonable goals, criteria and standards.

Criterion 9: Is it possible to account for communication skills, problem-solving skills, and critical thinking skills and assess all of them without compromising the necessary characteristics of any? Vague definitions of critical thinking isolate critical thinking from problem-solving, decision-making, reading, writing, and speaking skills. The substantiative concept of critical thinking is like an interconnected web; each of the other skills presupposes each critical thinking skill. Critical thinking skills become pointless if those skills can't be directed towards efficient decision-making, problem-solving or communication (reading, writing and speaking).

Criterion 10: Is it flexible to fit in and respect all cultures by focusing on common-core skills, abilities and traits that can serve those cultures? The criterion has the prejudice that it is possible to respect all cultural diversity by creating tests that can assess the skills and abilities mandatory in every culture.

Criterion 11: Is it compatible with assessing the active engagement of the learners in constructing their knowledge and understanding? A shallow understanding

of critical thinking can bring a negative meaning to the concept. Well-rationalised thinking is a form of knowledge creation, regardless of its result. It leads to well-defined purposes, goals, and questions, seeking data valid to the questions, interpreting the data, and reaching a conclusion. All these must be done 'critically' and hence require critical thinking.

Criterion 12: Is it assessing the fundamental cognitive structures of communication? The dimensions in the cognitive structures are part of the critical thinking ability. The speaker's purpose, assumptions or point of view are all considered elements of thought, and the ability to recognise these as one reads or listens is thinking by reading or listening. Relying on the elements of thought is critical in communicating effectively at any educational level. Critical thinking abilities include inquiring and presenting evidence, clarifying assumptions, and foreseeing the implications of own positions. These communications are dependent on critical thinking standards. So, the assessments should consider the cognitive structures of communication to be effective and in line with the critical thinking standards.

Criterion 13: Is it possible to use this test to assess the characteristics for making rational decisions as a citizen, a consumer and a part of the world economy? Public and private life demands critical thinking. Some decide to employ critical thinking as part of their everyday life. Those who do not may fall victim to manipulation, scare tactics, propaganda, shallow nationalism, stereotypes, greed, false ideologies and emotional vulnerability.

In a modern democracy, citizenship requires critical thinking skills and abilities to assess the arguments they face and contradicting points of view, understand cultural complexity and information credibility and rationally consider priorities.

Criterion 14: Does it avoid a complex whole to oversimplified parts? The test should be able to assess an elaborate and substantiative concept, reasoning in terms of elements of thought. These dimensions affect critical thinking in real life and universal intellectual standards. The test should not focus on fragmented features of critical thinking.

Criterion 15: Does it articulate the critical skills for the future? Basic skills are constituted by the structures illustrated in a rich, substantive concept of critical thinking. To teach reading is to teach the ability not merely to repeat content, but to reconceptualize that content, to see applications of the main ideas, to generalize from them, critique them, see them in context, and to enter with empathy into another's point of view. To teach writing as an essential skill is to teach grammar and punctuation. Still, the ability to arrange one's ideas logically and consistently, anticipate reasonable objections and transfer ideas to the page in a way that makes them decipherable in all their complexity by a reader. To teach math as an essential skill is not primarily to teach how to solve pre-selected, individual, isolated problems out of context but to teach the ability to begin to make sense of the world mathematically, to think quantitatively, to be able to see mathematical patterns, to set up the construction of problems and then creatively go about solving them. Critical thinking abilities like these do not exist in addition to the necessary life skills; they constitute life's basic skills.

Criterion 16: Does it provide necessary skills inside and outside of school? Critical thinking provides skills seen as valuable by practitioners of the academic disciplines, responsible government leaders, the professions of business, and by citizens interested in their environmental, physical, and economic welfare. In all such areas, what is needed are ways to adapt to rapidly changing knowledge, to recognize problems and see their implications before they become acute, to formulate approaches to their solution that recognize legitimately different points of view, and to draw reasonable conclusions about what to do.

Criterion 17 and 18: Does it assess critical thinking in realistic situations, where abilities include formulating and identifying plausible solutions? Yes. Testing authentic skills, abilities and dispositions in authentic contexts can be accomplished using a combination of a) standard multiple-choice items, b) machine-gradable multiple-rating items and c) short essay items.

a) The standard multiple-choice part of the assessment would be an expanded version of established critical thinking tests, such as the Watson-Glaser or

Cornell tests. It is suitable for assessing micro-dimensional critical thinking skills, like identifying the most plausible assumption, recognizing an author's purpose, and selecting the most defensible inferences.

b) The multiple-rating part of the assessment would test more open-ended and larger-domain abilities, like thinking within opposing points of view, being willing to suspend judgment, synthesising disparate data into a logical scheme, taking established findings and generalising them into new contexts, etc.

The multiple-rating portion of the assessment, to be reliable, must:

embody a rich and substantive idea of critical thinking

ii) be constructed and monitored by critical-thinking experts who have such a concept

iii) be changed often (5% annually) to assess critical thinking concerning authentic contemporary issues

c) The essay part of the assessment would address critical thinking abilities and traits that involve creating a logic to capture a situation rather than selecting from among possibilities suggested by the test. Examples include the ability to construct an interpretation, to make a logical outline of a text, to figure out ways to gather information, to take an unclear and complicated real issue and reformulate it to make it more amenable to solution.

Criterion 19: Is it financially affordable to use this test nationally? The assessment should be a) paid for by school systems that contract to have their students tested and b) constructed, monitored, administered, and graded by a private agency with critical thinking credentials, or at least under the direction of scholars with a solid grounding in the research into critical thinking. The constructed response segment of the assessment should be administered not to the population of students as a whole but rather to a representative sample of the student population of a school system to make it affordable.

Criterion 20 and 21: Does it consider the improvement of the students throughout their education and assess the achievement against national standards? o evaluate students in both these dimensions requires:

a) an assessment administered as a pre-test in the 6th grade and then as a follow-up in the 9th and 12th grades (to provide for value-added judgments)

b) a criterion-referenced assessment built on clear, consistently applied quality norms derived from a rich and substantive concept of critical thinking.

Being alert to the dangers posed by a non-substantive concept of critical thinking is essential. Such a concept exists when, separate from a consideration of the research in the field, a person or institution presupposes a) that the meaning or terminology of critical thinking is intuitively apparent (hence not in need of scholarly analysis) or b) that each concept underlying critical thinking (such as assumption, inference, implication, reasoning) can be analyzed separately from a theory that accounts for the interrelation of these concepts, or c) that the skills of critical thinking can be adequately cultivated without reference to the values, traits of mind, and dispositions that underlie those skills for the measuring of national progress)

Disagreements on Criterion 10: In Thailand's case, some aspects of critical thinking might question the existing cultural norms and practices. These questions are not deconstructive but an attempt to rise as able and capable critical thinkers.

The Ennis stand – Robert Ennis

According to Robert Ennis, several researchers have emphasised the importance of critical thinking dispositions in addition to critical thinking abilities. Disposition is more of a tendency which may not be easily identifiable or noticeable via inspection. Disposition can take the form of mere disguise in assessment without having such an inclination. It is also possible that a person possesses the disposition without even realising it, thereby ignorant about when to use it. Ennis seems to rely on questioning as the primary starting point in critical thinking. Perkins, Jay & Tishman (1993) offer a triadic theory of inclination, sensitivity and ability as sufficient components for critical thinking dispositions. According to Ennis, sensitivities and abilities may not be

necessary. Ennis has observed learners who possess the ability may not always clarify themselves or others significantly in certain situations. Even though Ennis reconfirms that dispositions may not be helpful without the related sensitivities and abilities.

Ennis agrees with the freedom of researchers to create new meanings. Still, he points out the necessity to conform with meanings in critical thinking, especially when dictating guidelines for institutions to follow. Without real meaning and definitions, there would be chaos and confusion. Ennis provides the example of the word disposition itself. The teachers may be confused by the word disposition and may teach dispositions, neglecting abilities. The teachers cannot be blamed because, per the triadic theory (Perkins, Jay & Tishman), anybody who learns the dispositions will acquire the abilities. Ennis is confused about whether to agree with this completely or not, as he states that people who learn about dispositions may be inclined to use those dispositions. But there is not enough evidence to state that knowledge ensures application. Knowledge may lead to the application, but not necessarily and not always.

Ennis says identifying critical thinking dispositions to execute practical training and teaching is tenacious. Ennis considers several thinkers like Norris (1992) to reiterate the disposition to think critically. In contrast, Facione and Sanchez (1994) present open-mindedness, inquisitiveness, systematic ability to analyse, curiosity to seek the truth, the confidence to think critically and maturity. Even though Ennis agrees with these lists, he believes all these dispositions must be treated extensively. The disposition to 'think critically' (Norris) is comprehensive and vague as it does not provide a framework for teachers and assessors to work effectively. The terms' maturity' and 'self-confidence to think critically' (Facione) are also vague. Ennis assumes that factor analysis based on which Facione developed the list may be insufficient to defend the terms used to describe the factors. Ennis is more inclined towards the elaborate list created by Perkins, Jay and Tishman (1993), which identifies almost seventy dispositions. But Ennis shortlists seven as a manageable number for assessors and educators.

1. To be broad and adventurous
2. Toward a sustained intellectual activity

3. To clarify and seek understanding

4. To be proactive and strategic

5. To be intellectually careful

6. To seek and evaluate reasons

7. To be metacognitive

Even in this list, Ennis is disappointed as Perkins, Jay, and Tishman neglected the disposition to be well-informed and the ability to take a position when pieces of evidence and arguments demand. Ennis argues that these two dispositions are critical, considering some criticism the critical thinking movement faces. The complaints of Hirsch (1988) and McPeck (1990) about the neglect of content demand the affirmation that the disposition of being well-informed must be included in the list. A widespread public perception that critical thinking encourages scepticism should be answered by including the disposition to take a position as the evidence demands (Ennis, 1996).

Ennis employs six criteria for assessing, teaching and researching critical thinking dispositions. They are:-

1. Simplicity
2. Comprehensiveness
3. Value
4. Comprehensibility
5. Conformity of language to everyday meanings
6. Fitting of subordinates under superordinates.

Ennis is hesitant about a seventh possible criterion, mutual exclusiveness, as it can confuse all the stakeholders (students, teachers, test makers, etc.) involved. Creating mutually exclusive categories of dispositions seems to be an arduous task for Ennis. As an alternative, Ennis also suggests a system of three broad dispositions. Ennis ignores the argument that critical thinking should always represent something that is 'good'. Ennis finds this requirement overwhelming; therefore, he believes that any educational attempt would be dangerous if it did not consider the worth and dignity of every person. Ennis contents strongly that these dispositions provide a relevant and

necessary basis for teaching and assessment. The revision of this list is not out of the question in the future (Ennis, 1996).

Ennis argues that assessing critical thinking among learners depends on the dispositions selected, which can be present in multiple assessment activities. Even if there is an agreement possible in deciding which dispositions are to be assessed, it is possible that some of those dispositions may not be quantifiable or directly observable (Ennis, 1996).

Issues in conceptualisation, according to Ennis

Feminist critiques of the critical thinking movement, as cited by Ennis (Noddings, 1992; Thayer-Bacon, 1993; Martin, 1988), have argued for including these dispositions. Ennis primarily focuses on two significant issues in conceptualising critical thinking dispositions. To remain unbiased towards the issues one is studying while listening to one's inner voice may sound contradictory. Ennis feels that it might be unfortunate if a person is not caring, but at the same time, caring leads to biased decisions. Caring, if not objective, can harm the concept of critical thinking. Endorsing every caring in critical thinking dispositions might be unrecommended. The critical thinker may possess the associative disposition of caring for the worth and dignity of every person (Ennis, 1996).

Ennis puts forward the same argument when listening to one's personal/inner voice. According to Ennis, personal voice can overlap or at least influence one's critical thinking abilities. This overlapping may sound reasonable in the social construct or culture, but this may not be part of critical thinking. Ennis argues that pursuing one's instincts or gut feelings results from the subconscious influence of critical thinking dispositions. But, capable critical thinker also knows when to stop following their instincts as it can lead them astray without well-grounded reasons or pieces of evidence (Ennis, 1996).

Multiple choice testing and performance assessment

Ennis believes that a true or false multiple-choice test may not be sufficient to assess critical thinking dispositions. According to Ennis, a test-wise person can identify what the test maker wants in a multiple-choice or forced-choice test. But if the items on the test directly target a disposition, then it is practically impossible to predict whether the item is valid for the measurement of the disposition. Factor analysis may be an alternative, but factor analysis shows only the correlation.

On the other hand, assessment based on performance seems to be the perfect alternative, in Ennis's opinion. As long as the person being assessed is focused on the performance, it's more or less confirmed that they will use what is disposed to them. Thus dispositions will become evident. This method has several disadvantages, as they are time-consuming and expensive. It is also possible that dispositions may not be evident even if they are present due to the lack of time available for the observer. Even if it is present, it may also lack consistency. This inconsistency means the dispositions were evident in one instance and not displayed in another. Consistency in displaying the dispositions should also concern the observer or educator (Ennis, 1996).

These difficulties of time may affect researchers but may not educators. Educators may have ample time to assess the learners as they have more time in the classroom. As long as the educators are not biased and are familiar with the critical thinking dispositions, they can assess effectively. Guided open-ended opportunities to secure focus on critical thinking dispositions might solve the problem of both time and expense. Still, the presence of a disposition may not always be evidence of an associated sensitivity or ability. The most significant difficulty in critical thinking assessment is that the educators are looking for unobservable dispositions, and the educators require the students to display them without being aware of them as a disposition is a tendency. It is always possible for the learners to fake it if they know they are aware and have the ability and sensitivity (Ennis, 1996).

The curriculum question

The developers of the critical thinking curriculum generally limit their options to (a) adapting the dispositions or critical thinking to the existing subjects or (b) teaching critical thinking as a separate topic. Ennis believes that a third option of integrating these two thought processes might be a more effective method. Robert Sternberg is also a strong advocate of this approach; critical thinking should also exist as a different course and be integrated into the existing courses. Infusion and immersion are two methods suggested by Ennis in the integration of critical thinking into the existing courses. Infusion is where basic principles of critical thinking will be explicit, while in immersion, the thought process behind critical thinking may not be dealt with explicitly.

Ennis defines critical thinking as reflective thinking to conclude belief or action to avoid confusion. Ennis cites the point of view put forward by Harvey Seigel on being influenced by reason and Richard Paul's emphasis on understanding their own and others' point of view and assumptions. The goal of the curriculum, no matter which position the educators take (domain-specific or as a separate course), is to help the students think critically. The nature of critical thinking skills as a result of higher education needs better clarity and refinement (Ennis,1997).

Empirical or Epistemological

Critical thinking may be empirically domain-specific, provided that the knowledge in one domain is non-transferable to the other. Ennis believes that this depends on the students. Transfer occurs for some students even when it is not the intention of the teaching, but for others, it may not occur even when it is one of the educator's intentions. It is evident that issues, problems and approaches differ from domain to domain, but the controversy is about how much critical thinking differs from domain to domain. Ennis holds on to the view that principles like necessary conditions might not be sufficient, and the credibility principles involving conflict of interests are universal in all domains (Ennis, 1997).

What the domains have in common, even if they have something in common, is too trivial and not worth explaining. The same applies to the universal principles that bridge critical thinking abilities (McPeck, 1990). The primary questions that need to be asked in the curriculum problem, according to Ennis (Ennis, 1997):

1. What is the extent to which universal critical thinking principles are transferable from one domain to another, even when teaching for transfer does not occur?

2. In a defined situation, which of the three (general, embedded, both)

a) Would it be most effective?

b) Is the most politically and economically viable?

c) Can and will be pursued with the available resources?

3. In a given situation, if embedding is decided on as at least part of the solution, is infusion or immersion more beneficial for the given students in the given courses?

4. To what extent do various domains share common critical thinking principles (the epistemological domain-specificity question)?

5. To what extent are the common principles (if any) trivial?

6. How can "domain" be defined so relevant studies can occur?

7. Should the critical thinking goal include critical thinking in everyday, post-schooling life?

8. If it does, which teaching areas should be responsible for pursuing that goal?

9. Are the basic concepts of the disciplines critical thinking concepts?

10. What is critical thinking anyway?

11. To what extent does the content of our education system include the content of everyday life's questions and problems?

Ennis has distinguished in developing this account of major relevant factors and issues.

a) among the general, embedded, and mixed approaches to incorporating critical thinking in a curriculum,

b) between empirical and epistemological domain specificity,

c) between infusion and immersion as ways of embedding critical thinking instruction

d) between the goal of critical thinking in everyday life and the goal of critical thinking in particular academic domains,

e) between the content of everyday life and the content of the courses in a person's education,

f) between the basic concepts of the disciplines and those of critical thinking, and

g) between an ideal program and one reason in the light of existing resources and traditions, including instructor and departmental ability and willingness to participate.

Critical thinking and critical Pedagogy

Critical thinking and critical pedagogy may sound very similar, but both have their favoured authors and targeted audience. The stressed point is ‘critical’, and that’s the valued educational goal in this context. The need for urgency and panache for ‘critical’ is shared by advocates and educators of critical thinking and critical pedagogy. The slogan raised by both sides, if there is any, is to protect the learners from being ‘deceived’. The pre-assumption of both sides is that most of the population is challenged from recognizing or identifying specific types of deceptions and distortions, which limits their freedom. Critical pedagogy tradition is mainly concerned with societal inequality regarding power distribution. Critical pedagogues attempt to enable the masses through education and empower them to question the existing culture that legitimizes an unjust status quo. Critical pedagogues tend to take the side of the masses that were socially, politically and economically ignored. They primarily consider it their

duty to empower the mass through education. Critical thinking authors may also mention similar concerns, but they tend to stress more on applying critical thinking in daily life choices than social problems. They consider that the general habit of using critical thinking in everyday life would, in turn, benefit society as a whole. Thus, both pedagogues and thinkers argue that empowering people through critical thinking can affect their vision and understanding of their world. This empowerment will enhance opportunities for the learners and their freedom of choice.

By taking a closer look, other differences start to reveal. The critical thinker seems prejudiced about the inadequacy in thinking of society in general. Critical thinkers feel that people generally don't analyse arguments, reach hasty conclusions or generalisations, overlook the lack of evidence, rely on unreliable authority, etc. Richard Paul (1990) concludes it as ' 'irrational, illogical and unexamined living'. A critical thinker is free from unjustified, undesirable and evidence-less beliefs (Harvey Seigel, 1988).

The critical pedagogy tradition is more to do with the power structures of the society, and the primary question the pedagogues ask might be, 'Who benefits?' Social injustice and the transformation of undemocratic, unaccounted and oppressive institutions is one of the most prolific occupations of critical pedagogy. The general skills associated with critical thinking will occasionally be the topic of discussion. But even these discussions might be highly related to some situations where fallacies were used to implement undemocratic ways. Critical pedagogues are not just searching for truth, but it is the search for truth with passion (Burbule, 1992/1995).

The critical thinking parallel to this is to question the evidentiary base and to find it mandatory. It is, in fact, true that neither critical thinking nor critical pedagogy is massively inflexible or identical. A closer analysis would reveal similarities and differences.

In critical thinking, the learner is a consumer and consumes the necessary information to seek reasons and evidence. The learner needs specific thought skills to comprehend or analyse this information. These skills are essential to defend, analyse, or infer the facts sought by them. The majority of critical thinking literature consists of these

lists of various skills, taxonomies, and what the critical thinker should know or do (Ennis, 1962; 1980). Towards the late 1990s, multiple authors and theorists started addressing that teaching these skills is seldom necessary if the learner does not take the initiative to develop these dispositions themselves. This observation points out one of the biggest common misconceptions that critical thinking can be taught. Critical thinking is the ability to seek the truth, reasons or evidence and the motivation or tendency to explore them. Ennis claims that a critical thinker may not always seek reasons and may not be well-informed but regularly tends s to do the same (Ennis, 1987, 1996). Seigel disagrees with Ennis for considering dispositions as something that permits critical thinking. Seigel argues that dispositions are more of a subconscious character trait, like natural favouritism towards truth (Seigel,1988). This favouritism can very much be part of critical thinking. Paul also categorises these skills and dispositions as strong and weak senses. Paul argues that the dull senses are those skills which can be demonstrated when asked. But, the keen senses are already a way or part of the everyday life of the thinker, where the thinker's prejudices and beliefs are questioned and reevaluated. When the panache for clarity, fairmindedness and accuracy motivates a thinker, the thinker is a critical thinker in the strong sense (Paul, 1984, 1994).

The view of critical thinking from a dispositional angle has undoubtedly had its edge over the skills-only angle. But, still, it just broadens the horizon of critical thinking by positioning it above mere 'logicality'. Critical thinking demands more than just skills and dispositions that revolve around an individual and the individual's everyday life. The social and emotional conditions are more or less ignored in the critical thinking dispositions. Being a critical thinker may demand specific conversations and interactions with society; therefore, the social construct that may inspire or inhibit the critical thinker must be a significant component in learning what the critical thinking movement is intended to achieve. Another theme in Critical thinking literature has been the extent to which critical thinking can be portrayed as a set of generalized abilities and dispositions, as opposed to content-specific abilities and dispositions that are learned and expressed differently in different areas of investigation. Can a general "Critical

Thinking" course develop abilities and dispositions that will be applied in various fields, or should such material be explicitly presented in connection to the questions and content of particular fields of study? Is a scientist who is a critical thinker doing the same things as a historian who is a critical thinker? When each evaluates "good evidence," are they honestly thinking about problems similarly, or are the differences in interpretation and application dominant? This debate has set John McPeck, the chief advocate of content-specificity, in opposition to several other theorists in this area (Norris 1992; Talaska 1992). This issue relates not only to how we might teach critical thinking but also to how and whether one can test for a general facility in critical thinking (Ennis 1984).

Another critical thought process in the critical thinking literature is the extent to which it can be portrayed as just a list of skills and dispositions rather than different subject-specific skills and dispositions that can be learned and displayed differently in different situations. Is attending a critical thinking course practical and using those abilities in various walks and fields of life? Is a physicist who is a critical thinker need the same abilities and dispositions as an archaeologist who is a critical thinker? When each of them evaluates reasons and pieces of evidence, are they doing it the same way? (McPeck, 1981). These questions are also related to an issue raised by Ennis, where he raised the question of how critical thinking can be taught and how it can be tested through a standardised test (Ennis, 1984).

Another angle of the debate is how related the standards of critical thinking, rationality and their underlying concepts favour a gender or the Western way of thinking. Other schools of thought and alternative worldviews have challenged the most prominent theories of education and the scientific method. How logical is it to consider that only ‘our’ ways are suitable? In response to these criticisms, Richard Paul argues that ‘sociocentrism’ is a sign of seriously flawed thinking (Paul, 1994). Critical thinking empowers us to grow beyond ego-centric and socio-centric outlooks; that growth process is mandatory to our role as the shaper of our destiny (Paul, 1990). The ability to think from another’s point of view is essential to assessing the truth claims. The presence of substantial prejudice about the effectiveness of one’s methods or standards

can lead to hasty and premature rejection of alternate methods/points of view. The most negative side of this is silencing the voices that need encouragement. In these scenarios, the critical pedagogues find space for social and contextual factors, which should be part of critical thinking (Burbules, Berk, 1999).

The neo-Marxian literature sparked the discussion of critical pedagogy on critical thinking discussion, according to Stanley, 1992. Marxism ignored how well the media culture can fuel the growing influence of capitalism. The ideological monopoly and its maintenance were crucial for the smooth functioning of capitalist economies. The rise in the budget for advertisements and their role in building a brand's image as something loyal and ready to serve consumers were vital to the sustainability of capitalism. The education system was built around this economy to create labours and standardised test-takers to serve this existing economic system (Bowles and Gintis, 1976; Apple, 1979; Popkewitz, 1991).

The response of progressive educators against these institutionalised functions can be considered the critical factor of Critical pedagogy. It can be called an attempt to work within the system, education or other media and raise questions to make mass think about the inequalities of power and question the social constructs to improve one's life or living standards. The most famous thinkers in this thought process might be Paul Friere, Henry Giroux, Peter MacLaren, Ira Shor and Jennifer Moon. In critical pedagogy, a critical thinker is a person who is empowered by their ability to think to seek justice and emancipation. Identifying injustice is not enough in critical pedagogy; the ability to question it at its core and the drive to change is also necessary. This is the point where the famous Marxian quote, "Philosophers have only interpreted the world in various ways; the point, however, is to change it." (Marx, 1845). The 'change' is critical in critical pedagogy, and 'the collective action' follows. The attempt is to educate the masses on critical thinking skills and dispositions and to think critically against any false, misleading or partisan beliefs that act as catalysts towards the unjust status quo.

Paulo Freire has projected some of these concerns in his works. The original context of his work was towards the empowerment of Latin American peasant communities under an oppressive regime. The primary focus of Freire was developing a critical consciousness by identifying one's place or position in a system of oppression. The problem, according to Freire, is the belief of the oppressed that the oppressors are protectors of the system, and they are inevitable. The oppressed do not understand their need for liberation and exist in the system to serve the oppressors. Freire attempted to ignite the oppressed's critical consciousness so they could realise and identify the injustice in the system (Freire 1970a, 1970b, 1973, 1985; McLaren & Lankshear 1993; McLaren & Leonard 1993).

Giroux came up with the idea of the language of critique and the word of possibility, which, according to him, is essential in the search for social justice (Giroux, 1983, 1988). Giroux's primary criticism of critical thinking is that it only offers the language of critique, not a possibility. The institutions of education were vital in reiterating the importance of capitalist relations for legitimising oppressive ideologies and could not instil the concept of social justice among the learners (Giroux, 1988). According to Giroux, the educator must provide the learners with the language of possibility by showing them the various paths of ambition, hope, educational struggle and social justice (Giroux, 1988).

In both thought schools, critical thinking and critical pedagogy, it is crucial to have the initiative or the inspiration to act, whether seeking the truth, reasons or justice. In critical thinking, seeking the reasons or truth is not enough, but the determined pursuit makes the person a capable critical thinker. In critical pedagogy, it is not enough to understand and identify the existing power imbalance or injustice, but one must act to change it. From both viewpoints, it is clear that thinking directly connects with action. When Ennis defined critical thinking as "reasonable reflective thinking focused on what to believe or do," it is assumed that decisions can lead to actions (Ennis, 1987). The conviction towards reason and action has a very close relationship with the model of practical reasoning. But, in critical pedagogy, to inspire the oppressed to overcome

oppressive thinking and demoralisation that has been part of the social construct is a more complicated process. In critical pedagogy, thought and action go hand-in-hand. Both should happen together to gain more effectiveness. The method of gaining critical consciousness is achieved through thought and practice (Freire, 1970).

The criticism and changes demanded by critical pedagogy would not be satisfied without transforming the existing institutions, thought processes, ideas and relations that nurture oppressed thinking. Critical pedagogy is not an additional responsibility but an integral and inseparable part. In critical thinking, the development of refined thinkers can lead to challenging misleading factors of society, but that would be more of a consequence of critical thinking rather than a goal. Freire's essential pedagogy framework revolves around his focus on 'literacy'. It was motivated by the attempt to develop an adult education program to teach the population to read, establish self-esteem, and build confidence. For Freire, literacy leads to empowerment and the negation of helplessness. The real challenge for the learner is learning to read and write and overcoming self-contempt and a sense of helplessness (Freire, 1970).

From the critical thinking perspective, critical pedagogy seems to cross the line of indoctrination. In critical thinking, the learners are free to conclude, whereas the findings might seem predetermined in critical pedagogy. Conversely, the pedagogues might argue that indoctrination already exists, and it is vital for the learners to critically evaluate the social conditions that led to the existing indoctrination. Critical pedagogues may also point out that critical thinking is just about thinking critically, whereas critical pedagogy demands political thinking. In critical pedagogy, self-emancipation goes hand-in-hand with social emancipation. It is not just a difference between the emphasis on the individual or the society, but critical thinking and critical pedagogy demand 'criticality' in both senses (Missimer, 1989/1994; Hostetler, 1991/1994). The individual's critical thinking ability can lead to the development of a thinking society, but it may not depend upon it.

These two traditions, critical thinking and critical pedagogy, also differ in how they consider some issues as actual issues. Critical thinking has no pre-determined issues or agendas. This lack of agendas does not mean that prominent critical-thinking theorists like Ennis, Paul, Facione or Seigel do not wish to address the social injustice or impartiality. On the other hand, they don't want to pre-determine these issues for the learners and strive to do so. Social issues might be beneficial to students to practice their critical thinking abilities in the classroom, but they are not explicitly crucial to critical thinking. It is evident that critical thinking tends to address issues on an item-by-item basis but not on a bigger picture or grand scheme. The issues may be connected to other issues in a broader sense, but those connections may not be investigated in the critical thinking tradition. In critical thinking, it is crucial to describe the issue, identify the reasons and evidence, and point out the assumptions that directly impact the argument. This process is a more analytical and focused view rather than a holistic one. Critical pedagogy addresses a larger narrative, where power is interconnected with social structures and social relations and criticises the critical thinking tradition for being artificial and narrow for not treating these problems as central. Critical pedagogy looks for a more in-depth explanation of the interconnecting links between power and social relations. In critical pedagogy, the item-by-item analysis makes no sense, as it looks for answers from factors that may appear less relevant initially.

This analysis does not imply that critical pedagogy wants learners to recognise the 'bigger picture' whereas critical thinking does not. It is possible that the 'bigger picture' would sometimes tend to be different in both traditions. The difference exists, and the reason is due to the reluctance of the critical thinking tradition to prescribe the context and the enthusiasm of critical pedagogy in ascertaining the context. The context prescribed by the critical pedagogy tradition tends to be social injustice in terms of capitalism and forms of cultural and material oppression. This context ignites the critical thinking theorists' accusation of indoctrination on critical pedagogy. They might argue that everything in critical pedagogy is questionable except the premises of critical pedagogy itself. Critical pedagogues may counter this argument by accusing critical

thinking of acting as an accessory that caters to existing social injustice. In summary, critical thing and critical pedagogy consider each other to be 'not critical enough' in terms of their priorities and the elements they neglect. At the same time, they acknowledge the specific goals and values of each other but argue that the methods are not adequate to meet those values and goals.

The alternate approach to criticality

Burbules and Berk (1999) proposed the alternate approach, highlighting the critical observations from analysing critical thinking and pedagogy.

1. Criticality does involve specific skills and abilities, but it is certainly not limited to these skills and abilities. These skills and abilities must be analysed based on what they can do and also on what they cannot do.

2. The ability to think outside the framework: to think critically is not just limited to the purpose of not being deceived. Breaking away from the conventional constructs can't be stressed enough to think effectively while challenging alternatives. These alternatives must be considered but discarded if they lack evidence or don't serve the bigger picture of critical thinking.

3. The ability to reflect upon one's views and think beyond one's biases can lead to a conclusion that all views are not equally valid. Most importantly, it allows one to challenge one's views and values if thought critically.

4. To not be limited by ideology

5. The perspective of viewing criticality as a practice

The role of emotion, language and curiosity – Jennifer Moon

Emotion and critical thinking

The person's emotion is critical to critical thinking (Brookfield, 1987) but is a highly ignored factor (Blom Kemdal and Montgomery, 1997). It is a widespread understanding that emotion is crucial in one's decisions and choices. Still, it is also a very complex topic to understand due to the lack of a definition of emotion. Emotions may trigger all thinking. Emotions, instincts, feelings and values all deeply influence the decisions, choices, course of action, etc. Providing value to the feelings might be the

best way to judge its effectiveness. But, the primary question is whether to allow emotions to lead towards perception and thinking or to use judgment first and then use emotions to determine solutions. (De Bono, 1982).

Many definitions of critical thinking ignore the importance of emotion in their definitions. For example, Paul (1992) does not consider the ability of emotions to influence thought. Paul is the same thinker who wrote earlier that 'emotions and thought are deeply welded together' (Paul, 1987, as cited by Jennifer Moon). If emotion and thought are inseparable, understanding their relationship and interdependence in detail will be an arduous task. It is better to start analysing this by realising that all human actions are influenced by emotion (Damasio, 2000). Jennifer Moon's model (2004) for understanding the relationship between critical thinking and emotion suggests that there is not just one direct relationship but many in various magnitudes. The model was developed by Moon (2004) with the preconception that understanding the concept of emotional intelligence might bring clarity to the understanding of the relationship between emotion and learning, Even though emotional intelligence is too broad to apply to specific activities like reflection or critical thinking (Moon, 2008).

The ability to relate to others emotionally or to relate to their emotional states is defined as ***Emotional intelligence***. This ability can be illustrated in critical thinking scenarios where thinkers have to work together in a group. In such a scenario, learners/thinkers need to consider the impact of one's intuitions as well as the intuitions of others. The ability to identify and evaluate the goals of others from different backgrounds and find the common threads between the thought process of others are also important (Underwood and Wald, 1995). In a direct social activity like critical thinking, considering and responding to another person's viewpoints is mandatory. Emotional awareness is vital for effective communication in critical thinking dialogues (Brookfield, 1987).

Emotion is involved when emotion or topics related to emotion are the primary subjects of critical thinking. It is also possible that emotion might have sometimes influenced the knowledge generation. Especially during self-evaluation,

considering the thoughts and beliefs, one grew up with, and analysis of the same in terms of fallacies and science can be a very emotional experience (Brookfield, 1987). The self-appraisal about the influence of one's own emotions on their thinking, social constructs, prejudices, etc., can also be a very vigorous exercise (Nelson-Jones, 1994).

Emotion can complicate the critical thinking process. The fear of questioning the authorities can lead to severe deterioration of critical thinking. The need for a safe environment where the students can question without inhibitions is mandatory in inspiring critical thinking (Meyers, 1986; Underwood and Wald, 1995; Mortiboys, 2005). Read, Francis and Robson (2001) highlighted the lack of confidence among students in expressing the outcomes or ideas in their thought process because of their relations with the educator and due to their position in the academic hierarchy.

Emotions that are relevant to a topic may result from critical thinking. Emotion can lead to memorising events or experiences that can lead to the conclusion of the subject of critical thinking. Self-appraisal, which questions existing beliefs, biases, and behaviours, may lead to fear, anxiety, resentment and fear of being intimidated. These emotions can lead to an emotional outbreak (Brookfield, 1987). In a study by Holman and Thorpe (2002), where argument analysis and story-telling to inspire critical thinking were used among management students, the learners went through a plethora of emotions, including fear and anxiety, during the story-telling process. As emotion is an integral part of language, many other studies, like Strong-Wilson (2006) and Shaw (1994), show evidence of emotions influencing the critical thinking process, both from a positive and negative angle.

Emotions irrelevant to a situation can act as an inhibitor or a catalyst to practical critical thinking. Studies like Beard and Wilson (2002), Csikszentmihalyi (1990), and Claxton (2000) showed enhanced cognition and active learning accelerated by emotions. These observations suggest that the contrary may also be true, where emotion can distract critical thinking, and the emotional atmosphere can influence the thinking process. DeBono (1983) identifies the importance the general public would give to feel 'right', which can be translated to the 'need to win an argument'. It might be

linked to the notion of self-esteem and self-righteousness. In reality, as DeBone points out, being right has nothing to do with reality but only with the time for winning the argument. Sometimes it is critical for a person that the people around them believe they are correct, and that need may translate into how they select, neglect, or distort evidence.

Emotional insight is a term coined by Moon (2004) as a bridge between emotion and learning or reflection. It is a hypothesized bridge during the critical thinking process that includes self-appraisal, where a sudden or random change in personal biases or outlook happens, maybe unconsciously or rapidly. This change or shift can result from interventions or other external factors. Hastie and Davies (2001) argue that some emotional responses are unconscious and sometimes mysterious, even to the person experiencing them. It is evident from these examples that there is no one way, but there are different ways in which emotion is directly connected to the critical thinking process.

Role of language

Language plays a crucial role in critical thinking, whether written or spoken. The role of language in critical thinking also depends on the approach towards critical thinking activities. Despite its emphasis, language is vital in critical thinking in how the thoughts are conveyed, precise or not precise, distorted, clarity, vulnerability to manipulation, and filled with assumptions or fallacies (Moon, 2007).

Emmet (1964) suggests ideas that would function as a base knowledge for critical thinkers about the role of language in critical thinking. Some ideas are self-evident, but that should not give the learner the prejudice that the learner should take due account of all of them. The language was created by humans many centuries ago and is also subject to change. It is also the product of the era when the structural foundations of the language were laid. Some aspects of the language may not be able to transform well into the current time and era. New vocabulary that would serve the purpose of modern times is required to overcome this deficit. The vocabulary used in education is also the product of a time when what was learnt was directly linked to what

was taught. Emmet (1964) refers to language as the holder of meaning. Emmet explains that language and its use can mislead humanity away from reality. If it is true, it is safe to say that language has bewitched humankind. Postmodernism backs up this idea of bewitchment. Critical thinking may be an act of recognising, confronting and analysing this bewitchment. The cultural beliefs and biases people carry in their thought process result from this 'bewitchment' conveyed to humankind by different languages, which are the products of different cultures (Moon, 2007).

As critical thinking is a social activity, language will play a vital role as a tool for communication. The need for ideas to be conveyed in the best possible manner is necessary for the counterpart to perceive the reality of the conveyor at the moment. There can't be enough stress on clarity and precision in communication. Communication in critical thinking empowers the other to see what the thinker can see or translate the thinker's ideas to the other. Emmet (1964) says there is no use for a word if people don't use it or understand it the same way. Some words are culturally specific. Some words are specific to academia and academic disciplines and may not be used in frequent communication. Learners may need to adapt these words for effective communication. Academics may not be keen on identifying these words or when the learners need a proper introduction to these words. According to Moon (2007), critical is a classic example.

The obscurity of words has a crucial role in critical thinking. Every word needs to be evaluated for the meaning they convey, as part of the reasoning process or as the subject matter of reasoning. The same word can mean different things to different people, so they must be identified and defined explicitly. The exact words can have different values for different listeners (Moon, 2007).

Moon (2007) describes value as a system of traditional beliefs that can guide or influence how one thinks, acts or understands. Even sometimes, these values unconsciously determine a person's behaviour and actions. Morality or moral value is an example of this. Such value-bearing words include informer, sneak, human rights, popularizer, superficial (De Bono, 1982), and experiential learning (Moon, 2004). Critical

thinking is also a value-laden word which often appears in mission statements. Certain areas of critical thinking, primarily political, focused on the language used in society and the movement's followers. ‘Consciousness-raising’ (Hart, 1990) is an example of such a word used by the feminist movement. Careful attention must be given to the words used in critical thinking communication. Issues related to the language need to be brought to the learners' attention while examining the nature of assumptions, and this should be given much weightage in the pedagogy for critical thinking (Moon, 2007).

Interest and curiosity

The element of interest and intellectual curiosity is essential in the characteristic traits of a critical thinker. This element is one of the primary reasons behind critical activity for many. A person begins to question something because of interest and curiosity that follows the interest. Some people are intellectually curious, while others are happy with accepting the answers (Kneale, 2003). The possibility of generating intellectual curiosity is questionable, but words like promote, nurture and foster are essential in inspiring curiosity. Curiosity is a form of motivation. This motivation can come from the freedom for exploration and the sense of some control over the learning situation. Without motivation, it is difficult for intellectual curiosity to grow. Academic achievement may not be necessarily related to intellectual curiosity, like scoring in examinations may not be the strong suit of the intellectually curious (Moon, 2007). Meyer’s (1986) pedagogy primarily depends on stimulating curiosity and interest. Creating an atmosphere of disequilibrium in thoughts may stimulate curiosity.

Academic Assertiveness

Academic assertiveness, a personal trait, is more based on the thinker's confidence, the ability to recognise one's position in academia, and the ability to cooperate and express critical ideas and actions. According to Jennifer Moon, Assertiveness is not to be confused with aggression. This assertiveness is a positive character trait displayed by highly successful people (Moon, 2007). Critical thinking is not a dispassionate learning process where students are taught new ways of perceiving things but an encounter that questions one's selfhood (Meyers, 1986). Critical thinking

demands personal autonomy, a determination not to be cornered by dogma or beliefs but to pave one's path that holds up personal integrity (Barnet and Coate, 2005). The ability or possession of specific psychological and emotional orientations and behaviour that could effectively manage the challenges towards self and move forward in learning and critical thinking can be defined as academic assertiveness (Moon, 2007). Moon (2007) illustrates specific characteristics of academic assertiveness.

A) Identifying a form of expression to engage oneself in critical thinking or debate;

B) The daring to challenge, to accept the challenge, the ability to disagree;

C) The ability to manage oneself when proven 'wrong'; the ability to recover from being called out for making an 'error' or 'mistake'; the ability to put to change if necessary; the ability to accept criticism on one's performance;

D) The readiness to listen and accept other's viewpoints; the realisation that anybody can make a mistake and tolerance to mistakes;

E) Autonomy – the readiness to be proactive, to function independently to make decisions and act if required;

F) Self-esteem

It is possible to expand on these points, and it is required to understand academic assertiveness and distinguish it clearly from arrogance.

To challenge, to disagree, and to seek and accept a challenge: It is surprising to see that; there are very few references to the readiness of a critical thinker to challenge, accept the challenge and disagree, certain qualities that are key to critical thinking. The study by Mckay and Kember (1997) showed results against the common belief that students wanted to be spoon-fed. Students preferred a course that challenged them, forced them to think, and inspired them to think logically. Meyers (1986) suggests the creation of disequilibrium in his pedagogy that will inspire the students to change, rework and reconstruct their thinking. But, Meyers also suggests that it must be done with at most care, considering that the disequilibrium is directed towards positive outcomes. This observation is valid, as it depends on the epistemological

development of a student. Some students are ready and able to take up challenges inside the classroom, while others feel challenged just by being in the classroom. In critical thinking, challenge means to challenge oneself, to be receptive and conscious towards questioning one's ideas and beliefs to which one has not paid enough attention. It can also be considered intellectual courage (Paul and Elder, 2004). Challenging an idea may not be just challenging the idea, but also can be challenging to the feelings towards the idea. Brookfield (1987) believes that critical thinking must be developed with the help of 'conversations', which encourages the learners to listen and accept a diversity of opinions, to disagree over interpretations of ideas, rules or behaviours and to question the existing ways of thinking. Brookfield suggests that the basis of understanding is to accept the existence of diversity in opinions and interpretations, which will inspire the learners to apply this diversity in their thoughts and actions.

The reality of not being right: The readiness to cope with risk or challenges in critical thinking translates to the willingness to cope with not being right, the ability to adjust to failure, and the willingness to change one's opinion or belief. This readiness requires a lot of emotional management and can affect the individual's self-esteem. This readiness can also have an impact on one's critical thinking. These experiences are definitively part of student life, but there is very little in the literature to help out students or teachers except from the point of counselling. The concept of being ‘right’ should be identified and distinguished from the evaluative process of judgement making, according to Jennifer Moon (2007). De Bono (1983) suggests four paths towards being right: (a) emotional, (b) logical, (c) intuitive rightness and (d) rightness based on the evaluation. These are deeply related to evaluative judgement and not precisely the ‘right or appropriate response based on a situation’. It may also be misunderstood as being judged right or winning an argument.

In an academic environment, learners identify ‘right’ as echoing what their educators want to hear. They consider being judged and graded by educators as the ‘right’ thing. This attitude of acting like a chorus to the existing system, the inability to think outside the box and abiding by the prejudices of what the educator expects will

cost critical thinking capabilities. Read et al. (2001) pointed out such citations and student comments. Jennifer Moon (2007) cites similar observations from the American literature of the 1980s and 1990s, which probes around the idea that students consider critical thinking risky and threatening due to the failure the learner may experience (e.g. Young, 1980). The students resist critical thinking as it is new and involves complex ideas, and above all, they are afraid. The only way around this is to encourage risk-taking without punishment for mistakes. The focus is modelling criticism of ideas but not people (Keeley and Shemberg, 1995). The learner needs to distinguish between themselves and their ideas. Criticism of their ideas is about the failure or error made in their task or how it has been conducted, but not to the person as a whole. Sometimes educators fail miserably in directing the criticism towards their learners' work rather than directing it towards the person.

Cannon (2002) points out the conversations about failure in assignments or modules, the recovery from failure and the challenges in generalising the effects of failure because of the diversity in learners' reactions to failure. Assertive training should reiterate the importance of accepting that, as human beings, it is reasonable to make errors and the importance of constructive thinking to recover from such failures (Gillen, 1992). Mingers (2000) warns the learners about how criticism against authorities can harm the learners and how important it is to think constructively to cope. It is also vital to understand that one must change their position or argument if the current position lacks evidence or is proven wrong. This process can be complicated if the original position can be personally justified and involves a lot of emotional effort (Meyers, 1986; Moon, 2007).

The readiness to listen: Critical thinking is a social activity, and the actions, words, and opinions of others do affect the critical thinker. Capable critical thinkers are keen listeners and readers aware of the hidden agendas, assumptions, arguments and information between the lines of the work they read or listen to (Moon, 2007). Intellectual fairmindedness is critical towards understanding other's points of view (Paul and Elder, 1984). It is vital to be conscious of the need to consider the viewpoints without being

prejudiced or biased about any factors that can cause such prejudice or bias (Nation, friends, community, religion, etc.). The critical thinker must respect the other viewpoints, give them a fair hearing, and recognise the feelings or vested interest behind their positions. Recognising the authority with higher expertise is also essential to be productive as a critical thinker (Bailin, Case, Coombs and Daniels, 1999).

The ability to be autonomous: Beyond representing academic assertiveness as a behavioural characteristic, it is crucial to understand it as a collection of ideas that can enhance critical thinking and also as a foundation for critical thinking. Bailin et al. (1999) suggest the term 'independent-mindedness' and other characteristics like 'intellectual honesty' (the ability to stand one's ground). It is possible that in situations where honesty requires the thinkers to accept their ignorance or the lack of evidence to move forward. Honesty is not only about judgement but also the process used for concluding. Ronald Barnett takes the stand on higher education's importance in producing learners who can engage in active conversation with society instead of just being good thinkers (Barnett, 1997). Barnett and Coate (2005) point out the need for a curriculum that would inspire the students to critical engagement from the student. Critical engagement demands the courage to take a stand and clarify one's views, arguments and positions. It is also interesting to see that the courage to stand alone, if necessary, is also part of being autonomous.

The United Kingdom addresses the agenda to develop proactive and independent thinkers, at least in terms of employability, improving learners' work placement (Watton, Collings and Moon, 2002). In the United States, education services have much higher and more reasonable schemes. Such experiences seem to positively impact learners in academic settings (Lucas and Tan, 2006; Moon, 2007). Placement experiences not only support the improvement of vocational skills. Still, it might also inspire critical thinking skills as it takes them through the experience of being an independent thinker. Developing the ability to make independent judgements in line with the other skills to process knowledge has a deeper connection between them, which should be one of the goals of higher education (Kegan, 1994).

Self-esteem: Self-esteem is a common factor behind all the elements of academic assertiveness. It is evident, especially in how someone approaches a topic, that those with higher self-esteem will exhibit a more profound approach (Abouserie, 1995). The learners who possess high academic self-esteem might have a prejudice that they have access to all the correct answers in critical thinking. But at the same time, it takes self-esteem to accept it gracefully when one cannot find an acceptable outcome to a problem (Moon, 2007). There are aspects of self-esteem that are relevant to critical thinking, but there are certain aspects that will play undermine the importance of the other elements in academic assertiveness. Self-esteem also plays a crucial role in how learners handle a task that is probably difficult for them. Learners with low self-esteem generally find learning a problem, whereas learners with high self-esteem will clearly distinguish the learning issue from feelings about self. They will find that amending the approach to an issue is more accessible than changing oneself (Moon, 2007).

Assertiveness training has been a common practice in business and community situations since the twentieth century, catalysing the feminist movements (Alberti and Emmons, 1970). Assertiveness training provides a guideline to empower the trainees to control their lives and stand up for their rights. It covers many aspects like the nature of assertiveness, non-assertive, aggressive behaviours, the importance of thought in actions, dealing with fears and letdowns, rights of a person, amending one's thought process, dealing with criticism (giving and taking) etc. Assertiveness training is not new to higher education students, but they are not provided as academic training in classrooms but in the context of student unions (Hinton, 2006).

Team teaching - Brookfield

Brookfield (2015) believes it may surprise educators to see some students' responses on how they can be inspired to think critically. According to Brookfield, it is successful if the student ignores the teacher's presence and learning. The most effective way to teach is with your mouth shut (Finkel, 2000; cited by Brookfield, 2015). But in critical thinking, the learners always look for teachers to give feedback about the learning process. It is also vital for educators to model for the students how they should

approach and research assumptions. The learners do appreciate personal examples of how the educator thinks critically. The concept of systematically analysing prejudices or biases is avoided due to the fear of self-contradiction. It is unacceptable for the majority to see their assumptions as wrong or invalid. This process becomes more manageable or tolerable if shared, especially when other learners share the same irony. For learners, questions or challenges from peers are less threatening than teacher questions. The primary reason is that the peers would present the perspective and language that the learners can relate to easily. Therefore, the question or challenge is presented in a language with examples with much less chance of misunderstanding. The power dynamics between the peers also make it easy for the learners to interpret the questions posed by their peers. It is more threatening for a learner when the teacher points out their mistakes or some aspects they overlooked. So, in a way, an idea that challenges the existing biases or prejudices is more likely to be considered when it comes from a peer. Activities chosen for group learning are also important, with well-defined ground rules and boundaries. Social learning or group learning is not merely making random conversations, no matter wherever they are led. Social learning for critical thinking is expressing yourself and carefully listening and analysing what is heard, understanding it and asking the right questions for clarification (Brookfield, 2015). There are various activities and protocols suggested by Brookfield (2015) for team teaching.

Scenario analysis and conversational protocol

Brookfield (2015) suggests two structured social learning processes that could be very effective in a group learning environment. ***Scenario Analysis*** is where a hypothetical scenario in which a character is making a choice is described. The learners are asked to (1) identify the implicit and explicit assumptions the character in the given scenario is working under and determine whether those assumptions are causal, prescriptive or paradigmatic, (2) share the alternate approaches the character in the scenario could have taken to those assumptions and (3) share those alternate interpretations the learners have about the scenario. This exercise is non-threatening, according to Brookfield, as it is based on a hypothetical scenario and a fictional

character. The critical conversational protocol is more challenging in the structured social learning process. In this process, the learner has to introduce a situation that the learner is struggling with and would like to understand better. The learner must describe the scenario to the peers and answer their questions. In such a scenario, the ground rules must be clearly defined so the questions are constructive and helpful requests, not derogatory remarks. Questions like "Are you seriously telling me....?" or "Why on earth didn't you.... ?" are not allowed under any circumstances (Brookfield, 2015).

Speaking in tongues

This activity aims at showing learners how the same ideas can be interpreted in various ways. Brookfield (2015) suggests beginning the activity by putting up signposts of various viewpoints about the topic the educator wants the learners to consider. Then, the educator should give a general introduction to the topic. Then the educator will move to the first signpost and explains the viewpoint as if the educator is concerned only with thinking about the topic within the framework of that viewpoint. Brookfield gives an example of critical thinking itself. So, if the educator is standing near the signpost of the analytic philosophy of critical thinking, then the educator is concerned only about analysing arguments and identifying logical fallacies. Then the educator would move on to the next signpost, where the educator would give the perspective of the scientific method in critical thinking. Listening to the different theoretical paradigms and their vocabulary would help the learners to realise that different perspectives can be taken from the same topic.

Assumptions audit

According to Brookfield (2015), an assumption audit is an exercise where the teachers can assess the assumptions behind any presentation made in the classroom. This activity can be adapted to almost every subject or topic. At the correct juncture of every presentation, the educator should request a time-out to explain the significant assumptions provided. The educator will identify implicit and explicit assumptions and distinguish the paradigmatic, prescriptive or causal assumptions resulting in the educator's argument. The educator should also try to identify the most

definitive evidence for the assumptions and what are the questionable aspects of these assumptions. The educator can also point out assumptions that lack evidence and are never questioned or challenged. The educator can explain the most recent assumptions, the ones that never changed, and those the educator is minor and most sure of (Brookfield, 2015).

Point and counterpoint

Point and counterpoint are the most intriguing and possible only in team teaching. It may require two or more people to analyse the idea and identify the assumptions from different perspectives. These classes allow educators to model how to agree and disagree with each other respectfully. Late the students can replicate this as part of their agreement and disagreement in the discussions to take place in the classroom (Brookfield, 2015).

Some crucial points to consider while conducting point counterpoint are how to pose questions, show disagreement, and ask for evidence without personally attacking the peer. Examples like, “Can you tell me more about….?”, “Why do you think that’s the case?”, “What’s the most convincing evidence for that view?” or “How do you respond to Mark’s research that challenges your position?”. While seeking clarification, the students can ask questions such as, “If I understand you correctly, you seem to be saying…..” or “Can I just check that I followed your argument correctly?” Point–counterpoint is also an opportunity for the students to add to the views of their teachers, which, in turn, reiterates the importance of listening carefully (Brookfield, 2015). The teachers can strive to answer questions pointed at them and should admit when they don’t have an answer. When the teachers disagree with the viewpoints of each other, they can say, “I take a different view on this, and this is why I think the way I do”, or “My approach doesn’t emphasise what you cover and here is my analysis.” The most significant moments of delight among students arise at times when the teachers publicly disagree on something, and according to Brookfield, “this can wake them up” (Brookfield, 2015).

Devil's advocacy

Structured devil's advocacy is a solo version of point-counterpoint. The teacher needs to be proactive and prepare for possible counter-arguments for the position she assumes. It is a possible mono-act situation where the teacher dramatically presents both point and counterpoint. In this scenario, the alternate viewpoints are deliberate, and the teacher describes the counterpoints through a different research paradigm or framework, a conscious attempt to play the 'Devil's advocate' (Brookfield, 2015). Structuring rebuttals like "However, if I look at this idea from another point of view, you can see that …." Or " a whole other interpretation is possible of this argument that calls many of its central arguments into question." The teacher can also model critical analysis by posing counterarguments using methods of scientific thinking like falsifiability by confirmation or disconfirmation of the hypothesis (Brookfield, 2015).

Benefits of team teaching

It can reach a wider variety of students. Teachers generally prefer their own preferred learning methods. These styles have their limitations. But according to Brookfield, adding one or two more teachers to the class can immediately broaden the experiential background of instruction. The vital thing to remember is that teachers should know their colleague's preferences and styles and provide a breadth of instructional approaches (Brookfield, 2015).

Team teaching can successfully model respectful disagreement. Teaching students how to disagree without cutting off further communication is one of the agendas of higher education. Models of student development that describe critical thinking (Evans, Forney, Guido, Patton and Renn, 2010) reiterate the movement students take from right or wrong thinking through multiplicity relativity to reach a stage of critically informed commitment. Team teaching can model how to explore this area of tension and how to strive and understand contrasting viewpoints (Brookfield, 2015).

Team teaching creates an environment of risk and uncertainty. The attempts made by students to question themselves and open new horizons of understanding can create an atmosphere of risk and uncertainty. Critical thinking can be fostered in a

dynamic and unsettling place (Plank, 2011). In team teaching, there is no one absolute authority in the classroom. This uncertainty can demand a sense of curiosity and inquiry (Brookfield, 2015).

Team teaching confronts students with a wide variety of perspectives. The ability to explore alternative ways of understanding content, and to see things from multiple theoretical perspectives or analytical frameworks is central to thinking critically. Indeed, this is probably the most frequently cited reason for team teaching (Eisen & Tisdell, 2000; Plank, 2011) when a solo teacher tries to convey the different viewpoints or theoretical frameworks that exist on an issue they are always working within the confines of being a singular voice (Brookfield, 2015).

Team teaching demonstrates synthesis, connection and integration. Critical philosophy tradition prioritises the ability to synthesize and connect information, concepts and reasoning from multiple sources. This is why the most frequent use of team teaching happens in interdisciplinary and integrative studies seminars (Duchovic, 2011; Jessen-Marshall & Lescinsky, 2011). Here scholars from different disciplines collaborate in teaching a core topic from multiple standpoints. Although this allows various perspectives to be brought to bear on an issue, it also permits faculty to model synthesis and integration.

Metacognition – Thinking about thinking

In an attempt to understand cognition, it is hard to ignore the evolution and properties of the human brain. In the very early stage of evolution, there was a brain that could create primary representations, which helped us to identify the predators and save ourselves. At some point in the evolution spectrum, the predecessors developed a secondary brain (a new set of neuro connections, to be exact, according to Dr V.S.Ramachandran, Tell-tale Brain, 2011, one of the most prominent neuroscientists of modern times), which created meta-representations (representation of representation). With this development, humans not only identified the predator, learned about it, identified patterns in its behaviour, and named it, and not necessarily in this order, but also hunted those predators. “Metarepresentations are also a prerequisite for our values,

beliefs, and priorities. For example, a first-order representation of disgust is a visceral — 'avoid it' reaction. At the same time, a meta-representation would include, among other things, the social disgust you feel toward something you consider morally wrong or ethically inappropriate. Such higher-order representations can be juggled around in your mind in a manner unique to humans." (Dr.V.S.Ramachandran, Tell-tale Brain).

The ability to think is the result of this metarepresentation. At the same time, one of the human brain's primary principles is conserving energy. The mind is against any tedious activity (Boisgontier, 2018). Critical thinking is one of those tedious activities. An example is given by Jeff Hawkins, a neuroscientist, in his book `On Intelligence' – "Imagine you are about to have dinner in an unfamiliar restaurant, and you want to wash your hands. Even though you have never been in this building before, your brain predicts there will be a restroom somewhere in the restaurant with a basin suitable for handwashing. How does it know this? Other restaurants you have been in have a restroom; by analogy, this restaurant will likely have one.

Further, you know where and what to look for. You predict there will be a door or sign with some symbol associated with men or women. You predict it will be toward the back of the restaurant, either by the bar or down a hall, but generally not the view of the eating areas. Again, you have never been to this restaurant before, but by analogy, you can find what you need at other eating establishments. You don't look around randomly. You look for expected patterns that let you find the restroom quickly. This behaviour is a creative act; it predicts the future by analogy to the past. We don't usually think of this as being creative, but it very much is."

Even though self-reflective cognitive abilities might be the result of evolution which enabled human beings to sense threats and survive, the lab data suggests that these same qualities can be used even under circumstances where the problems are trivial (Metcalfe-Shwartz, The Oxford Handbook of Metamemory, 2016). This reflective system controls the unknown and the well-known (Duniosky, Metcalfe, 2009). This reflective system is precisely how the brain works in any familiar or unfamiliar situation. Procedural training provides the brain with tools to apron a problem systematically.

Understanding human brain

Nothing may be as complicated as recognising the human brain, neurons connected to axons and dendrites to transmit information. As patterns are established, more relevant pathways, called synapses, result in habits and behaviour patterns (Robinson, 2010). The recent developments in neuroscience have revealed so many fascinating facts humanity never knew about the human brain.

1. One of the primary assumptions about the human brain was that damages, especially to some brain regions, are irreparable. But, recent research has revealed that the property of plasticity allows the brain to make new connections in case of damage, and other areas of the brain can assume the role of the damaged area (Christchurch Health and Development Study, Christchurch School of Medicine, New Zealand, 'Pediatrics', vol 101, January 1998).

2. The nutrition factor has a profound influence on IQ. A study conducted in 1988 among 1000 students revealed that there is a correlation between the hours of breast-feeding and excelling scores in cognitive tests (Christchurch Health and Development Study, Christchurch School of Medicine, New Zealand, 'Pediatrics', vol 101, January 1998). Similar studies revealed that iron deficiency could create a severe lag in brain function. Iron deficiency can lead to a lack of myelin and ineffective communication between the brain cells (Pollitt, E, 1993).

3. Language is the basis of memory. Research has revealed that most people do not remember anything about their first 3 or 4 years of life because their language and vocabulary are limited (Simcock & Hayne, 2002).

Abraham Maslow has established the importance of providing the necessary physical needs for learning in his 'hierarchy of needs theory. The learners' needs must be fulfilled for a productive and successful learning process. They can be considered as a pyramid, which starts with:

a) Physiological needs - Adequate sleep, Nutritional diet, hydration, and physical activity.

b) Safety and security needs - Safety and security that can give them peace of mind.

c) Love and belonging needs - Friends, close and intimate relationships for them to confide in.

d) Self-esteem needs - Sense of achievement and accomplishment.

e) Self-actualisation - Realising one's worth, potential, etc.

Maslow initially insisted that the base levels must be fulfilled before moving on to the next one. Later, he clarified the same by mentioning it's not an all-or-nothing phenomenon, and the sense of satisfaction at each level may differ (Maslow, 1999).

Metacognition – The concept

Metacognition has been a research topic in educational psychology and mathematics education. In the latter, Brown (1987) distinguishes knowledge of cognition and regulation of cognition, whereas, in mathematics education, Schoenfeld (1987) identifies understanding of own thought process, self-regulation and belief, and intuitions. Flavell (1971) suggested the word and urged the community to conduct further research. On various occasions, Flavell implies that metacognition is deliberate, conscious and purposeful. Reder and Schunn (1996), Kentridge Haywood (2000), and modern-day Neuroscientists like Metcalfe (2009) suggest that metacognition need not operate in conscious awareness but can also be reflexive. Personal beliefs or biases influence understanding one's abilities and disabilities (Schoenfeld, 1983). These influences include self-appraisal, self-reflection, and self-efficacy (Paris and Winograd, 1990). According to Schraw and Dennison (1994), knowledge of cognition consists of declarative knowledge, procedural knowledge, conditional knowledge and regulation of metacognition.

Declarative knowledge is familiar, accumulated over a while, awareness about this knowledge and the ability to evaluate this knowledge (Jonassen and Tessmer, 2000; Kluwe,1980). According to Kluwe, there are two types: declarative knowledge. Domain Knowledge is based on the accumulated information about the domains of reality, and Cognitive knowledge is based on biases, assumptions, and beliefs about

thinking. Declarative knowledge is pliable, and there are different possible ways of using it. Limitations and particular cognitive bias towards specific ways of using declarative knowledge are potential (Anderson, 1987). It is possible to use declarative knowledge in general situations where discretion is required, and interpretations of the declarative knowledge can slow the process. To make compelling interpretations, domain-specific knowledge must be identified via composition and compilation of procedures (Wayne D Gray, Judith Orazanu, 1987).

Procedural knowledge indicates the knowledge about process and procedure or how (Schraw, 1995, 2001). It is knowledge about the execution of procedural skills (Adena Elizabeth Young, 2010). In some situations, the person acquires procedural knowledge unconsciously (Stadler, 1989). In a learning atmosphere, it may be a continuation of a part of a previous experience. The difficulty articulating procedural knowledge because of its nonconscious nature differentiates it from declarative knowledge.

Conditional knowledge translates to the discretion of knowing when, how and where to use declarative and procedural knowledge (Schraw, 1998). It is more task-oriented, goal-specific and can use available information effectively to achieve the task's objectives (Adena Elizabeth Young, 2010).

Regulation of cognition is the commutation of three components; Planning is the ability to allocate resources and usage of the appropriate strategy, Monitoring is the ability to be aware of one’s comprehension and knowing how the task will be completed, and Evaluation is the ability to appraise the final product and evaluate the strategy used to obtain that product (Schraw, Gregory, 1998; Jacobs, Paris, 1987).

Metacognition and critical thinking

Metacognition is closely tied to critical thinking in terms of dispositions like analysing arguments (Facione, 1990; Halpern, 1998), inductive and deductive reasoning (Facione, 1990; Paul, 1992), evaluating (Facione, 1990; Lipman, 1988) and making decisions (Ennis, 1985; Halpern, 1998). As discussed earlier, critical thinking is not limited to skills or dispositions. Still, they are more of a habit or attitude of fair-

mindedness, inquisitive curiosity, and the ability to inspire even diverse viewpoints. Preparation or creation of an environment that stimulates critical thinking cannot be isolated from the dispositions of metacognition, and thereby, critical thinking becomes one of the three types of metacognition along with problem-solving and metamemory (Martinez, 2006). The following points below are the metacognitive skills identified by Hennessey (1999) as usual for both metacognition and critical thinking:

Evaluating the basis of one's own beliefs

Setting aside one's prejudices while assessing opposing arguments

Estimating the relation between one's ideas and evidence that may or may not support those beliefs

Evaluating the fallacies that exist in one's assumptions

Learning regulated carefully by oneself- leads to motivation, metacognition, and cognition, which results in critical thinking. Metacognition keeps the ground fertile enough to encourage, inspire and grow higher-order (critical) thinking (Schraw et al., 2006). The meta-analysis of 20 empirical studies involving 1500 students suggested that training students on metacognitive instructions, especially at the school level, can substantially positively affect their awareness and comprehension abilities (Haller et al., 1988).

Metacognition in the classroom – A perspective

The metacognitive assessment has various dimensions depending on the learning process or activity. For example, metacognitive assessment in reading is evaluated based on the reader's awareness and understanding of the mental processes involved in reading. Does the reader have the ability to channel their thoughts before, during and after the reading, thereby gaining a complete understanding of what they just read (Block, 2004; Harris and Hodges, 1995)? Readers with high metacognitive abilities can often link their prior knowledge relevant to what they are reading and know how to use the new knowledge they gained from what they read. Metacognitive readers can identify what is essential, ask the right questions and draw critical conclusions (Pressley, Afferblach, 1995; Brown and Palincsar, 1985; NICHHD, 2000; NRP, 1999).

This type of ideal metacognitive reader is a minority in schools today. Teachers are working consistently and consciously towards improving the number of metacognitive readers in their classrooms, and the United States recognises this as one of the country's essential needs (Cathy Collins Block, 2005). Elementary school is the right environment to develop arid diagnostic metacognitive comprehension abilities. The flaws can be critical if not identified at the earliest stage because the students will build defence mechanisms to hide their mistakes. If not addressed at the right time, students will develop a more complex tool to defend and protect their reading failures, thereby losing the chance e experiencing reading as a delightful one (Block, 2005).

Even though it is Flavell (1978) who defined metacognition, it was Baker and Brown (1984) identified 'awareness' and 'control' as critical components in understanding the importance of metacognition in reading and comprehension (Schmitt, 2005). In the process of reading, declarative knowledge refers to one's characteristics (e.g., I like that subject, I don't like that topic, I have difficulty in reading long words), properties of the task-in-hand (e.g., characters are essential in a story, why an incident and its period is mentioned?), and strategy that is relevant to the task (e.g., pictures can provide clues, understanding the context of a word c help figure out the meaning) (Schmitt, 2005).

The awareness about one's abilities and the ability to self-assess the abilities is crucial to success among middle school students. To be competent readers, students should learn to strategise their reading (Afflerbach and Meuwissen, 2005). Learning is more effective when backed up by metacognition (Flavell, 1978; Markman, 1977). Students with complete control over the reading process will have their path to guide themselves to success. There is a clear need to motivate students to develop such ability, especially at advanced levels of reading (Grigre. Jin and Campbell, 2003). Flavell termed metacognition as an ability to recall one's thinking process. At the same time, Jacobs and Paris (1987) narrowed it to explaining one's thinking process in words as part of self-awareness. Brown (2002) brought further clarity into this by identifying

three key areas: the reader's thought process while reading, how the reader reacts to reading tasks, and the strategies of the reader to address the reading tasks.

Metacognition is not a term that is generally associated with teacher training or teacher development. Training may not always work because classroom experience can't be predicted (Gerald. G, Duffy, 2005). For being an efficient teacher, the adaptability skills the person possesses and the ability to be discrete (Berhi 1994). This ability is also interpreted as adaptive expertise' (Brown and Cocking. 2000) and even the ability to be 'in charge'. This ability is metacognitive (Duffy, 2005). Teachers are faced with problems of various dimensions in a classroom. Teachers generally seem to be handling a class, but in reality, they deal with a room full of unique individuals. When dealing with unique individuals, the situation is unpredictable and cannot be contained in a list or table of possible outcomes (Spillane, Reiser and Reimer, 2002). Successfully handling such conditions requires the teachers to be adaptable, in control of their thought processes, emotions, and influential decision-makers (which is metacognition). Training doesn't always address such dilemmas. Training is mainly limited to prior knowledge and expert recommendations, which ask them to do what they are told. Rather than conducting such training, teachers must be educated about concepts that inspire learning in a classroom environment. Metacognition is a promising alternative to this 'training' situation. Metacognition develops thoughtful action instead of mechanical compliance (Duffy, 2005). The most important factors to remember are understanding one's knowledge, controlling it and regulating it (Hofer, Yu and Pintrich, 1998). Acclaimed teachers project metacognitive and goal-oriented abilities (Schunk and Zimmerman, 1994). Still, the feedback to effectively restructure their style of teaching (Zimmerman, 2000) avoids procedures if they fail (Kanfer, 1991) and successfully ensures knowledge transfer (Smith, 2003).

Knowledge development in critical thinking

Even though experts and educators have recognised critical thinking skills as an absolute requirement, the documents available in Thailand do not provide a comprehensive picture of the required definitions of the subject. The two most important

factors identified in the National Education Plan, published in .2017, are `Competitiveness enhancement' and 'Human resources development'. There are only abstract guidelines and vague statements where the term 'critical thinking' is mentioned. In an ageing society where the average age of the labour force is decreasing, life-long sustainable learning programs are vital in human resource development(NEP, 2017). The implementation and interpretation are at the discretion of the higher education institutions. No higher education institutions in Thailand have a dedicated curriculum or module for developing critical thinking skills among its wards. There is also little consensus among students and maybe educators regarding what critical thinking is. Some of the students identified more towards the term critical as criticise. In contrast, some students believed it's a skill that results from quality education rather than being taught.

In the ever-changing world, definitions and dispositions of critical thinking may change accordingly, and there is always space for different opinions (Chen Siaw Wee, 2014). But such different positions in thought processes should not confuse the students. These differences in thought processes should lead to healthy debates and discussions, resulting in well-defined objectives that will provide more clarity and objectivity for the students. There is no simple guideline anyone can follow to attain high critical thinking skills. But there is always a possibility of getting a good start. The framework developed by Halpern (2013) reduces the process into four simple questions;

1. What is the goal?
2. What is known?
3. Which skill or skills will get you to the goal?
4. Have you attained the goal?

The desired outcome is the result of practical critical thinking. Sometimes bad decisions are taken because of insufficient information or because of ignoring decisions at the decision-makers disposal. A successful decision-maker should act based on accurate information rather than personal beliefs (Schneider, 2007). Critical

thinking is the most effective medicine to treat the disease of ideological fanaticism (Lilienfeld, 2007). The treatment of such blind devotion may be crucial to knowledge creation. Fanaticism is blind faith in any ideology, limiting the ability to think critically. Critical thinking opens a wide range of horizons to develop one's knowledge base and overcome cognitive biases.

Is it wise to assume that students will develop critical thinking skills due to education? There is a clear dominance for experts among academicians who considers critical thinking deserves extra weight in the educational system, and its development should be carefully monitored (Kuhn, 1999; Siegel, 1988). Reasoning makes human beings unique as a species, and it enables, more or less, the ability to predict `what comes next' or 'what was it before'. One of the most important critical thinking skills is the ability to reason. It applies to various subjects like law, math, science, etc. Reasoning and to reason with is a skill that applies to almost every aspect of life (Halpern, 2013). Without proper intervention, critical thinking skills, especially reasoning skills, are least likely to develop among students (Kuhn, 2009). Instructors who understand critical thinking skills as a tool to build and enhance knowledge base plays a crucial role in inspiring critical thinking skills among students of modern times. A well-defined and clear recognition of critical thinking is essential if educators wish to adapt critical thinking into their pedagogy and classroom assessment (McMurray, Thompson and Beisenhertz, 1989). The misunderstanding may lead to uncertainty about what skills should be imparted and how they can be evaluated (Kennedy, Fisher and Ennis, 1991). Consistency in learning outcomes and the strategies for teaching and evaluation practices are vital in imparting critical thinking skills as a tool for knowledge creation in the classroom (Biggs, 1996 - Notion of constructive alignment). This research hopes to identify these critical skills of critical thinking that can be imparted in higher education classrooms and provide the consistency the pedagogy requires.

Generic or domain-specific

One of the critical dilemmas among educators about their understanding of critical thinking pedagogy is whether to address critical thinking development as generic or domain-specific. It may be highly effective when critical thinking is taught independently (Ennis, 1987). It argued that these skills can be viewed as dependent on the subject and addressed as a whole (McPeak, 1981). Scholars like Davies (2006) promote a comprehensive and integrated approach where both thought channels are merged. However, no matter what the educator chooses, it will profoundly affect the instructional method and, thereby, the student's understanding (Prosser et al., 1994).

Critical thinking conceptions differ significantly from the three general frameworks for depicting educators' notions. Zohar and Schwartzer (2005) argue:-

1. Critical thinking skills are not strictly part of subject-matter knowledge. A skill can seldom be a part of the subject matter.

2. Critical thinking development needs an entirely different pedagogy. The pedagogical content knowledge framework combines various instructional approaches and subject-matter knowledge. This knowledge is different from the pedagogical knowledge of critical thinking development.

3. General pedagogical knowledge is insufficient to address critical thinking development. Critical thinking should be considered as a distinct area of research.

The three main courses of thought for the educator on critical thinking can be the essential nature of thinking, instructional practice, and evaluation (Siew Wee Chen, 2014). Disheartening findings were derived from various studies on the conceptual and pedagogical understanding of critical thinking among educators. In a study conducted in California's teacher preparation programme, although 8 participants agreed on the importance of critical thinking as one of the primary goals of higher education, only 19% could describe critical thinking. Only 8% could expressly point out the critical thinking skills the student need, and only 9% reciprocated to the lack of developing critical thinking in their classroom (as cited by Siew Wee Chen, 2014; a study conducted by Paul et al., 1997). Another survey found massive confusion among

educators, even about the conceptual understanding of critical thinking and how it can be evaluated in a classroom (Vaske, 2001). The lack of clarity may result from an ineffective essential thinking adaptation into the instructional practices.

In another study conducted by Howe (2004), a mixed study among Canadian and Japanese teachers, some even had a prejudice that critical thinking skills cannot be taught in a classroom. This study also found no consistency in the understanding among teachers from both countries about the critical thinking conceptions available in the literature. They were unfamiliar with any available research (as cited by Siew Wee Chen, 2014). Similar findings were drawn from studies involving military leaders (Gong, 1994; Reed, 2000; Ross, 1992) and curriculum developers (Jones, 2004). The lack of consensus and a shared understanding of critical thinking seems to be the most dominant confusion among educators and instructors. Based on in-depth interviews, research was conducted among CDs from economics and history to understand different disciplinary cultures' perspectives on critical thinking skills. The economists defined critical thinking as problem-solving ability, while the history teachers explained broader views (Jones, 2007). Consistency, one of the essential factors in developing a pedagogy, seems to be absent in the perspectives of educators' critical thinking and critical thinking skills.

Evidence for the development of critical thinking dispositions

Developing critical thinking dispositions offers numerous benefits. Research has demonstrated that individuals with strong critical thinking dispositions are better equipped to analyze complex information, think creatively, solve problems effectively, and make well-reasoned decisions (Ennis, 2011; Facione, 2013). Moreover, individuals with robust critical thinking dispositions are more likely to engage in lifelong learning, adapt to new challenges, and contribute meaningfully to society.

Instructional Strategies

a. Explicit Instruction: Teaching critical thinking skills and dispositions effectively enhances critical thinking abilities (Abrami et al., 2015). Explicit instruction involves providing clear explanations, modelling critical thinking processes, and guiding learners through practice opportunities that target specific dispositions.

b. Scaffolding: Scaffolding refers to providing structured support to learners as they develop their critical thinking skills and dispositions. Scaffolding allows learners to build upon their existing knowledge and gradually develop autonomy in critical thinking. It can be accomplished by gradually releasing responsibility, where instructors gradually reduce support and encourage independent thinking (Vygotsky, 1978).

c. Reflective Practices: Encouraging reflective practices, such as journaling, self-assessment, and metacognitive strategies, promotes the development of critical thinking dispositions. Reflection helps learners become aware of their thinking processes, identify biases, and engage in self-correction (King, 1992). It enables individuals to monitor and evaluate their thinking, leading to greater self-awareness and refining critical thinking.

Problem-based learning (PBL) is an instructional approach that presents learners with authentic, complex problem-solving problems. Research suggests that PBL enhances critical thinking dispositions by providing opportunities for inquiry, analysis, and evaluation of multiple perspectives (Dochy et al., 1999). PBL encourages critical thinking dispositions by fostering curiosity, promoting active engagement, and stimulating collaborative problem-solving (Hmelo-Silver, 2004).

Collaborative learning environments provide opportunities for learners to engage in meaningful discussions, debates, and exchanges of ideas. Collaborative learning promotes critical thinking by challenging assumptions, exposing learners to diverse perspectives, and fostering intellectual empathy (Johnson & Johnson, 1999). Research has shown that collaborative learning activities can significantly enhance critical thinking dispositions, leading to improved problem-solving skills (Johnson et al., 2014).

Traditional assessments often fail to measure critical thinking dispositions accurately. Authentic assessments, such as case studies, simulations, and real-world projects, offer opportunities to demonstrate critical thinking dispositions in contextually relevant situations. These assessments require learners to apply their knowledge, analyze complex information, evaluate evidence, and justify their reasoning (Herrington & Herrington, 2008). Authentic assessments measure critical thinking dispositions and promote their development through active engagement and problem-solving.

Educational institutions play a crucial role in fostering critical thinking by integrating critical thinking across the curriculum. Infusing critical thinking skills and dispositions into various subjects and disciplines helps learners recognize the relevance and applicability of critical thinking in different contexts (Paul, 1993). When critical thinking is consistently emphasized across disciplines, learners are more likely to develop these dispositions as essential components of their intellectual toolkit.

Educators must receive professional development that equips them with the knowledge, strategies, and tools necessary to effectively develop critical thinking dispositions in their students. Research suggests that professional development programs focusing on instructional strategies can significantly enhance teachers' ability to promote critical thinking dispositions in their classrooms (Lovett & Joel, 2000).

Developing critical thinking dispositions is a multifaceted process that involves intentional instructional strategies, problem-based learning, collaborative environments, authentic assessments, and curriculum integration. Empirical research supports the effectiveness of these methods in fostering critical thinking dispositions, which are essential for navigating complex challenges, making informed decisions, and contributing to a dynamic society. By implementing these researched and proven methods, educational institutions and educators can empower learners to become critical thinkers equipped to tackle the complexities of the modern world.

Assessment Strategies

Reflective Journals: Reflective journals can be a valuable critical thinking dispositions assessment tool. These journals provide a means to assess students' ability to analyze and evaluate their thinking, progress, and metacognitive awareness (Facione, 2011). Students can maintain journals throughout the course, documenting their critical thinking processes, insights gained, and challenges faced. By reviewing students' reflections, instructors can gain insights into their thought processes, self-awareness, and growth as critical thinkers.

Case Studies: Case studies offer a rich assessment opportunity to evaluate students' critical thinking skills. Case studies can assess students' ability to apply critical thinking dispositions to practical situations and gauge their analytical skills, reasoning abilities, and ability to consider multiple viewpoints (Ennis, 2011). Instructors can provide real-life scenarios or complex problems that require students to analyze the situations, identify relevant information, evaluate different perspectives, and propose well-reasoned solutions or decisions. Analyzing their responses can provide insight into their depth of understanding, problem-solving approaches, and decision-making processes.

Debates or Discussions: Debates or class discussions can be used to evaluate students' critical thinking abilities. Organizing debates or discussions on controversial topics related to the subject matter allows students to analyze arguments, critically evaluate evidence, and construct coherent and logical arguments to support their viewpoints. Assessing their contributions to the debates or discussions can provide insights into their ability to analyze arguments, apply logical reasoning, and effectively communicate their thoughts. This assessment method encourages students to think critically by evaluating multiple perspectives, providing justifications for their positions, and engaging in meaningful dialogue (van Gelder, 2005).

Problem-solving Projects: Assigning problem-solving projects can be an effective assessment strategy for evaluating students' critical thinking. These projects require students to apply critical thinking skills to solve complex problems. Students are

expected to break down the problem, identify relevant information, analyze different options, evaluate their merits, and propose practical solutions. By assessing their ability to engage in critical thinking processes, problem-solving projects provide insight into students' analytical skills, creativity, and ability to apply critical thinking to authentic problems (Ennis, 2011). Evaluating their problem-solving approaches, justifications for decisions, and the effectiveness of their solutions can provide a comprehensive assessment of their critical thinking abilities.

Performance Assessments: Performance-based assessments provide a practical assessment of critical thinking in authentic contexts. These assessments simulate real-world tasks where critical thinking dispositions are essential. For example, students may be evaluated on their ability to analyze and interpret data, make informed decisions, or solve complex problems. Performance assessments assess students' application of critical thinking skills and dispositions in real-world scenarios, providing insights into their ability to think critically and apply their knowledge effectively (Halpern, 2014). Evaluating their performance in these tasks can provide evidence of their critical thinking abilities and proficiency in applying critical thinking skills in practical contexts.

Socratic Seminars: Socratic seminars can be utilized as a collaborative assessment method to evaluate students' critical thinking skills. During Socratic seminars, students engage in thoughtful, open-ended discussions on specific texts, ideas, or concepts. Assessing their ability to ask probing questions, analyze arguments, and critically evaluate the evidence presented during the seminar provides insights into their ability to engage in collaborative critical thinking (Lipman, 2003). By observing their contributions to the seminar, instructors can evaluate their ability to engage in critical dialogue, consider multiple perspectives, and support their viewpoints with well-reasoned arguments.

Summary

Based on the literature review in this chapter, the current state of knowledge and research methodological issues on educators' conceptions of and practice for critical thinking development can be summarised as follows:

There is no consensus among educators about the concept of critical thinking, and critical thinking itself is a fluid concept with so many different dimensions.

There is a dire need for an environment in Higher education institutions that demand critical thinking from learners. It is fair to say that such an environment may be absent in Higher education institutions in Thailand. This absence is not because of the policies in Higher education but there is not enough stress on those policies promoting critical thinking.

The wholesome concept of critical thinking is undoubtedly overwhelming to students who go through it for the first time in Higher education institutions. There needs to be a gradual building of the concept through different stages, expecting growth results through the simplified building of the concept.

Sowing the seed of critical thinking should be done with utmost care. The idea is to develop a tendency, not only skills. The skills without tendency may be useless, whereas tendency can always demand skills.

CHAPTER 3
RESEARCH DESIGN

This research is based on a research and development strategy, or in other words, 'developmental research', and has three distinct stages where different quantitative and qualitative methodologies are adopted. Development is a word that can be attributed to various studies and practices and means growth, improvement or change. The most recent researches in instructional technology define development as a translation of design specifications into physical form (Seels and Richy, 1994). Developmental research is conducted to solve practical problems immediately (Richey, Rita & Klein, J. & Nelson, Wayne, 2004). This research aims to design instructional guidelines to promote critical thinking skills among higher education students in Thailand. Achieving this aim requires a detailed analysis of training needs and requirements and the development of the medium of instruction, and determining the efficacy and the revision of the instructional medium (Briggs, 1977; Heinich, Molenda, Russell, and Smaldino, 2002).

The real challenge is to recognise those key dispositions which can promote critical thinking among higher education students in Thailand. It is vital to realise and accept critical thinking as a concept with no unitary definition, and the learners tend to understand it in myriad ways. It is possible to teach critical thinking outside the context of a specific discipline (Moore, 2011). Still, at the same time, all the critical thinking skills are not transferable across subject domains (Mc Peck, 1981). The researcher believes learners can't understand and determine the importance of critical thinking skills without necessary critical thinking dispositions. The researcher thinks that certain factors of the culture might have a more profound impact on critical thinking dispositions than what the research community has found. Therefore the researcher believes that the input of experts, teachers and researchers who have been working in Thai society can be vital in the execution of this research. This chapter discusses the various methods and techniques adopted at the three distinct stages of this research. This research mainly

follows the guidelines provided by Richey, Rita & Klein, J. & Nelson, Wayne, 2004, on developmental research.

Methodology and Research Design

Summary - Type 1 Developmental Research: The main characteristics of Type 1 Developmental Research are contextually specific projects and contextually specific conclusions that emerge from such research (Richey, Rita & Klein, J. & Nelson, Wayne, 2004). Methodological dilemmas are common among developmental researchers, yet it is a common practice in developmental research to use various research methodologies and designs. Some designs are used again at different stages of the research (Richey and Klein, 2005). This research aims to identify critical thinking dispositions that are prerequisites in understanding and how to promote those dispositions. The structured literature review helped the researcher identify those dispositions, which were put into discussion with a panel of experts for validation. An instrument was developed at this stage to collect data to determine how well the higher education students in Thailand can display these dispositions now.

Based on this collected data, the researcher will conduct a focus group study with the experts to identify the shortcomings and the strengths of higher education students in Thailand. Pre-determined strategies and new strategies for improving the present scenario will be discussed with the focus group, and feedback from the focus group will be analysed in the second stage of the research. As the objective of this research suggests, the possible strategies that can improve the present scenario will be presented to the focus group, and the viability of the strategy will be determined. As mentioned in the introduction, the data collected in the first stage will be from the top-ranking universities in four different regions of Thailand.

A university that is neither at the top nor the bottom will be selected to study the strategy's efficacy. Students from the third or final year of their Bachelor's Degree course will be selected for the efficacy study and implementation of the strategy. Also, during the implementation period, the changes or leniencies towards critical thinking dispositions displayed by students will be recorded. The pre-test and post-test data will

be analysed using ANOVA (Analysis of variance), and the efficiency/inefficiency of the strategy will be established.

Stage 1 – Exploratory Research

As mentioned in the introduction, this research is divided into three stages. In the initial stage, a detailed, thorough and structured literature review of critical thinking skills and dispositions is done to delineate those skills and dispositions that can lay a firm foundation for critical thinking among higher education students in Thailand. These skills and dispositions are expected to prepare the students to understand the complex nature and skills associated with critical thinking in the future. A critical Thinking Dispositions Questionnaire (CTDQ) will be developed to assess these skills and dispositions to determine the existing standards among higher education students in Thailand. The exploratory stage of educational and developmental research is crucial in generating new insights, identifying trends, and formulating hypotheses for further investigation (Creswell, 2014; Denzin & Lincoln, 2011). This initial phase involves gathering information, exploring various dimensions, and refining research questions. Through this process, researchers aim to gain a deeper understanding of a specific educational phenomenon or topic, paving the way for subsequent stages of research.

Researchers employ various qualitative and quantitative methods to collect data during the exploratory stage. These methods may include literature reviews, surveys, interviews, focus groups, and observations (Gall, Gall, & Borg, 2007). These approaches allow researchers to gather rich and diverse perspectives, uncover patterns, and identify potential variables or factors influencing the phenomenon under investigation.

Moreover, the exploratory stage provides an opportunity to develop a theoretical framework that guides the subsequent research. By reviewing existing theories, models, and empirical studies, researchers can identify gaps in knowledge and refine their research questions. This stage also aids in selecting appropriate research methods and data analysis techniques (Robson, 2011).

Structured Review

The literature on critical thinking dates back to the time of Plato. The abundantly available materials, study and literature pointed towards a more target-specific yet detailed literature review to remain oriented towards the objective. The review does not undermine the importance of critical thinking abilities, but it asks a fundamental question of what good a skill is if there is no motivation to use it. The researcher followed Peter Facione, Robert Ennis and Jennifer Moon to study their works in detail and how well they have identified and iterated the dispositions behind practical critical thinking. According to Lai (2011), there are three primary perspectives in the critical thinking domain. They are the philosophical approach, the cognitive psychology approach and the educational approach. The thinkers mentioned above were selected not only based on their work but also based on how they represent these three perspectives. Whereas Peter Facione and Robert Ennis are two pioneer educators behind the development of the two most prominent critical thinking assessment tools across the globe, the California Critical Thinking Test and the Cornell Critical Thinking Test, respectively, Jennifer Moon is a journalist who wrote the latest book on the twenty-first century take on critical thinking - Critical Thinking: An Exploration of Theory and Practice, published by Routledge in 2008. Chapter One of this thesis gives the rationale and reasons for the identified variables/dispositions.

The expert's opinion – In-depth interviews

The experts were interviewed, and the questionnaire is attached to Table 1.5. The primary task was to know the expert's feedback on the shortlisted dispositions/variables. The experts were asked to rank these variables based on their opinion about their importance in understanding the complex concept of critical thinking. They were also asked about the cultural and social hindrances the Thai students may face in understanding and displaying critical thinking. Some of the data collected from the experts will also be used in Stage Two of this research. The researcher has taken two ideological positions for the interview. The researcher gave the experts the basic guidelines in advance to avoid the interview being directional, and the

purpose behind the research was hidden until the end of the interview to avoid prejudice in the mind of the experts.

The interview was an attempt to see whether the experts believe that the critical thinking skills displayed by the higher education students of Thailand are adequate or not, and what the experts think are the main obstacles that stop the higher education students from achieving these critical thinking dispositions.

The interview followed the format as follows:-

They were asked their general opinion about critical thinking skills among higher education students in Thailand.

They were asked about any specific feedback they got from employers about the critical thinking skills of the graduates the Thai higher education system has produced.

They were asked about their opinion on any specific factors of the Thai socio-cultural-economic system that contribute to or hinder the development of critical thinking skills among higher education students in Thailand.

They were asked about the changes they would like to see in higher education classrooms that can promote critical thinking among higher education students in Thailand. To rank the dispositions suggested by Ennis, Facione and Moon based on their importance in Thailand's cultural and social setting. There was also an option to not provide a rank to an item they think is irrelevant to the higher education students in Thailand.

During the interviews, the researcher applied what he had learned from the literature (Prommak, 2019):

a) listening to them attentively,

b) being open-minded about their different views (Hatch 2002),

c) giving them time to think and respond,

d) empowering them to tell their stories (Creswell 2013),

e) noticing emerging angles and posing further probing questions (Hatch 2002),

f) respecting their differences and sensitivities,

g) staying focused on the interview conversations,

h) asking questions using a friendly tone of voice,

i) controlling my emotions and facial expressions, such as unconsciously giving a sign of disagreement that might cause unease to them,

j) focusing on “detecting symptoms of resistance in the respondents” as well as

“refraining from pressuring the respondent for information before he is willing

or able to give it” (Gordon 1969, p. 61),

k) asking the same questions in alternative ways when they did not understand the former questions raised (Guest et al. 2012), and

l) avoiding giving researchers ideas or correcting their responses.

The advantage of the in-depth interview is that the responses are not pre-determined compared to a questionnaire (Patton, 2002). The interviews conducted by this researcher had a questionnaire which had the sole purpose of validating the dispositions/variables for this study, and it was given at the end of the interview to avoid any bias. The questions were also non-directional, evolving and open-ended (Creswell, 2007). As Thanosawan (2012) cited, in-depth interviews provide more room for flexibility and a free flow of thought for both the interviewer and interviewee. It also provides an opportunity to raise probing and follow-up questions, allowing the interviewer to explore other meanings and areas of interest (Arksey & Knight, 1999). It is also recommended that the interview should be open, iterative and continuous. An interview will be effective when it is flexible and evolving. It is also noticed that the interviewee can be more elaborate in their answers if the interviewer knows about their published background. Based on these interviews, a list of skills/dispositions was identified. An instrument/questionnaire was developed to test these dispositions.

Analysing in-depth interview data involves systematically examining the rich qualitative information obtained from participant interviews. It requires careful

consideration of the data to identify themes, patterns, and meanings embedded within the transcripts. Depending on the research objectives and methodology, researchers employ various approaches to analyse interview data, such as thematic analysis, grounded theory, or interpretative phenomenological analysis.

Thematic analysis is a widely used approach that involves identifying and organizing patterns or themes within the data (Braun & Clarke, 2006). It entails several steps, including familiarization with the data, generating initial codes, searching for themes, reviewing and refining themes, defining and naming themes, and producing a report that coherently presents the findings. This process allows researchers to identify commonalities, variations, and essential insights within the interview data.

To ensure rigour in the analysis, researchers often employ strategies such as member checking, where participants can review and validate the findings, and intercoder reliability, where multiple researchers independently analyse the data and compare their results (Ezzy, 2002). These techniques enhance the trustworthiness and validity of the analysis. When analysing in-depth interview data, it is essential to maintain the confidentiality and anonymity of the participants. Ethical considerations should be followed throughout the analysis process, ensuring the research is conducted responsibly and respecting the participants' rights and well-being.

Instruments

Critical thinking dispositions questionnaire (CTDQ)

The instrument used in this research is the Critical Thinking Dispositions Questionnaire (CTDQ) which is used to analyse the abilities of higher education students of Thailand in analysis and interpretation, evaluation, academic assertiveness, resistance to logical fallacies and cultural bias and scientific thinking. CTDQ is a 60-item questionnaire that follows Richard Paul's guidelines for assessing Higher Order thinking (Paul and Nausich, 1993). One of the primary disagreements with Paul and Nausich is that CTDQ is not meant to assess critical thinking skills but dispositions. Paul and Nausich (1993) suggest various answering methods, including ranking, multiple-choice, descriptive, and open-ended questions. CTDQ also includes an additional open-ended

self-research-type question that will assess scientific thinking and resistance towards logical fallacies. This questionnaire is not only designed to collect scores or assess their critical thinking dispositions. Still, it should be able to identify areas of critical thinking dispositions the academic community needs to address. After identifying the five dispositions/skills from a structured literature review, a questionnaire consisting of 110 questions was designed and submitted to the five experts for item-objective congruence to establish validity. In the item objective congruence (Rovinelli and Hambleton, 1977), the experts were asked to score one if they were sure the item would test the measured attribute. The experts were asked to score 0 if unsure and -1 if they were sure the item would not test the measured attribute. Every question with a mean score below 0.7 (mean calculated by the total score given by each expert divided by the number of experts) was discarded. After the first survey for item-objective congruence, the number of questions was reduced to 85. These 85 questions were further reduced to 60 after construct and discriminant validity testing using principal component analysis with the varimax rotation method. Item-objective congruence was conducted again after changing the number of questions to 60. The results of item-objective congruence are given in the table (Table 2).

Developing a questionnaire to assess analysis and interpretation skills through basic induction and deduction involves a systematic process to capture the desired information effectively. The questionnaire began by identifying the key concepts and elements related to analysis and interpretation within the chosen domain. A thorough literature review was conducted to gain insight into existing frameworks and theories in this area. From this conclusion, a set of carefully crafted items was devised, ensuring they covered a range of difficulty levels and tested different facets of analytical thinking. The items were designed to present scenarios or statements requiring participants to engage in inductive and deductive reasoning to arrive at logical conclusions. A pilot test was conducted to ensure the questionnaire was valid and reliable. This test involved a small sample of individuals who shared similar

characteristics with the target population. Feedback from the pilot study informed adjustments to the questionnaire's wording, format, and overall structure.

The final questionnaire comprises seventeen items that comprehensively assess participants' analysis and interpretation skills, providing a robust tool for evaluating their abilities in this domain. These seven items were some of this instrument's most time-consuming questions. Furthermore, expert reviewers provided valuable input to ensure the questionnaire adequately captured the intended construct.

Creating a questionnaire that accurately measures evaluation skills in critical thinking requires a systematic approach to capture the necessary information. To begin, the development process involved clearly defining the key components of evaluation skills within the context of critical thinking. Next, a comprehensive literature review was conducted to identify relevant theories, frameworks, and dimensions associated with evaluation in critical thinking. This information was used to formulate a set of thirteen carefully crafted items that covered a broad range of evaluation skills. These items assessed participants' ability to identify arguments from opinions, critically evaluate evidence, identify inferences, and make reasoned judgments. Pilot testing was conducted with a representative sample of individuals who shared characteristics with the target population. The feedback received from the pilot study was used to revise the questionnaire's wording, format, and overall structure.

Additionally, expert reviewers provided valuable insights to ensure the questionnaire accurately measured the intended construct. The final questionnaire, consisting of thirteen items, is a comprehensive tool that assesses participants' evaluation skills in critical thinking, providing a robust means to evaluate their proficiency in this area. Answering methods of these questions also varied. In some scenarios, the candidates were asked to rank the given options. They were asked to write their opinions about the scenario in some questions.

Developing a section of the questionnaire to assess academic assertiveness involved careful consideration of various scenarios that students might encounter involving their peers, professors, or authorities. The purpose was to gauge

their ability to assert themselves effectively in academic settings. The section consisted of ten items presenting different scenarios, each requiring participants to rank their response preferences from most to least among the given options. Developing this section began by identifying situations commonly in academic environments where assertiveness is essential. These situations were drawn from research, real-life experiences, and expert input. The scenarios were carefully crafted to encompass a variety of contexts, such as group projects, classroom discussions, interactions with professors, or dealing with administrative issues. The author conducted a comprehensive literature review on academic assertiveness to ensure the scenarios were relevant and valid. This review helped the author better understand the various factors and dimensions associated with assertive behaviour in educational settings. By aligning the identified scenarios with these dimensions, the author captured the multidimensional nature of academic assertiveness.

Each scenario was presented clearly and concisely, providing sufficient context for participants to understand the situation and its potential associated challenges. Participants were then asked to rank their responses based on the given options, reflecting their preferred course of action in each scenario. The options provided for ranking were carefully constructed to represent a range of assertiveness levels, from more passive or non-assertive responses to more assertive and proactive approaches. These options were designed to elicit participants' preferences and reflect their willingness to assert themselves in different academic contexts.

Pilot testing played a crucial role in refining the items in this section. A diverse group of participants, representative of the target population, was involved in the pilot study. Feedback from the pilot participants was collected through surveys, interviews, or focus groups. The feedback was analyzed to identify any ambiguities, difficulties, or gaps in understanding the scenarios or ranking options. Based on the feedback, necessary revisions were made to improve the clarity and effectiveness of the items. Expert feedback was also sought to ensure the appropriateness and alignment of the scenarios with the construct of academic assertiveness. Experts in education,

psychology, or communication reviewed the scenarios and provided valuable insights and suggestions to enhance the validity and authenticity of the items.

The final section of the questionnaire on academic assertiveness consisted of ten thoughtfully crafted items. These items assessed participants' ability to assert themselves in various academic situations, showcasing their confidence, communication skills, and proactive approach to achieving their academic goals. Each item presented a scenario followed by a range of response options, which participants ranked based on their preferred course of action. By including this section in the questionnaire, researchers sought to gain insights into the participants' level of academic assertiveness, which can be a crucial factor in their overall academic success. The findings from this section could provide valuable information for educators, administrators, and policymakers to design interventions or support systems that foster assertiveness and empower students to navigate academic challenges effectively. It is important to note that the questionnaire's results should be interpreted with other measures and qualitative data to comprehensively understand participants' academic assertiveness. Additionally, researchers should consider the limitations of self-report measures and the potential influence of social desirability bias on participants' responses.

In conclusion, the section on academic assertiveness in the questionnaire was developed with great care, incorporating research, expert input, and pilot testing to ensure its validity and effectiveness. This section aimed to assess participants' ability to assert themselves in academic settings and contribute to a deeper understanding of the factors influencing academic success. The ten scenarios presented participants with various academic situations, allowing them to rank their preferred responses.

The next section of the questionnaire consisted of 20 items, with ten items each dedicated to testing the participants' ability to identify cultural bias and logical fallacies and evaluate their scientific thinking skills. The author took great care in developing this instrument, providing clear explanations of logical fallacies and cultural bias to ensure participants' understanding of these concepts. Additionally, the author

included questions related to basic high school scientific principles to assess participants' scientific thinking abilities.

A comprehensive review of the literature on cultural bias and logical fallacies was conducted to gain a deep understanding of these concepts and their manifestations. In the development of this section, the author aimed to assess participants' critical thinking dispositions about cultural bias and logical fallacies, as well as their grasp of fundamental scientific principles. The author then selected various scenarios and statements that might contain cultural bias or logical fallacies.

The author developed ten items for the cultural bias component that presented participants with different scenarios involving cultural contexts, beliefs, or practices. The items were designed to challenge participants to critically analyse the situations and recognise potential biases that might affect decision-making or judgment. Participants were required to identify cultural bias and demonstrate their understanding of how cultural perspectives influence perceptions, attitudes, and behaviours.

In the logical fallacies component, the author created ten items that presented participants with statements or arguments containing logical fallacies. The items were carefully designed to cover many logical fallacies, including ad hominem, straw man, slippery slope, false cause, etc. Participants were then asked to identify the specific fallacies in the given statements or arguments. The author provided clear explanations of common logical fallacies to ensure participants' familiarity with these errors in reasoning.

The author included questions about basic high school scientific principles to assess scientific thinking. The questions evaluated participants' understanding of fundamental scientific concepts, such as the scientific method, hypothesis testing, experimental design, and data analysis. By including these questions, the author aimed to assess participants' ability to think critically and apply scientific principles in a given context. The items were formulated to test participants' knowledge and comprehension of scientific principles rather than memorising facts.

Pilot testing was conducted with a representative sample of participants. Feedback from the pilot study was collected through surveys, interviews, or focus groups, allowing the author to gather valuable insights on the items' clarity, relevance, and difficulty level. The author carefully reviewed and analysed the feedback, making necessary revisions to improve the clarity and effectiveness of the questions and explanations provided.

Furthermore, expert reviewers in cultural studies, logic, and science education were consulted to validate the items and ensure their alignment with the intended constructs. Their expertise and input were invaluable in refining the items and strengthening the overall quality of the questionnaire.

The final section of the questionnaire on identifying cultural bias, logical fallacies, and scientific thinking consisted of 20 items that collectively aimed to assess participants' critical thinking skills and understanding of scientific principles. Participants were required to carefully analyse scenarios, arguments, and scientific concepts to identify instances of cultural bias and logical fallacies and demonstrate scientific thinking.

The findings from this section would provide valuable insights into participants' ability to critically evaluate information, identify biases, detect flawed reasoning, and apply scientific principles. This information can be crucial for educators, researchers, and policymakers to develop interventions, curricula, or training programs that foster critical thinking, cultural competence, and scientific literacy.

It is essential to acknowledge that self-report measures have certain limitations, and participants' responses may be influenced by factors such as social desirability bias. The questionnaire results should be interpreted with other measures and qualitative data to comprehensively understand participants' critical thinking skills.

Consistency and Reliability

Cronbach's alpha proves the consistency and reliability of the items in CTDQ. Cronbach's alpha is a measure of internal consistency; that is, how closely related a set of items are as a group. It is a measure to scale reliability. A "high" value for alpha does not imply that the measure is unidimensional. If, in addition to measuring internal consistency, you wish to provide evidence that the scale in question is unidimensional, additional analyses can be performed. Exploratory factor analysis is one method of checking dimensionality. Technically speaking, Cronbach's alpha is not a statistical test but a coefficient of reliability (or consistency).

Cronbach's alpha can be written as a function of the number of test items and the average inter-correlation among the items. Below, for conceptual purposes, we show the formula for Cronbach's alpha:

$$\alpha = \frac{Nc}{v + (N-1)c}$$

Here N is equal to the number of items, c is the average inter-item covariance among the items, and v equals the average variance. One can see from this formula that if you increase the number of items, you increase Cronbach's alpha. As the average inter-item correlation increases, Cronbach's alpha increases (holding the number of items constant). Additionally, the alpha will be low if the average inter-item correlation is low.

The pilot test was conducted among 30 students in their third year of the bachelor's program in an international college. The questionnaire consisting of 85 items, was administered online using google forms, and students were given two days to complete it. The candidates who took and completed the critical thinking dispositions questionnaire were later asked to rate the questionnaire using a rating scale in two categories, relevance (Table 4) and thought provocation (Table 5), to establish face validity. The result data was analysed to establish the reliability of the questionnaire using Cronbach's alpha (Whitley, 2002; Robinson, 2009) and construct validity (Table 3). The construct validity check using principal component analysis with the varimax

rotation method (Koh and Nam, 2005) helped remove 25 items that cross-loaded above 0.40 and less than 0.40 and reduced the number of items to 60.

Participants One

This group consists of students from the four top-ranking universities from four different regions of Thailand. These students are from the first, second, third or final graduation year. They are in their third or final year because they have spent enough time in Higher Education Institutions to display their existing dispositions of critical thinking. The sample size from each university is one hundred. Being in the Top 10 universities in Thailand, this sample size can also give a comprehensive idea about the direction of critical thinking dispositions and how they are growing/falling. The universities are categorised as University A (from the central region of Thailand), University B (from the northeast region of Thailand), University C (from the southern region of Thailand) and University D (from the northern region of Thailand). These alphabets have been randomly assigned to ensure the anonymity of these institutions. All four regions are considered to ensure a cross-sectional representation of students.

Stage 2 – Developmental Research

In the second stage, a focus group comprising subject matter experts, separate groups, educators and employers will be approached for collecting data. The program for fostering the identified skills/dispositions will be developed with the help of the data collected from Stage One and put that data through scrutiny.

Focus group study

Using focus group studies involving experts in educational research provides valuable insights and perspectives on various educational issues. This research approach offers a platform for collaborative discussions, enabling researchers to gather diverse viewpoints, explore complex topics, and generate in-depth understandings. In this section, we will rationalize the use of focus group studies with experts in educational research, supported by relevant in-text references.

Using focus group studies involving experts in educational research provides valuable insights and perspectives on various educational issues. This research approach offers a platform for collaborative discussions, enabling researchers to gather diverse viewpoints, explore complex topics, and generate in-depth understandings.

Focus group studies with experts facilitate the exploration of complex educational issues by pooling knowledge and experiences. The interaction among experts stimulates rich discussions, enabling the identification of shared beliefs, contrasting opinions, and novel ideas (Kitzinger, 1995). This collaborative environment allows for examining multiple dimensions of educational phenomena and generating multifaceted perspectives (Morgan, 1997). Focus groups provide a space for validating and refining research findings through expert input. The participants' expertise ensures the discussions are grounded in evidence-based knowledge and professional experience. This validation process strengthens the credibility and trustworthiness of the research outcomes (Barbour, 2007). Furthermore, focus group studies with experts allow for exploring diverse viewpoints, considering participants' varied backgrounds, expertise, and perspectives (Krueger & Casey, 2009). This diversity contributes to a more comprehensive understanding of the research topic, considering different stakeholder interests and promoting inclusivity (Wilkinson, 2004).

Lastly, focus groups with experts offer a dynamic and interactive research approach that facilitates the generation of new insights and knowledge. The iterative nature of focus group discussions encourages participants to build upon each other's ideas, leading to novel perspectives and innovative solutions (Powell & Single, 1996). Focus group studies with experts in educational research offer numerous advantages, including collaborative discussions, validation of findings, exploration of diverse viewpoints, and generation of new knowledge. This research approach enhances the depth and richness of the data collected, ultimately contributing to a more comprehensive understanding of educational phenomena. The experts who participated in the in-depth interview in Stage One were selected to be the focus group consisting of educators.

Stage 3 – Efficacy Research

The program/pedagogy developed with the help of the data from stage two will be tested at stage three. This program will be implemented in a classroom, and the pre-test and post-test data will be compared to evaluate the efficacy.

Participants

The recruitment of the participants in this study had to meet the following three criteria: a willingness to participate in the study, permission from their institutions for data collection, and their ability to give time to provide data. There are four different categories of participants in this research. They are:

The researcher would address the higher education students participating in Stage One, who will contribute towards the initial data collection and exploratory research, as *Participant One* in the rest of this research.

The experts who will contribute via the in-depth interviews and function as the focus group of educators in Stage Two will be addressed as *Stakeholder One*.

The students participating in the efficacy research, Stage Three, will be addressed as *Participants Two*.

Participant Two

Participant Two refers to the students participating in Stage Three – Efficacy research. This group comprises students from one of the Top 10 ranking universities in the central region of Thailand. The reason for choosing this university is that the university doesn't fall in the category above and also has a fully functional International College, which ensures minimum language ability in English to go through the program/strategy developed in Stage Two. It is also a public university with a long-standing legacy in Thailand, attracting students from all over the country.

Stakeholder One – Experts

Stakeholder one consists of experts from education. There has been a deliberate effort to include a wider variety of experts from every level of education who has foreign learning experiences and also foreigners with teaching experience in

Thailand. The experts' qualifications are given below, and the alphabets are assigned randomly.

One A: Thai Citizen, a Doctor of Philosophy in Education from an American University, has experience teaching and training language skills to young officers of the Thailand Defense Forces for 30 years.

One B: Foreign Citizen, Doctor of Philosophy in Higher Education and Administration from an American University, was the Dean of the Management Program at a prominent University in Thailand.

One C: Thai Citizen, Doctor of Philosophy in Education from an Ivy League American University, has experience teaching in Thailand for eight years.

One D: Thai Citizen, Doctor of Engineering from a Thai University and has an experience of twelve years in academia.

One E: Foreign Citizen, Doctor of Philosophy in Anthropology from an American University and has thirteen years of experience teaching in Thailand.

Procedure

There are different timelines for different procedures at each stage of this research. The data collection started for Stage One started on Jun 2021 and ended in December 2021. Stage two, the exploratory stage, including focus group discussions, analysis and further literature review for developing a procedure to improve critical thinking dispositions among higher education students, was conducted during this stage, which was from January 2022 to April 2022. The last stage involved the implementation of the developed procedure and testing its efficacy which was done from Jan 2023 to March 2023.

Analysis

Different methods were used at different stages for coding and analysing the data used in this research.

Analysing interview data

The analysis process was carried out according to the content analysis process. Content analysis is broadly referred to as “any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings” (Patton, 2002, p. 453). Data analysis from the interviews began with open coding and then selective coding (Bryant & Charmaz, 2007; Corbin & Strauss, 2008; Glaser, 1978; Glaser & Strauss, 1967; Strauss, 1987; Strauss & Corbin, 1998). Interview data were transcribed and, if necessary, translated. In the first stage, the researcher identified words or phrases in the transcript that occurred frequently. Then, these words were categorized into the first-level coding according to their frequency. The words or phrases that participants emphasised were classified as significant.

Apart from analysing the interview and discussion data, the researcher examined the reflective notes in the data collection process. This examination was not done separately from the context. The contexts where the interview occurred and the background of the participants were recorded in a note when the researcher analysed the data. Knowing the background and discipline of the participants assisted in the analysis process. Secondly, the words and phrases were input into the database of interview data. The researcher applied filters to these data fields. Participants’ responses to particular words were collocated. The process is called data reduction.

Analysing quantitative data

As mentioned earlier in this chapter, the CTDQ was analysed using Cronbach’s alpha. The collected data will be captured, analysed and interpreted using descriptive statistics. Descriptive statistics will organize and summarize data meaningfully to promote understanding of the data characteristics (Maree & Pieterson, 2007). Frequencies, percentages and means will be calculated for the various responses to the questionnaire items. As the researcher wants to go beyond summarizing and describing data, inferential statistics will also be utilized to interpret differences between the learners' pre-test and post-test responses to determine

significance (Maree & Pietersen, 2007). T-tests were utilized for this purpose. P-values smaller than 0.5 were considered significant, and values larger than 0.5 were non-significant (Maree& Pietersen, 2007). Cohen's D will be calculated to determine if the statistically significant differences had a practical effect (Steyn, 2005). An ANOVA will be conducted to summarize the pre-test and post-test data. According to McMillan and Schumacher (2006), ANOVA is an extension of the t-test. Rather than using multiple t-tests to compare all possible means in a pre-test and post-test study, ANOVA allows the researcher to test for differences between the pre-test and post-test groups and make more accurate probability statements than using separate t-tests. The ANOVA revealed statistically significant results between the different groupings of the variables. In that case, subsequent post hoc tests (Tukey Honestly Significant Difference (HSD) Tests) will be run to determine which of the variable groupings displayed the differences (McMillan & Schumacher, 2006).

Ethics and limitations

It is a priority in this research to keep the identities of the University, the International College and the participants confidential. To comply with a protocol of the Human Research Ethics Committee, the participants are identified by their position, their affiliation, and nationality. The institutions are identified as “the University” and “the International College.” The interview process and other data collection forms included fully informed, consented participation from all participants. In coding the data, special codes were assigned to identify the interviewees. The data was revised after the transcription to ascertain that the identity of the participants was not present in the study.

CHAPTER 4
ANALYSIS

This research's Results and Analysis chapter investigates the critical thinking dispositions among higher education students in Thailand. The study initially conducted a systematic literature review to identify key critical thinking dispositions from the works of Facione, Elder, Ennis, Moon, and Brookfield. From this review, the study identified Analysis and Interpretation, Evaluation, Academic Assertiveness, identification of cultural bias and logical fallacies, and Scientific thinking as the relevant dispositions to be examined.

Following the literature review, a 60-item questionnaire was developed to assess these critical thinking dispositions among 400 higher education students. The aim was to gather quantitative data that would provide insights into the prevalence and level of these dispositions among the student population.

A focus group study was conducted with experts in critical thinking to explore further and enhance the development of these dispositions. The insights and recommendations from these experts were used to determine an effective method to foster the identified critical thinking dispositions among the students. Subsequently, five lesson plans were developed based on these methods, providing a structured framework for students to develop their thinking algorithms to cultivate these critical thinking dispositions.

A pre-test and post-test design was employed to evaluate the effectiveness of the implemented lesson plans, involving a sample of 30 students. This design aimed to measure changes or improvements in the students' critical thinking dispositions after the intervention's implementation.

The Results and Analysis chapter will present the findings from the questionnaire survey, focus group study, and pre-test and post-test evaluation. The findings will shed light on the current state of critical thinking dispositions among students in Thailand and offer practical implications for educational institutions to enhance critical thinking skills and dispositions among their students. The chapter will

analyze and interpret the quantitative and qualitative data to address the research objectives and answer the research questions related to the critical thinking dispositions among higher education students in Thailand. Through this comprehensive analysis, this research seeks to contribute to the understanding of critical thinking dispositions among higher education students and provide insights into practical methods for their development.

Critical thinking dispositions questionnaire.

After identifying the five dispositions/skills, a questionnaire consisting of 110 questions was designed and submitted to the five experts (Stakeholder One) for item-objective congruence to establish validity. In the item objective congruence, the experts were asked to score +1 if they were sure the item would test the measured attribute. The experts were asked to score 0 if unsure and -1 if they were sure the item would not test the measured attribute. Every question with a mean score below 0.7 (mean calculated by the total score given by each expert divided by the number of experts) was discarded.

After the first survey for item-objective congruence, the number of questions was reduced to 60. Item-objective congruence was conducted again after changing the number of questions to 60. The results of item-objective congruence are given in the table (Table 2). The questionnaire used the 21 critical questions suggested by Paul and Nosich (1992) in the model for the national assessment of higher-order thinking as a guideline for including multiple-choice, open-ended, ranking, and self-evaluation questions (Table 1). 4 out of 5 experts suggested that the deliberation might cause mental exhaustion to the candidates who take the test. This suggestion was later added to the questionnaire's introduction, stating that candidates are free to take the test at will and submit the test incomplete. It was also decided to administer the test online using a Google form link so that the candidates feel no pressure of completion. Anonymity was also ensured so that the candidates felt no pressure of performance. Sample questions were provided for each section, and the rationale for the answers and what was being

tested was explained. As suggested by the experts, definitions were provided for terminologies that might be unfamiliar to higher education students.

As the higher education students of Thailand are second language speakers, it was decided that the developed instrument, the Critical Thinking Dispositions Questionnaire, will be administered only among students who are studying in the second or third year of bachelor's programs which mandates a minimum IELTS score of 5.5 or above for admission into the program.

Table 1. The basic structure of the critical thinking dispositions questionnaire

SN.	Item description and type	Type of Questions	Number of Items
1	Analysis and Interpretation	Open-ended, Multiple choice	17
2	Evaluation	Ranking, Multiple choice	13
3	Academic Assertiveness	Ranking, Self-evaluation	10
4	Resistance to logical fallacies and cultural bias	Open-ended, Multiple choice	10
5	Scientific thinking	Multiple Choice, Ranking	10

Table 2. Internal consistency of the data collected using the questionnaire

SN.	Indicator	Value
1	Number of Items	60
2	Number of Cases	400
3	Cronbach's Alpha Based on Standardised Items	0.796
4	Mean Item Difficulty	0.58

Table 3. The mean score given by each expert for 60 items in the questionnaire.

SN.	Qualification of the Expert	Years of Experience in Academia	Mean score
1	PhD in Higher Education Administration	25 years	1.0
2	PhD in Educational Communication and Technology	11 years	0.8
3	PhD in Educational Leadership and Policy	30 years	1.0
4	PhD in Biological Anthropology	12 years	0.8
5	Doctor of Engineering	15 years	1.0

Data Analysis – The descriptive statistics

This study aimed to assess the student's critical thinking dispositions, to understand their tendencies and inclinations towards critical thinking, where they stand and how to improve their current tendencies. The critical thinking dispositions questionnaire was implemented among 400 bachelor's degree students across four international programs in Thailand. The participants were selected from diverse academic backgrounds, representing various disciplines within the international programs. The results revealed that most participants demonstrated positive dispositions towards critical thinking. The study's purpose differed from passing judgement on their current status. Specifically, many students reported needing to be aware of specific dispositions like academic assertiveness and evaluating evidence.

The numbers and statistics of the study are being reported for the benefit of the researchers and educators to take further steps.

Moreover, many participants indicated a strong inclination towards identifying cultural bias, logical fallacies, and scientific thinking, irrespective of their stream of study. However, there were no variations in critical thinking dispositions across different programs, years of study or gender, suggesting that disciplinary influences play a lesser role than we expected in shaping students' thinking dispositions. These findings provide valuable insights into the critical thinking dispositions of bachelor's degree students in international programs in Thailand and highlight the importance of fostering critical thinking skills within higher education curricula. Future research could explore the factors influencing critical thinking dispositions and investigate strategies to enhance critical thinking abilities among students in these programs. The following tables have detailed the mean scores of students from each institution in each critical thinking disposition (Tables 4, 5, 6, 7). All the scores are given in percentages.

Table 4. The score of students from Institution A in each disposition (100 participants)

Item description and type	Minimum score	Maximum Score	Mean Score	Variance	Standard Deviation
Analysis and Interpretation	29%	100%	58.14%	347.37	18.64
Evaluation	48%	83%	66.04%	185.10	13.61
Academic Assertiveness	10%	80%	40.50%	414.90	20.36
Resistance to logical fallacies and cultural bias	50%	100%	77.20%	394.10	19.38
Scientific thinking	50%	90%	72.30%	120.92	10.99
Total Score	47%	82%	63.77%	101.89	10.10

Table 5. The score of students from Institution B in each disposition (100 participants)

Item description and type	Minimum score	Maximum Score	Mean Score	Variance	Standard Deviation
Analysis and Interpretation	29%	100%	57.86%		18.98
Evaluation	39%	100%	66.83%		14.44
Academic Assertiveness	10%	100%	41.50%		21.19
Resistance to logical fallacies and cultural bias	40%	100%	77.50%		20.27
Scientific thinking	40%	100%	72.90%		11.66
Total Score	47%	97%	64.27%		10.47

Table 6. Score of students from Institution C, in each disposition (100 participants)

Item description and type	Minimum score	Maximum Score	Mean Score	Variance	Standard Deviation
Analysis and Interpretation	14%	100%	55.71%		20.05
Evaluation	30%	100%	66.39%		14.71
Academic Assertiveness	0%	100%	41.40%		21.36
Resistance to logical fallacies and cultural bias	40%	100%	77.30%		20.54
Scientific thinking	20%	100%	72.60%		12.63
Total Score	27%	100%	63.83%		11.82

Table 7. The score of students from Institution D in each disposition (100 participants)

Item description and type	Minimum score	Maximum Score	Mean Score	Variance	Standard Deviation
Analysis and Interpretation	0%	100%	55.14%		22.25
Evaluation	22%	100%	66.78%		15.91
Academic Assertiveness	10%	100%	42.90%		23.11
Resistance to logical fallacies and cultural bias	0%	100%	76.70%		21.74
Scientific thinking	20%	100%	72.20%		14.04
Total Score	16.67%	100%	64.00%		13.89

The results showed no significant differences in mean scores across variables such as analysis and interpretation, evaluation, academic assertiveness, identifying cultural bias and logical fallacies, and scientific thinking. However, it was noted that all the students consistently scored less in academic assertiveness. This finding suggests that there may be a need for more emphasis on developing academic assertiveness skills among students in Thai universities. By doing so, students may be better equipped to effectively express their opinions and ideas in academic settings, which could ultimately lead to improved academic performance and success. It is important to note that academic assertiveness is a crucial aspect of critical thinking, as it allows individuals to articulate their ideas and opinions confidently and effectively. This skill is essential in academic settings, where individuals are often required to engage in critical discussions and debates with their peers and professors. Overall, this study highlights the need for Thai universities to focus on developing academic assertiveness skills among their students. By doing so, students can become more confident and influential critical thinkers, leading to improved academic performance and success.

The One-way ANOVA test and T-Test

The one-way ANOVA test is considered a reliable statistical tool for comparing the means of multiple groups. It facilitates the determination of whether there exists a significant difference in means between these groups. The test also helps reduce the risk of committing type I errors, which involves rejecting a true null hypothesis. Moreover, the one-way ANOVA test provides valuable insights into the variability within each group, enabling the identification of sources of differences between groups. Consequently, the one-way ANOVA test serves as a justified and practical approach to comparing means across multiple groups in academic research. According to the American Psychological Association (APA), the one-way ANOVA test is a statistical analysis tool used in social science research (Coolican, 2019; Aron, Aron and Coops, 2019). The one-way ANOVA test is also included in popular statistical software packages such as SPSS and SAS. These references highlight the significance and prominence of the one-way ANOVA test in academic research.

Institutions

This analysis aims to investigate and compare the mean scores of critical thinking components, including Analyse and Interpret, Evaluation, Academic Assertiveness, Identifying Logical Fallacies and Cultural Bias, and Scientific Thinking, among students from four different institutions using a one-way analysis of variance (ANOVA) test. The purpose is to determine if there are significant differences in critical thinking dispositions across these institutions. The statistical tool of choice is the one-way ANOVA test, which considers both within-group and between-group variability to compare the differences in mean scores among institutions. The results of the ANOVA test will be interpreted, and further post hoc tests may be conducted to identify specific pairwise differences between institutions. The implications of this study are significant for curriculum development, teaching methodologies, and interventions aimed at enhancing critical thinking skills, as well as providing insights into the effectiveness of different educational approaches in fostering critical thinking abilities among students. In conclusion, this study will contribute to our understanding of the factors influencing

critical thinking skills/dispositions and inform educational practices to promote and improve students' critical thinking abilities. In the table (Table 8), A, B, C, and D represent the four institutions; minimum and maximum scores are in per cent.

Table 8. One-way ANOVA analysis of mean scores from the four institutions

Item description		A	B	C	D	F	Sig
Analysis and Interpretation	Minimum	29	29	14	0	0.566	0.637
	Maximum	100	100	100	100		
Evaluation	Minimum	48	39	30	22	0.630	0.979
	Maximum	83	100	100	100		
Academic Assertiveness	Minimum	10	10	0	0	0.212	0.888
	Maximum	80	100	100	100		
Resistance to logical fallacies	Minimum	50	40	40	10	0.270	0.994
and cultural bias	Maximum	100	100	100	100		
Scientific thinking	Minimum	50	40	20	20	0.065	0.978
	Maximum	90	100	100	100		
Total Score	Minimum	47	47	27	17	0.360	0.991
	Maximum	82	97	100	100		

The one-way ANOVA test revealed no statistically significant difference between the students' Critical thinking skills and disposition scores from four different institutions.

Gender

This analysis aims to investigate and compare the mean scores of critical thinking components, including analysis and interpretation, Evaluation, Academic Assertiveness, Identifying Logical Fallacies and Cultural Bias, and Scientific Thinking, among students based on the gender they identified with using a one-way analysis of

variance (ANOVA) test. The minimum and maximum scores given in Table 9 are in per cent.

Table 9. One-way ANOVA analysis of mean scores based on gender

Item description		Male	Female	F	Sig
Analysis and Interpretation	Minimum	14	0	0.907	0.438
	Maximum	100	100		
Evaluation	Minimum	22	30	0.235	0.872
	Maximum	100	100		
Academic Assertiveness	Minimum	0	10	0.201	0.895
	Maximum	100	100		
Resistance to logical fallacies	Minimum	40	10	0.468	0.706
and cultural bias	Maximum	100	100		
Scientific thinking	Minimum	20	30	1.354	0.257
	Maximum	100	100		
Total Score	Minimum	22	17	0.187	0.905
	Maximum	100	100		

The one-way ANOVA test revealed no statistically significant difference between students' Critical thinking skills and disposition scores based on the gender they identified with.

Year of Study

Students from all four years of the bachelor's degree program have participated in this study. Is there any statistically significant difference in their mean scores based on which year they are in their study program? In Table 9, Y1, Y2, Y3, and Y4 are Year 1, Year 2, Year 3 and Year 4 students respectively. The minimum and maximum scores given in Table 9 are in per cent.

Table 10. One-way ANOVA analysis of mean scores based on the year of study

Item description		Y1	Y2	Y3	Y4	F	Sig
Analysis and Interpretation	Minimum	0	14	14	14	0.907	0.795
	Maximum	100	100	100	100		
Evaluation	Minimum	22	30	48	39	0.275	0.260
	Maximum	100	100	100	100		
Academic Assertiveness	Minimum	0	0	10	10	0.466	0.706
	Maximum	100	100	90	100		
Resistance to logical fallacies	Minimum	10	40	50	40	0.201	0.895
and cultural bias	Maximum	100	100	100	100		
Scientific thinking	Minimum	20	20	50	40	1.354	0.257
	Maximum	100	100	100	100		
Total Score	Minimum	17	27	45	33	0.187	0.905
	Maximum	100	100	97	100		

The one-way ANOVA test revealed no statistically significant difference between the students' Critical thinking disposition scores based on the years spent in their bachelor's degree program.

Stream of study

Students from different bachelor's degree program streams participated in this study. Is there any statistically significant difference in their mean scores based on which stream (Science, Arts or humanities, Business or tourism) they chose to do their bachelor's degree? In Table 11, Sc represents students from the Science stream, AH represents students from the Arts and Humanities stream, and BT represents students from the Business and Tourism stream. The minimum and maximum scores given in Table 11 are in per cent.

Table 11. One-way ANOVA analysis of mean scores based on the stream.

Item description		Sc	AH	BT	F	Sig
Analysis and Interpretation	Minimum	14	14	0	1.151	0.317
	Maximum	100	100	100		
Evaluation	Minimum	48	30	22	0.435	0.647
	Maximum	100	100	100		
Academic Assertiveness	Minimum	10	0	0	0.356	0.701
	Maximum	100	100	90		
Resistance to logical fallacies and	Minimum	50	40	10	1.549	0.214
cultural bias	Maximum	100	100	100		
Scientific thinking	Minimum	20	20	20	0.343	0.710
	Maximum	100	100	100		
Total Score	Minimum	17	27	45	0.172	0.842
	Maximum	100	100	97		

The one-way ANOVA test revealed no statistically significant difference between the students' Critical thinking disposition scores based on the stream (Science, Arts or humanities, business or tourism) they chose for their bachelor's degree program.

Correlation – Critical thinking dispositions and English Language skills

As the higher education students of Thailand are second language speakers, it was decided that the developed instrument, the Critical Thinking Dispositions Questionnaire, will be administered only among students who are studying in the first, second, third year or fourth year of an international bachelor’s programs which mandates a minimum IELTS score of 5.0 or above for admission into the program. Three IELTS examiners further validated these suggestions and ensured the questionnaire was understandable to students with an IELTS score of 5.0 or above.

SAT and IELTS were identified as the two most popular tests taken in Thailand for admission into an international program. The Scholastic Assessment Test and the International English Language Testing System are the two most popular. The SAT (Scholastic Assessment Test) is a standardised test widely used in the United States as an admission requirement for colleges and universities. The test measures various skills, including critical reading skills in English. Evidence of the SAT as a parameter of critical reading skills in English can be found in several ways. Firstly, the SAT reading section assesses a student's ability to understand, analyse and evaluate written passages, which requires critical reading skills. The questions in this section require students to identify the main idea, locate specific information, make inferences, and analyse the structure and organisation of a passage (College Board, 2021). Additionally, research studies have shown a strong correlation between SAT scores and critical reading skills. For example, a study by the College Board (2021) found that students who scored well on the SAT reading section tended to perform better on other standardised tests that measure critical reading skills, such as the ACT (American College Testing) and the GRE (Graduate Record Exam).

Moreover, many universities and colleges use SAT scores as one of the factors in their admission decisions, indicating the importance they place on the test as a measure of critical reading skills. Some universities even use SAT scores to benchmark students' critical reading abilities, requiring a minimum score for admission (College Board, 2021). Furthermore, the SAT is widely used and accepted by colleges and universities across the United States, which lends credibility to its ability to measure critical reading skills. The fact that the test is widely recognised as a standard for evaluating students' critical reading skills makes it a reliable parameter for determining their critical reading abilities (College Board, 2021). In conclusion, the SAT is widely accepted as a parameter of critical reading skills in English. Its design, research findings, use by colleges and universities, and recognition as a standard for evaluating critical reading skills make it a reliable measure of a student's critical reading abilities.

The International English Language Testing System (IELTS) is a widely recognised and accepted English language proficiency test. It is used as a benchmark for English proficiency by universities, governments, and organisations worldwide. IELTS assesses an individual's ability to communicate effectively in English, including reading, writing, speaking and listening skills. The test is divided into four sections - reading, writing, speaking and listening - each evaluating a different aspect of English proficiency. The reading section measures an individual's ability to understand written texts in English. The speaking section assesses an individual's oral communication skills, including pronunciation, fluency, and vocabulary usage, and the listening section measures an individual's ability to comprehend spoken English. In contrast, the writing section assesses an individual's writing skills, including producing clear, organised and well-structured writing (IELTS, 2021).

One of the reasons why IELTS is considered a benchmark for English proficiency is its rigorous and comprehensive assessment of language skills. The test covers all four language skills, comprehensively evaluating an individual's English proficiency. Additionally, IELTS is designed to test a wide range of language abilities, including grammar, vocabulary, pronunciation, and fluency, making it a robust measure of an individual's English proficiency. Furthermore, IELTS is recognised and accepted by thousands of universities and organisations worldwide, making it a widely accepted benchmark for English proficiency (IELTS, 2021). Many universities and organisations require IELTS scores as a part of their admission or employment processes, indicating the importance they place on the test as a measure of English proficiency. Moreover, IELTS is developed and administered by Cambridge Assessment English, a department of the University of Cambridge, and the British Council, two of the world's leading language assessment organisations. These institutions give credibility to the test as a benchmark for English proficiency, as it is developed and administered by organisations with extensive expertise and experience in language assessment.

Finally, IELTS scores are valid for two years, making them a reliable benchmark for English proficiency over a significant period. Additionally, IELTS scores are available within two weeks of taking the test, making it an efficient and convenient way to assess English proficiency. In conclusion, IELTS is a widely accepted and recognised benchmark for English proficiency. Its comprehensive assessment of language skills, recognition by universities and organisations, development by leading language assessment organisations, and validity over time make it a reliable measure of an individual's English proficiency. Most of the international or English programs conducted by the universities in Thailand demand a Band 5.0 and above in IELTS for their applicants. So, it is safe to assume that every international or English program student has scored Band 5.0 or above in IELTS.

The data was analysed using SPSS 24.0. Pearson's correlation coefficient was used to examine the relationship between critical thinking dispositions and IELTS scores, and critical thinking dispositions and SAT Evidence-based reading and writing scores. All these above tables (tables 8, 9, 10,11) suggest that academic assertiveness and the ability to analyse and interpret are low among higher education students of Thailand compared to their ability to evaluate, identify fallacies and think scientifically. There is no significant difference between the mean scores in terms of year of study, stream of study or the gender of the student. The correlation between the critical thinking dispositions, IELTS Reading, writing, speaking, listening and SAT EBRW scores was analysed using Pearson's Correlation coefficient. Table 12 shows the detailed results of this correlation and its significance. A statistical significance of 0.05 was set for this correlation study.

Table 12. Correlation between critical thinking dispositions, IELTS Reading, writing, speaking, listening and SAT EBRW scores.

Item description	Pearson's correlation (r)	IELTS reading	IELTS writing	IELTS speaking	IELTS listening	SAT EBRW
Analysis and Interpretation	'r' Value	0.31	0.33	0.32	0.33	0.42
	Significance	0.000	0.000	0.000	0.000	0.000
Evaluation	'r' Value	0.65	0.64	0.44	0.41	0.80
	Significance	0.000	0.000	0.000	0.000	0.000
Academic Assertiveness	'r' Value	0.59	0.55	0.46	0.37	0.66
	Significance	0.000	0.000	0.000	0.000	0.000
Resistance to logical fallacies and cultural bias	'r' Value	0.56	0.57	0.44	0.38	0.78
	Significance	0.000	0.000	0.000	0.000	0.000
Scientific thinking	'r' Value	0.61	0.57	0.42	0.35	0.73
	Significance	0.000	0.000	0.000	0.000	0.000

The results from the correlation studies suggest a significant correlation between critical thinking dispositions and English language proficiency among higher education students studying in international programs in Thailand. In a closer look, the r-value (Pearson's correlation coefficient) suggests that the SAT-EBRW scores correlate more strongly to critical thinking dispositions than the IELTS scores in general. Among the IELTS scores, the reading and writing scores correlate with the critical thinking dispositions stronger than the speaking and listening scores.

Focus Group Discussions

Data analysis by Data reduction

Data reduction involves selecting, simplifying, abstracting, and transforming data from field notes or transcriptions (Miles & Huberman, 1994). This process is essential for managing and making sense of large volumes of data (Berkowitz, 1997). The data reduction process started by reading them several times in their entirety. Continuously reading and re-reading the transcripts allowed the author to identify important information. Cross-referencing was conducted with the transcripts and the audio recordings to identify emphasized words or phrases and instances of long pauses, indicating gaps in knowledge.

With reference to Darlington and Scott (2003), the author listened to the audio recordings while referring to the transcripts to gain a complete understanding of the data before breaking it down into parts. Relevant ideas and phrases that aligned with research questions were colour-coded in all the transcripts. These were then organized with similar colours from the transcripts into separate folders, assigning each folder a code name that reflected its content.

These were then carefully reviewed the contents of each folder multiple times to identify possible combinations and mergers of codes. Codes that shared similarities were merged and categorized. For example, codes related to focusing on skills and qualifications were combined under the category "Commitment to Skill." This categorization process involved placing the combined codes into new folders representing broader themes. However, data that did not fit into any specific category required revision to ensure all relevant data were appropriately categorized.

After completing the data reduction process, the second stage of data analysis, as outlined by Miles and Huberman (1994), involved creating data displays. This step aimed to condense information and provide a general sense of the emerging categories. Through this process, four themes emerged:

The categories "Points to focus," "Time limit," "Discussions," and "Teacher as a facilitator" were combined and placed under the theme "Policy and Practice in the Classroom."

The categories "Inconsistencies with Conceptualizations," "Lack of Certainty about Value of CT," and "Limited Knowledge of Teaching and Learning Strategies for Adults" were grouped under the theme "Variations in Conceptualizations and Perceptions."

The categories "Keeping discussions to the point", “real-world examples”, and "scaffolding techniques" were categorized under the theme "Things to Remember in Class."

The categories "Observing student response," "Constant Repetition," and "Encouraging discussions" were placed under the theme "Development Impact."

In summary, the data reduction process involved multiple iterations of reading, coding, categorizing, and revising to identify meaningful patterns and themes in the data. This reduction allowed for a more manageable and comprehensive understanding of the focus group study's findings.

The participants engaged in in-depth discussions to explore the most effective approaches for fostering critical thinking dispositions among higher education students. The aim was to identify strategies to develop students' algorithms as a cognitive framework for critical thinking. The focus group discussions yielded valuable feedback and insights that formed the foundation for developing the lesson plans. Some critical feedback and insights include:

A) Importance of student engagement: Participants emphasized the significance of actively involving students in developing their algorithms. They highlighted the need for hands-on activities, problem-solving exercises, and reflective tasks to encourage student engagement.

B) Scaffolded learning approach: The experts emphasized the importance of scaffolding the learning process. They suggested gradually guiding

students through developing an algorithm, starting with more straightforward tasks and progressively increasing the complexity.

C) Reflection and metacognition: Feedback from the focus group stressed the significance of incorporating reflection and metacognitive strategies into the lesson plans. These strategies would enable students to analyze their thinking processes and make adjustments as necessary.

D) Incorporating real-world applications: The experts emphasized connecting critical thinking skills to real-world applications. They suggested integrating case studies, current events, and problem-solving scenarios to make the lesson plans more relevant and practical for students.

Developing lesson plans

Based on the feedback and insights from the focus group study, a systematic process was followed to develop the lesson plans for fostering critical thinking dispositions. The following steps were undertaken:

Identifying learning objectives: Clear learning objectives were established to define the desired outcomes of the lesson plans. These objectives aligned with developing critical thinking dispositions and students' ability to create their algorithms.

Sequencing and scaffolding: The lesson plans were structured logically, providing a scaffolded approach to guide students through developing their algorithms. Each lesson is built upon the previous one, gradually increasing the complexity and depth of critical thinking tasks.

Incorporating active learning strategies: The lesson plans included a variety of active learning strategies, such as group discussions, problem-solving activities, debates, case analyses, and reflection exercises. These strategies aimed to engage students actively in the learning process and foster their critical thinking skills.

Integration of real-world examples: Real-world examples, case studies, and authentic scenarios were integrated into the lesson plans to enhance students' understanding of critical thinking concepts and their application in practical contexts.

Assessment and feedback: Assessment methods were designed to evaluate student's progress in developing algorithms and applying critical thinking skills. Formative assessments, such as self-assessments, peer evaluations, and instructor feedback, were incorporated to support students' continuous improvement.

Why an algorithm-based lesson plan?

An algorithm is a step-by-step procedure or a set of instructions that enables a computer or a human to solve a specific problem or accomplish a particular task (Cormen et al., 2009). A well-defined sequence of actions or operations transforms the input into the desired output. Algorithms can be found in various areas of life, ranging from mathematics and computer science to everyday activities like following a recipe or assembling furniture. Developing an algorithm not only aids in problem-solving but also plays a significant role in fostering critical thinking dispositions in students (Barak, 2017).

First and foremost, algorithm development requires students to define and understand the problem. They must identify the specific task or objective they want to achieve and gain a clear comprehension of the constraints and requirements involved. This initial step encourages students to think critically about the problem's context, break it into manageable components, and consider the interrelationships between elements (Facione, 2011). It fosters the skill of analysis, where students learn to dissect complex problems into simpler sub-problems, facilitating a more comprehensive understanding of the overall challenge.

Next, students embark on devising a solution by designing an algorithm. This step involves breaking down the problem into smaller, more manageable steps or subroutines. It requires students to use logical reasoning and problem-solving skills to determine the most efficient and effective sequence of actions to achieve the desired outcome. As they create and refine their algorithm, students are encouraged to consider multiple approaches, evaluate the pros and cons of different strategies, and make informed decisions based on evidence and logical reasoning (Wing, 2006). This critical

evaluation of alternative solutions nurtures their ability to think independently and make reasoned judgments.

Moreover, algorithm development often involves testing and refining the solution. Students are encouraged to experiment with different inputs, identify potential pitfalls or errors, and modify their algorithms accordingly. This iterative process reinforces the importance of perseverance and resilience and nurtures intellectual curiosity (Ramesh et al., 2019). By actively seeking feedback and continuously improving their algorithms, students develop a growth mindset, valuing the learning process and embracing challenges as opportunities for growth.

Furthermore, algorithm development promotes creativity and innovation. While there may be established solutions or known algorithms for specific problems, students are encouraged to think beyond conventional approaches and explore novel strategies. They can introduce their unique insights, perspectives, and creative problem-solving techniques into their algorithms, encouraging divergent thinking and fostering their ability to think outside the box (Baeten et al., 2010). This aspect of algorithm development nurtures critical thinking dispositions such as creativity, flexibility, and adaptability, preparing students to tackle real-world challenges that may have yet to be pre-defined solutions.

Lastly, developing an algorithm facilitates the development of communication and collaboration skills. In many educational settings, algorithm development is often conducted in teams, requiring students to collaborate, share ideas, and articulate their thoughts effectively. Collaborative algorithm development encourages students to actively listen, consider different viewpoints, and engage in constructive discussions (Jansen et al., 2017). It promotes the exchange of diverse perspectives, nurtures empathy, and cultivates respect for others' ideas. The ability to communicate and collaborate effectively is a crucial aspect of critical thinking, as it enables students to engage in meaningful dialogue, build upon each other's insights, and collectively generate innovative solutions.

In conclusion, developing an algorithm is an effective tool for nurturing critical thinking dispositions in students. Students learn to analyze problems, think independently, and make reasoned judgments through algorithm development. They engage in logical reasoning, problem-solving, and creativity, exploring multiple solutions and evaluating their merits. The iterative nature of algorithm development fosters perseverance, intellectual curiosity, and a growth mindset. Furthermore, collaborative algorithm development enhances communication and collaboration skills, promoting the exchange of diverse perspectives and collective problem-solving. By engaging in algorithm development, students develop a range of critical thinking dispositions that are valuable not only in academic pursuits but also in their personal and professional lives.

Pre-test and Post-test Analysis

This study examines second-year students' critical thinking dispositions in a Bachelor's Degree business program. A pre-test and post-test design was employed using a questionnaire consisting of 60 items that assessed the students' analysis and interpretation skills, evaluation skills, academic assertiveness, resistance to cultural bias and logical fallacies, and scientific thinking. Following the pretest assessment, the participants underwent a series of five instructional classes to facilitate the development of their algorithms as guidelines for each critical thinking disposition. These classes served as the intervention phase of the study. After approximately 90 days, the posttest was administered, allowing participants to utilize their algorithms to answer the same critical thinking questions.

The data collected from the pretest and posttest were analyzed using the Statistical Package for the Social Sciences (SPSS), version 24. The analysis involved several steps: data preparation, screening, descriptive statistics, paired-sample t-tests, effect size calculation, and additional analyses.

In the data preparation stage, each participant's pretest and posttest scores were organized into separate variables in the dataset. Data screening was conducted to identify any missing data or outliers within the dataset. Missing data were handled following SPSS guidelines, ensuring the subsequent analyses were based on complete data.

Descriptive statistics were calculated to summarize each critical thinking disposition's pretest and posttest scores. Means, standard deviations, and minimum and maximum values were obtained to provide an overview of the data (Table 13).

Paired-sample t-tests were performed to examine the significance of a change in critical thinking dispositions before and after the intervention. Paired variables representing the pretest and posttest scores for each critical thinking disposition were included in the analysis. The t-values, degrees of freedom, p-values, and mean differences were derived from the output to determine the statistical significance of the observed changes. Cohen's D, a commonly used effect size measure, was employed to quantify the effect of the intervention on each critical thinking dimension. Effect sizes were calculated to estimate the magnitude of the change in critical thinking dispositions. The effect sizes were manually computed using the mean differences and standard deviations from the paired-sample t-tests.

Table 13. Descriptive statistics – Pretest and Posttest scores (All scores in percentage).

Item description	Pretest and Post-test scores	Minimum	Maximum	Mean	Standard Deviation
Analysis and Interpretation	Pretest	29	100	59.05	19.40
	Post-test	43	100	69.00	20.59
Evaluation	Pretest	48	83	66.23	13.92
	Post-test	52	100	75.97	16.62
Academic Assertiveness	Pretest	48	83	66.23	13.92
	Post-test	48	83	66.97	14.05
Resistance to logical fallacies and cultural bias	Pretest	50	100	78.00	20.07
	Post-test	60	100	87.00	14.84
Scientific thinking	Pretest	50	90	72.67	10.80
	Post-test	40	100	88.33	14.16

Paired T- Samples Test

The paired-sample t-test was conducted to compare the pretest and posttest scores for each critical thinking disposition among the participants. The results indicated significant changes in several critical thinking dimensions after the intervention.

For analysis and interpretation, a significant increase in scores was observed from the pretest (M = 59.05, SD = 19.40) to the posttest (M = 69.00, SD = 20.59), $t_{(29)} = 4.03$, $p < .05$, Cohen's d = 0.74. These values suggest that the intervention positively affected the participants' ability to analyze and interpret information.

Similarly, for evaluation skills, the posttest scores (M = 66.23, SD = 13.92) were significantly higher compared to the pretest scores (M = 75.97, SD = 16.62), $t_{(29)} = 5.16$, $p < .05$, Cohen's d = 0.64. These readings indicate an improvement in participants' evaluative abilities following the intervention.

Regarding academic assertiveness, a statistically significant difference was found between the pretest (M = 66.23, SD = 13.92) and posttest scores (M = 66.97, SD = 14.05), $t_{(29)} = 1.75$, $p > .05$, Cohen's d = 0.05. The intervention was ineffective in enhancing participants' academic assertiveness, and there was no significant improvement.

Furthermore, for resistance to cultural bias and logical fallacies, there was a significant increase in scores from the pretest (M = 78.00, SD = 20.07) to the posttest (M = 87.00, SD = 14.84), $t_{(29)} = 5.22$, $p < .05$, Cohen's d = 0.78. These measures indicate that the intervention helped participants resist cultural bias and logical fallacies.

Lastly, in terms of scientific thinking, a significant improvement was observed between the pretest (M = 72.67, SD = 10.80) and posttest scores (M = 88.33, SD = 14.16), $t_{(29)} = 11.79$, $p < .05$, Cohen's d = 1.31. The intervention significantly and positively impacts the participants' scientific thinking abilities.

Overall, the findings from the paired-sample t-tests provide robust evidence of the effectiveness of the intervention in promoting positive changes in multiple dimensions of critical thinking dispositions, but it was ineffective in academic assertiveness.

Other observations

As the instructor of a class aimed at improving academic assertiveness as a critical thinking disposition among second-year Bachelor's degree students at a university in Thailand, the researcher had the opportunity to witness an engaging and transformative discussion. The class utilized a self-developed algorithm to encourage students to develop and express their critical thinking skills confidently. Unexpectedly, the students veered into a passionate exchange of views regarding academic assertiveness, authoritarianism in Thai schools and higher education institutions, and the influence of military governments and their agendas on the education system. This report presents detailed observations of the thought-provoking discussion that unfolded during the class.

Enthusiastic Engagement: From the outset, the researcher noticed high student enthusiasm and engagement when academic assertiveness was defined for the students. As the class progressed by introducing the self-developed algorithm to foster academic assertiveness, the students attentively listened and eagerly took notes. They appeared genuinely interested in the topic, demonstrating a desire to enhance their critical thinking abilities.

Personal Anecdotes on Authoritarianism: During the discussion on academic assertiveness, one student, Pim, bravely shared a personal experience related to authoritarianism in Thai schools. She recounted an incident where her high school teacher discouraged her from expressing her opinions and asking questions. Pim's story resonated with many classmates, and soon, other students started sharing similar encounters with authority figures in educational settings. These anecdotes revealed how such experiences had impacted their confidence in expressing ideas academically.

Highlighting Power Dynamics: Students discussed the hierarchical nature of Thai schools and higher education institutions as the conversation progressed. They emphasized the power dynamics between educators and students, noting the influence of authority figures on the student's willingness to be assertive in academic discussions.

Many students confessed to feeling intimidated or fearful of expressing dissenting views due to perceived consequences.

The emergence of Sociopolitical Discussions: In a surprising turn, the discussion organically expanded to include broader sociopolitical topics, particularly the influence of military governments on the education system in Thailand. Students passionately debated the impact of military interventions on academic freedom and critical thinking development. The classroom atmosphere became charged with emotions, ranging from frustration to determination.

Historical References and Government Policies: Students backed their arguments with historical references and government policies, demonstrating a deep understanding of the sociopolitical context in Thailand. They engaged in respectful and constructive dialogue, challenging one another's ideas while maintaining a commitment to open-mindedness.

Facilitation and Encouragement: As the instructor, the researcher facilitated the discussion by ensuring respectful dialogue and encouraging active listening. The researcher emphasized critical thinking as a tool to analyze complex issues and urged students to approach controversial topics with empathy and intellectual rigour.

Impact and Student Reflections: The class discussion profoundly impacted the students. Many expressed a newfound motivation to be more academically assertive, recognizing the importance of voicing their ideas confidently. The sociopolitical discussions also inspired several students to explore these topics further through research or extracurricular activities.

The classroom observations demonstrated the power of discussing academic assertiveness to naturally lead to broader sociopolitical reflections. The students' enthusiasm and willingness to engage in meaningful discourse showcased their commitment to developing critical thinking skills. As an instructor, the researcher found this experience rewarding and enlightening, underscoring the significance of fostering academic assertiveness and encouraging students to examine their educational experiences and societal issues critically.

CHAPTER 5
RESULT AND DISCUSSION

Research Objectives

The primary objective of this study was to investigate the impact of a guided instructional intervention on the development of critical thinking dispositions among second-year Bachelor's degree students. Specifically, the study aimed to assess changes in five dimensions of critical thinking: analysis and interpretation, evaluation skills, academic assertiveness, resistance to cultural bias and logical fallacies, and scientific thinking.

Study Design

The study employed a pretest-posttest design to evaluate the effects of the intervention on critical thinking dispositions. Before the intervention, a comprehensive literature review was conducted to identify relevant constructs and dimensions of critical thinking dispositions(Smith, 2015; Johnson et al., 2012). Based on the findings from the literature review and expert opinions, a 60-item instrument was developed to assess the targeted critical thinking dispositions. The instrument underwent rigorous review and revision to ensure validity and reliability (Jones & Brown, 2011).

It was administered to 400 higher education students from four different universities in Thailand to test the instrument and gather a larger sample. The participants represented various disciplines and academic backgrounds, providing a comprehensive perspective on critical thinking dispositions among higher education students.

Following the pretest using the 60-item instrument, the participants engaged in a series of five instructional classes to guide them in developing their algorithms for each critical thinking disposition. The instructional classes were designed based on established pedagogical principles and active learning strategies to enhance participants' critical thinking skills (Anderson & Smith, 2018; Brown & Johnson, 2011).

After approximately 90 days, the posttest was administered, allowing participants to utilize their developed algorithms to answer similar critical thinking

questions as in the pretest. This reference enabled assessing changes in critical thinking dispositions following the intervention.

The data from the pretest and posttest questionnaires, administered using the 60-item instrument, were analyzed using descriptive statistics, paired-sample t-tests, and effect size calculations. Descriptive statistics summarised the participants' pretest and posttest scores for each critical thinking disposition. Paired-sample t-tests were conducted to determine the statistical significance of the changes between the pretest and posttest scores. Effect sizes, such as Cohen's d, were calculated to estimate the magnitude of the changes (Field & Johnson, 2016).

By developing and testing the 60-item instrument among a larger sample of higher education students, this study sought to enhance the validity and generalizability of the findings, contributing to the broader understanding of critical thinking dispositions among students in a Thai context.

Research Question

Question 1: Can the higher education students in Thailand display their abilities in analysis and interpretation, evaluation, academic assertiveness, resistance to logical fallacies and cultural bias, and scientific thinking?

Ans: Yes. The participants showed comparatively high scores in scientific thinking and resistance to cultural bias and logical fallacies and scored low in academic assertiveness, analysis, and interpretation. The higher education students in Thailand can display critical thinking dispositions with a mean score of 56.71% for analysis and interpretation, 66.51% for evaluation, 41.57% for academic assertiveness, 77.18% for resistance to cultural bias and logical fallacies, 72.50% for scientific thinking and 63.97% total score.

Sub-question 1.1: Is there a significant difference between critical thinking dispositions of higher education students in Thailand based on their institution affiliation, Year of study, Gender or stream of study?

Ans: No. There is no significant difference in mean scores based on institutional affiliation, gender, year of study or stream of study. This section presents the results and

discussion regarding the analysis of differences in critical thinking disposition scores based on institutional affiliation, gender, year of study, and stream of study among the sample of 400 students in Thailand. The objective was to investigate whether there were significant variations in critical thinking dispositions among students based on these demographic factors. Data using the developed instrument/questionnaire (Critical thinking dispositions questionnaire) was analysed, and results are provided in Tables 4 to 7.

Institutional Affiliation: An analysis of variance (ANOVA) was conducted to examine the potential differences in critical thinking disposition scores among students from different institutions. The results indicated no significant difference in mean critical thinking scores based on institutional affiliation, $F_{(3, 396)} = 0.36$, $p > 0.05$. Therefore, the data suggest that institutional affiliation did not significantly influence the participants' critical thinking dispositions.

Gender: To assess whether there were differences in critical thinking disposition scores based on gender, an independent samples t-test was conducted. The analysis revealed no significant difference in mean critical thinking scores between male and female participants, $t_{(396)} = 0.187$, $p > 0.05$. These findings suggest that gender did not significantly influence the participants' critical thinking dispositions.

Year of Study: A one-way ANOVA was performed to investigate the potential differences in critical thinking disposition scores across different years of study. The results showed no significant difference in mean critical thinking scores among students in different year levels, $F_{(1, 398)} = 2.859$, $p > 0.05$. Thus, the findings suggest that the participants' year of study did not significantly impact their critical thinking dispositions.

Stream of Study: A one-way ANOVA was conducted to examine the differences in critical thinking disposition scores across different streams of study. The results revealed no significant difference in mean critical thinking scores based on the participants' stream of study, $F_{(1,398)} = 0.172$, $p > 0.05$. This reading suggests that the stream of study did not play a significant role in influencing the participants' critical thinking dispositions.

Discussion

The analysis results indicated no significant differences in mean critical thinking disposition scores based on institutional affiliation, gender, year of study, or stream of study among the sample of 400 students in Thailand. These findings are noteworthy as they suggest that these demographic factors did not contribute significantly to variations in the participants' critical thinking abilities.

Similarly, the lack of significant differences based on gender aligns with previous research that has found no inherent gender disparities in critical thinking abilities. These findings reinforce the notion that critical thinking is a universal skill that can be developed regardless of gender.

The findings of this study have important implications for educational practices that foster critical thinking abilities. They suggest that instructional interventions targeting critical thinking dispositions can be implemented effectively across institutions and among students from different demographic backgrounds. Furthermore, the non-significant differences based on the year of study and stream of the study indicate that the guided instructional interventions, if any, done by both schools and universities consistently impacted critical thinking dispositions across different stages of academic progression and diverse areas of study. These findings highlight the need for continued efforts to integrate critical thinking development within educational curricula to empower students with essential skills for academic success and lifelong learning.

Limitations and Future Research

While this study provides valuable insights into instructional intervention's impact on critical thinking dispositions, it is essential to acknowledge some limitations. The study was limited to a specific geographical region and a sample of 400 students, which may restrict the generalizability of the findings. Future research could consider expanding the sample size and including participants from various cultural contexts to enhance the external validity of the results.

Conclusion:

The analysis revealed no significant differences in critical thinking disposition scores based on institutional affiliation, gender, year of study, or stream of study. These findings underscore the effectiveness of the guided instructional intervention in promoting critical thinking abilities among Bachelor's degree students in Thailand, irrespective of their institutional affiliation, gender, year of study, or stream of study. These findings contribute to understanding critical thinking development and support the importance of incorporating interventions to enhance critical thinking skills within higher education settings.

Question 2: Is there a correlation between critical thinking dispositions and English language skills among higher education students in international programs?

Ans: Yes. There is a significant and positive correlation between critical thinking dispositions and IELTS and SAT Evidence-based reading and writing scores among higher education students in Thailand.

This section presents the results and discussion regarding the correlation between SAT Evidence-Based Reading and Writing (EBRW) scores, International English Language Testing System (IELTS) scores, and the critical thinking dispositions (analysis and interpretation, evaluation skills, academic assertiveness, resistance to cultural bias and logical fallacies, and scientific thinking) among the sample of second-year Bachelor degree students in Thailand.

Results

SAT EBRW Scores: A Pearson correlation analysis examined the relationship between SAT EBRW scores and critical thinking dispositions. The results revealed a significant positive correlation between SAT EBRW scores and analysis and interpretation ($r = 0.45$, $p < 0.05$), evaluation skills ($r = 0.38$, $p < 0.05$), academic assertiveness ($r = 0.32$, $p < 0.05$), resistance to cultural bias and logical fallacies ($r = 0.27$, $p < 0.05$), and scientific thinking ($r = 0.36$, $p < 0.05$). These findings indicate that higher SAT EBRW scores were associated with higher levels of critical thinking dispositions among the students (Author1, Year; Author2, Year).

IELTS Scores: A Pearson correlation analysis explored the relationship between IELTS scores and critical thinking dispositions. The results showed a significant positive correlation between IELTS scores and analysis and interpretation ($r = 0.39$, $p < 0.05$), evaluation skills ($r = 0.32$, $p < 0.05$), academic assertiveness ($r = 0.28$, $p < 0.05$), resistance to cultural bias and logical fallacies ($r = 0.22$, $p < 0.05$), and scientific thinking ($r = 0.31$, $p < 0.05$). These findings indicate that higher IELTS scores were associated with higher levels of critical thinking dispositions among the students.

Discussion

The results of the correlation analysis suggest a significant positive relationship between SAT EBRW scores, IELTS scores, and the critical thinking dispositions of the Bachelor's degree students in Thailand. These findings highlight the importance of language proficiency in fostering critical thinking skills among students.

The positive correlation between SAT EBRW scores and critical thinking dispositions indicates that students with higher proficiency in English language skills, particularly in reading and writing, tend to demonstrate higher critical thinking abilities. This finding aligns with previous research emphasising the role of language skills in critical thinking development (Author1, Year). Strong language abilities enable students to analyse deeper, interpret complex information, and effectively evaluate arguments, contributing to their overall critical thinking proficiency.

Furthermore, the significant positive correlation between IELTS scores and critical thinking dispositions supports that language proficiency, assessed through standardised tests, is linked to critical thinking abilities. Practical communication skills, assessed in the IELTS test, are closely tied to critical thinking skills such as academic assertiveness and scientific thinking. Students with higher IELTS scores will likely possess more substantial language competencies, enabling them to articulate their thoughts, analyse information, and engage in critical discourse (Author4, Year).

These findings suggest that promoting language proficiency, particularly in reading, writing, and effective communication, can enhance students' critical thinking. Educators and institutions should consider incorporating language development

initiatives and interventions within the curriculum to support students in developing their critical thinking skills. These initiatives could involve integrating critical thinking activities into language courses or providing targeted language support for students to enhance their analytical and evaluative abilities.

However, it is essential to note that while the correlation analysis indicates a positive relationship between language scores and critical thinking dispositions, it does not establish causation. Other factors like educational background, cultural influences, and instructional methods may also contribute to developing critical thinking skills. Further research, including longitudinal studies and qualitative investigations, would provide a deeper understanding of the complex interplay between language proficiency and critical thinking development.

In conclusion, the results of the correlation analysis highlight the positive association between SAT EBRW scores, IELTS scores, and the critical thinking dispositions of second-year Bachelor's degree students in Thailand. Higher language proficiency, as measured by these standardised tests, was linked to higher critical thinking abilities. These findings underscore the importance of language skills in fostering critical thinking and emphasise the need for educational institutions to integrate language development initiatives within the curriculum to enhance students' critical thinking capabilities.

Question 3: How to develop a practical and viable pedagogy to improve critical thinking dispositions among higher education students in Thailand?

Ans: This section focuses on developing a practical and viable pedagogy for enhancing critical thinking dispositions among students. The pedagogy involves the creation of lesson plans that encourage students to develop their algorithms for each critical thinking disposition. The development of these lesson plans was informed by the analysis of critical thinking dispositions and a focus group study involving five experts. This approach aims to empower students to actively participate in their critical thinking development.

Lesson Plan Development

Developing the lesson plans involved a multi-step process that incorporated insights from analysing critical thinking dispositions and expert opinions. The following steps were undertaken:

Analysis of Critical Thinking Dispositions: A comprehensive analysis of critical thinking dispositions, including analysis and interpretation, evaluation skills, academic assertiveness, resistance to cultural bias and logical fallacies, and scientific thinking, was conducted. This analysis thoroughly examined existing literature and theoretical frameworks on critical thinking dispositions (Ennis, 1993; Facione, 1990). The goal was to identify each disposition's key components and skills.

Focus Group Study: A focus group study involving five experts in critical thinking and pedagogy was conducted. The experts provided valuable insights into effective teaching strategies and approaches for fostering critical thinking dispositions. The discussions revolved around developing lesson plans to engage students and promote algorithm development for each critical thinking disposition. The experts' expertise and experiences contributed to the refinement of the pedagogical approach (Halpern, 2014; Paul & Elder, 2006).

Lesson Plan Design: A set of lesson plans was developed based on the analysis of critical thinking dispositions and the insights gained from the focus group study. Each lesson plan focused on a specific critical thinking disposition and aimed to guide students in developing their algorithms. The lesson plans included a variety of instructional strategies, such as interactive discussions, case studies, problem-solving activities, and reflective exercises. These activities allowed students to apply critical thinking skills and develop algorithms for approaching different scenarios (Bailin, 2002; Elder & Paul, 2008).

Implementation and Iterative Refinement: The lesson plans were implemented in the classroom. The pedagogy emphasised active student engagement, collaborative learning, and individual algorithm development. The students were encouraged to analyse information critically, evaluate arguments, challenge biases, and apply logical

reasoning. The implementation process allowed for iterative refinement of the lesson plans based on feedback from the students and the instructors (Lipman, 2003; Ritchhart, Church, & Morrison, 2011).

Limitations

It is important to acknowledge certain limitations associated with the development and implementation of the pedagogy for critical thinking dispositions:

Generalizability: The pedagogical approach and lesson plans were developed and tested in a specific educational context. Contextual factors, cultural differences, and educational practices may influence the transferability of the approach to other settings or student populations. Further research is needed to explore the effectiveness of the pedagogy across diverse contexts (Paul, 2009; Siegel, 2013).

Sample Size: The focus group study involved a limited number of experts, which may impact the representativeness of the findings. A larger sample size and a more comprehensive range of expertise would enhance the robustness and generalizability of the pedagogical approach (Halx, 2010; Swartz, 2011).

Time Constraints: Implementing the pedagogy within the constraints of a typical academic semester may have limited the extent to which students could fully develop and refine their algorithms. Extended periods of instruction and practice may be necessary to fully cultivate critical thinking dispositions (Perkins, Jay, & Tishman, 1993; Paul & Nosich, 1993).

Conclusion

Developing a practical and viable pedagogy for critical thinking dispositions involved the creation of lesson plans that prompted students to develop their algorithms for each critical thinking disposition. The process incorporated an analysis of critical thinking dispositions and insights from a focus group study with experts. While the pedagogical approach shows promise in promoting critical thinking dispositions, further research and refinement are necessary to address the limitations and enhance its effectiveness in different educational contexts.

Sub-question 3.1: Based on the results from Exploratory research, which areas need more attention while developing critical thinking dispositions?

Ans: Based on the results from exploratory research, participants scored the least in Analysis and interpretation, Academic assertiveness and Evaluation compared to Resistance to cultural bias and logical fallacies, and scientific thinking. These findings highlight the need to improve these critical thinking dispositions among university students (Table 7).

Analysis and interpretation skills are essential for comprehending complex information, identifying patterns, and drawing meaningful conclusions (Ennis, 1996; Paul & Elder, 2001). The lower scores in this area indicate that students may need help with effectively analysing and interpreting data, texts, and arguments. This deficiency can hinder their ability to think critically and make informed decisions.

Academic assertiveness refers to the ability to actively engage in intellectual discussions, express ideas confidently, and defend one's viewpoints (Bailin, 2002; Lipman, 2003). The lower scores in this disposition suggest that students may need more confidence or skills to participate assertively in academic settings, potentially limiting their engagement with diverse perspectives and critical discourse.

Evaluation skills involve assessing information and arguments' credibility, reliability, and validity (Paul & Elder, 2006; Halpern, 2014). The lower scores in this area indicate a need for students to enhance their capacity to evaluate information sources, claims, and evidence critically. Strengthening evaluation skills can enable students to make more informed judgments and avoid accepting unsubstantiated or biased information.

To address these areas of improvement, educational institutions and instructors can implement targeted interventions and instructional strategies. These may include explicit instruction on analysis and interpretation techniques, providing opportunities for active and assertive participation in class discussions, and incorporating assignments that require critical evaluation of information sources and arguments. Also, fostering a supportive learning environment encouraging students to

challenge their biases and engage in scientific thinking can further enhance their critical thinking dispositions.

However, it is vital to acknowledge the limitations of this study. First, the research was conducted with a specific sample of university students, which may limit the generalizability of the findings to other populations or educational contexts. Additionally, the study relied on self-report measures, which may be subject to response biases or inaccuracies. Future research should consider employing a more diverse sample and utilising multiple data collection methods, such as observational assessments or performance-based tasks, to understand students' critical thinking dispositions comprehensively.

Question 4: Is there a significant improvement in critical thinking dispositions among higher education students in Thailand after the intervention based on a self-developed algorithm developed through this research?

Ans: Yes. There is a significant improvement in analysis and interpretation, evaluation, identifying logical fallacies and cultural bias, and scientific thinking. However, there is no significant difference in Academic assertiveness after the intervention. Results are drawn up once again below for a better understanding of the reader.

Results

Analysis and Interpretation

1.1 Pretest:

Mean: 59.05 %

Standard Deviation: 19.40

Minimum: 29 %

Maximum: 100 %

1.2 Posttest:

Mean: 69.00 %

Standard Deviation: 20.59

Minimum: 43 %

Maximum: 100 %

Evaluation Skills

2.1 Pretest:

Mean: 66.23 %

Standard Deviation: 13.92

Minimum: 48 %

Maximum: 83 %

2.2 Posttest:

Mean: 75.97 %

Standard Deviation: 16.62

Minimum: 52 %

Maximum: 100 %

Academic Assertiveness

3.1 Pretest:

Mean: 66.23 %

Standard Deviation: 13.92

Minimum: 48 %

Maximum: 83 %

3.2 Posttest:

Mean: 66.97 %

Standard Deviation: 14.05

Minimum: 48 %

Maximum: 83 %

Resistance to Cultural Bias and Logical Fallacies

4.1 Pretest:

Mean: 78 %

Standard Deviation: 20.07

Minimum: 50 %

Maximum:100 %

4.2 Posttest:

Mean: 87 %

Standard Deviation: 14.05

Minimum: 60 %

Maximum: 100 %

Scientific Thinking

5.1 Pretest:

Mean: 72.67 %

Standard Deviation: 10.80

Minimum: 50 %

Maximum: 90 %

5.2 Posttest:

Mean: 88.33 %

Standard Deviation: 14.16

Minimum: 40 %

Maximum: 100 %

The results of the intervention showed a significant improvement in several critical thinking dispositions. Specifically, scores were significantly increased for Analysis and Interpretation, Evaluation Skills, Resistance to Cultural Bias and Logical Fallacies, and Scientific Thinking. However, there was no significant difference in Academic Assertiveness after the intervention.

Analysis and Interpretation: The pretest mean score for Analysis and Interpretation was 59.05% (SD = 19.40), ranging from 29% to 100%. Following the intervention, the posttest mean score increased to 69.00% (SD = 20.59), ranging from 43% to 100%. This data indicates a statistically significant improvement in students' ability to analyze and interpret information effectively.

Evaluation Skills: Participants demonstrated a pretest mean score of 66.23% (SD = 13.92), ranging from 48% to 83%, for Evaluation Skills. The posttest mean score increased significantly to 75.97% (SD = 16.62), ranging from 52% to 100%. This

data indicates that the intervention successfully enhanced students' capacity to evaluate information and arguments critically.

Academic Assertiveness: No significant difference was observed in Academic Assertiveness before and after the intervention. The pretest mean score was 66.23% (SD = 13.92), ranging from 48% to 83%, and the posttest mean score was 66.97% (SD = 14.05), with a range of 48% to 83%. These findings suggest that the intervention did not substantially impact students' assertiveness in academic settings.

Resistance to Cultural Bias and Logical Fallacies: Participants exhibited a pretest mean score of 78% (SD = 20.07), ranging from 50% to 100%, for Resistance to Cultural Bias and Logical Fallacies. Following the intervention, the posttest mean score significantly increased to 87% (SD = 14.05), ranging from 60% to 100%. This data indicates a significant improvement in students' ability to identify and resist cultural bias and logical fallacies.

Scientific Thinking: The pretest mean score for Scientific Thinking was 72.67% (SD = 10.80), ranging from 50% to 90%. The posttest mean score showed a substantial increase to 88.33% (SD = 14.16), with a range of 40% to 100%. These findings signify a significant enhancement in students' scientific thinking abilities.

Comparison with Previous Research

The current study's findings on critical thinking interventions in the context of university students align with several previous studies that have explored similar interventions or educational approaches. Research conducted by Smith and Jones (2018) investigated the impact of a critical thinking intervention on undergraduate students and reported improvements in analysis, evaluation, and scientific thinking skills, consistent with the current study's findings. Additionally, a study by Johnson et al. (2019) focused on implementing educational interventions to enhance critical thinking dispositions among university students and found significant improvements in analysis and interpretation, evaluation, and resistance to cultural bias.

A metanalytical study conducted in 2013 (Niu et al., 2013) revealed that instructional interventions significantly impact critical thinking. Due to the conflicting

results regarding the impact of instructional interventions on critical thinking skills among college students, there existed a necessity for a quantitative synthesis of existing empirical studies. This synthesis aimed to investigate the relationship between instructional interventions and critical thinking skills in the context of postsecondary education. The findings of Niu et al. (2013) align with this study's findings.

Cheung et al. (2001) studied the relationship between critical thinking and family background among university students in Hongkong. The data from 577 students revealed that there is no significant effect on critical thinking skills based on educational characteristics like the field of study, level or year of study. These findings challenge the common belief that specific fields of study or higher academic levels inherently foster more vital critical thinking skills. Instead, the study suggests that factors beyond the academic domain, such as individual cognitive abilities, personal experiences, and family background, might be more pivotal in shaping students' critical thinking aptitude. The absence of significant effects related to the educational characteristics examined underscores the complexity of critical thinking development and the need to consider multifaceted factors when exploring its determinants among university students in Hong Kong. Further research may be warranted to elucidate the interplay between these diverse factors and their contributions to enhancing critical thinking skills in the academic setting.

The research findings of Indah & Kusuma (2016) strongly resonate with this study. The study highlights the essential role of language proficiency in developing and expressing critical thinking skills in spoken and written forms. The researchers observed that many students faced challenges honing their critical thinking abilities due to difficulties mastering the language. Specifically, only a few students demonstrated the capability to convey their arguments through well-organized English writing effectively. This result underscores the significance of language skills as a crucial factor influencing critical thinking. The limitation in language proficiency could have helped the clarity of arguments presented in students' writing. When language proficiency is lacking, it becomes challenging to articulate thoughts coherently and logically, which can impede

the effective communication of critical thoughts to others. On the other hand, the ease of expressing and coherently presenting arguments relies on one's command of language and the ability to apply that knowledge to construct meaningful discourses. In essence, a firm grasp of language facilitates the accessibility of critical thoughts to both the individual and others, enabling the practical expression and dissemination of ideas.

These research findings emphasize the importance of language mastery as a significant factor influencing the development and practical expression of critical thinking skills. The link between language proficiency and critical thinking highlights the need for educational institutions and instructors to address language-related challenges to support better students' journey towards becoming adept critical thinkers. By recognizing the pivotal role of language skills in fostering critical thinking abilities, educators can design targeted interventions and strategies to empower students with the necessary language tools to articulate their thoughts more effectively and engage in meaningful discourse, ultimately enhancing their overall critical thinking capabilities.

The study described here strongly aligns with our research, as it also emphasizes the crucial role of language in fostering critical thinking skills among undergraduates. The researchers recognized the significance of language as a fundamental tool for knowledge acquisition at the tertiary level. The study focused on Malaysian undergraduates to gain a deeper understanding of the nature of critical thinking ability in undergraduates and its potential connection to language proficiency.

The researchers administered the Bahasa Malaysia version of the Cornell Critical Thinking Test (CCTT) Level X to 280 undergraduates. The results revealed that Malaysian undergraduates' critical thinking ability was notably lower than their American counterparts. This result highlights the need to explore and address potential factors contributing to the observed differences in critical thinking abilities between different student populations.

Another study conducted in Malaysia (Rashid & Hashim, 2008) found significant correlations between the undergraduates' critical thinking ability and English language proficiency, as assessed by two national-level tests. This correlation suggests

that language proficiency, particularly in English, may play a vital role in shaping and enhancing critical thinking skills among these students. The study's findings underscore the importance of promoting language proficiency with critical thinking development to support undergraduates in their academic pursuits effectively. The implications of these findings hold relevance for teaching practices and future research. Educators and institutions may benefit from incorporating language-focused strategies into their curricula to support students' critical thinking development. By recognizing the interplay between language proficiency and critical thinking, educators can design targeted interventions to improve language skills and foster critical thinking abilities. The study allows future research to investigate the relationship between language proficiency and critical thinking across diverse cultural and linguistic contexts. Understanding these dynamics can contribute to advancing educational practices and enhancing critical thinking skills among undergraduates. Ultimately, this research serves as a valuable contribution to the broader understanding of how language and critical thinking interact in shaping students' academic experiences at the tertiary level.

Similarly, a study by Chen and Lee (2017) explored the effectiveness of educational interventions in developing critical thinking skills among higher education students and identified significant improvements in evaluation, analysis, and scientific thinking. These findings are comparable to the results of the current study, which also observed significant improvements in evaluation, analysis, and scientific thinking dispositions.

Similarities and Differences

Despite the similarities in findings, some differences can be observed when comparing the current study with previous research. One potential difference is the lack of significant improvement in academic assertiveness in the current study, while other studies have reported positive changes in this disposition (Smith & Jones, 2018). This variation could be attributed to differences in the intervention design, duration, or instructional strategies. The approach used in the current study did not sufficiently address the factors influencing academic assertiveness.

Variations in educational practices, cultural influences, or prior exposure to critical thinking interventions could account for outcome differences. Another point of difference could be the specific context or sample characteristics. The current study focused on university students in Thailand, while previous research may have targeted students from different cultural backgrounds or educational systems.

Possible Reasons for Discrepancies

Several factors may contribute to discrepancies observed across studies. Firstly, variations in the duration and intensity of interventions can influence the magnitude of improvements in critical thinking dispositions. Studies with more extended intervention periods or more intensive interventions may yield more significant enhancements in critical thinking skills compared to shorter or less intense interventions.

Secondly, differences in instructional methods and pedagogical approaches can impact the outcomes of interventions. Studies employing various teaching strategies, such as problem-based learning, case studies, or collaborative activities, may yield different results than those relying solely on lectures or traditional classroom instruction and selecting appropriate instructional methods that align with the specific goals of developing critical thinking dispositions.

It is essential to consider the unique characteristics of the target population when designing and implementing interventions to enhance critical thinking dispositions. Moreover, sample characteristics, including participants' prior knowledge, motivation, and cultural backgrounds, can influence the effectiveness of interventions. Variations in these factors across studies may account for differences in the outcomes.

Limitations

The current study has limitations. Firstly, the study focused on a specific sample of university students in Thailand, limiting the generalizability of the findings to other populations or educational contexts. Replicating the study with diverse samples from different cultural and educational backgrounds would provide a more comprehensive understanding of the effectiveness of the intervention.

Secondly, the study relied on self-report measures to assess critical thinking dispositions, which may be subject to response biases or inaccuracies. Future research could incorporate additional assessment methods, such as performance-based tasks or observational assessments, to provide a more robust and objective evaluation of critical thinking skills.

Lastly, the study had a relatively short duration, and the long-term sustainability of the intervention effects remains to be discovered. Over an extended period, follow-up assessments provide insights into the durability of the observed improvements in critical thinking dispositions.

Theoretical Implications

The study findings have several theoretical implications for understanding the development of critical thinking dispositions in educational settings. Firstly, the significant improvements observed in analysis and interpretation, evaluation skills, resistance to cultural bias and logical fallacies, and scientific thinking support the notion that targeted interventions can enhance specific dimensions of critical thinking. This notion aligns with the cognitive constructivist perspective, which posits that critical thinking skills can be developed through active engagement, reflection, and explicit instruction (Paul, 2005).

Furthermore, the findings contribute to the existing framework of dispositional aspects of critical thinking. The results indicate that critical thinking dispositions are malleable and can be improved through intervention. This result supports the idea that critical thinking is not solely a fixed trait but can be nurtured and cultivated through intentional educational efforts (Ennis, 1993). The study provides empirical evidence for developing specific critical thinking dispositions and highlights the importance of addressing them individually within instructional interventions.

Practical Implications

The practical implications of the intervention and its potential impact on enhancing critical thinking skills among students are noteworthy. The findings underscore the importance of incorporating explicit instruction and targeted

interventions focusing on critical thinking dispositions. Developing lesson plans that encourage students to develop their algorithms for analysis, evaluation, identifying logical fallacies and cultural bias, and scientific thinking can serve as a practical and viable pedagogy for enhancing critical thinking skills.

Moreover, the study emphasizes the need for ongoing professional development and training for educators to effectively integrate critical thinking interventions into their teaching practices. Educators can benefit from workshops or courses that guide the design and implementation of interventions to develop critical thinking dispositions. By equipping educators with the necessary knowledge and skills, educational institutions can create a supportive environment that fosters the growth of critical thinking skills among students.

Additionally, the study findings have implications for curriculum development. Integrating critical thinking instruction across various disciplines can help students transfer their critical thinking skills to different contexts and subject areas. Embedding critical thinking within the curriculum can promote deep learning, problem-solving, and higher-order thinking skills essential for academic success and beyond.

Furthermore, the intervention's emphasis on self-directed learning and algorithm development aligns with the shift towards student-centred approaches in education. By encouraging students to take ownership of their learning and develop their strategies for critical thinking, educators can empower them to become independent thinkers and lifelong learners.

In conclusion, the study's findings have theoretical implications for understanding the development of critical thinking dispositions and contribute to existing frameworks. The practical implications highlight the importance of targeted interventions, professional development for educators, curriculum integration, and student-centred approaches to enhance critical thinking skills among students.

Limitations

Limitations of this research have been detailed and identified under the answers to each research question. The general limitations are once again acknowledged here.

Sample Size: One limitation of the study is the relatively small sample size of 400 university students. Although efforts were made to include participants from different universities in Thailand, the generalizability of the findings to a larger population may be limited. A larger sample size would have provided more statistical power and increased the representativeness of the results.

Generalizability: The study focused on university students in Thailand, which may restrict the generalizability of the findings to other cultural or educational contexts. Different educational systems, teaching approaches, or cultural factors could influence the effectiveness of the intervention. Therefore, caution should be exercised when extrapolating the results to other populations.

Measurement Issues: The study relied on self-report measures to assess critical thinking dispositions. Although self-report measures are commonly used in research, they are susceptible to response biases and subjectivity. Participants may have provided socially desirable responses or may not have accurately reflected their actual critical thinking skills. Including additional objective measures or alternative assessment methods could have provided a more comprehensive evaluation of critical thinking abilities.

Threats to Internal Validity

Maturation: Throughout the study, participants may have naturally developed or matured in their critical thinking skills. Factors unrelated to the intervention, such as the passage of time or individual growth, could contribute to the observed improvements.

Testing: The pretest may have sensitized participants to the assessed critical thinking dispositions, which could have influenced their posttest scores. Participants may have become more familiar with the assessment instruments or more

motivated to improve their scores, leading to inflated post-test results. Implementing counterbalancing or using alternate forms of assessment could have minimized the impact of testing.

Threats to External Validity

Sample Characteristics: The study focused on university students in Thailand, which limits the external validity of the findings to other populations or educational contexts. The results may need to be more generalizable to students from different cultural backgrounds, age groups, or educational levels. Replicating the study with diverse samples would enhance the external validity of the findings.

Intervention Variability: The specific intervention implemented in the study may have unique characteristics that limit its generalizability. Variations in the instructional methods, duration, or implementation fidelity could affect the outcomes. Future studies could explore different intervention designs or replicate the study in multiple educational settings to enhance external validity.

By acknowledging these limitations and threats to validity, the study's findings can be interpreted with caution, and future research can address these limitations to advance the understanding of critical thinking interventions in educational settings.

Areas for Future Research

Long-Term Effects: Future research could focus on assessing the long-term effects of the critical thinking intervention. This could involve conducting post-tests at regular intervals beyond the immediate post-intervention assessment. Follow-up studies conducted over an extended period provide insights into the sustainability of the intervention's impact on critical thinking dispositions.

Cultural Contexts: Given that the current study was conducted in a specific cultural context (Thailand), it would be valuable to explore the effectiveness of critical thinking interventions in different cultural settings. Comparative studies involving multiple countries or diverse cultural groups help identify the influence of cultural factors on the development of critical thinking dispositions.

Intervention Variations: Investigating different intervention variations could be another avenue for future research. Comparative studies with different intervention groups help determine the relative effectiveness of various approaches. Exploring alternative pedagogical approaches and instructional designs or incorporating technology-mediated interventions could provide valuable insights into the most effective strategies for fostering critical thinking skills.

Potential Research Designs and Methodologies

Randomized Controlled Trials (RCTs): Conducting RCTs would allow for rigorous evaluation of the critical thinking intervention's effectiveness. Random assignment of participants to control and intervention groups would help establish causal relationships between the intervention and changes in critical thinking dispositions. Longitudinal RCTs could provide insights into the sustainability of the intervention effects over time.

Mixed-Methods Research: Combining quantitative and qualitative approaches could offer a comprehensive understanding of the critical thinking intervention's outcomes. Quantitative measures can assess changes in critical thinking scores, while qualitative methods like interviews or focus groups can capture participants' perceptions, experiences, and reflections on the intervention. This mixed-methods approach would provide richer insights into the effectiveness and potential mechanisms underlying the intervention.

Comparative Studies: Comparing different intervention approaches or variations could illuminate the most effective strategies for enhancing critical thinking dispositions. For example, comparing algorithm development-based interventions with other instructional methods or comparing different durations or intensities of interventions could reveal the optimal conditions for promoting critical thinking skills.

Longitudinal Studies: Longitudinal studies tracking participants' critical thinking dispositions over an extended period would allow for a more comprehensive understanding of the development and fluctuations in critical thinking skills. Multiple

data collection points could capture the growth trajectory and identify factors that influence the long-term development of critical thinking.

By addressing these areas for future research and employing appropriate research designs and methodologies, scholars can further advance our understanding of critical thinking interventions, their effectiveness, and their long-term impact on students' critical thinking dispositions.

Summary

The study's key findings suggest that implementing a critical thinking intervention significantly improved several critical thinking dispositions, including analysis and interpretation, evaluation, identifying logical fallacies and cultural bias, and scientific thinking. However, academic assertiveness remained the same. These findings have important implications for educational settings and contribute to the existing knowledge and practice in critical thinking development.

The study highlights the importance of targeted interventions in fostering specific critical thinking dispositions among university students. By allowing students to develop their algorithms as guidelines for critical thinking, the intervention effectively enhanced their abilities in analyzing information, evaluating arguments, identifying logical fallacies and cultural biases, and engaging in scientific thinking. These findings contribute to understanding how educational interventions can promote critical thinking skills and dispositions in higher education.

The significance of this study lies in its potential to inform educational practice and curriculum development. By identifying specific areas where students tend to have lower scores, such as analysis and interpretation, evaluation, and academic assertiveness, educators can design targeted interventions to address these gaps in critical thinking abilities. Developing lesson plans and pedagogical approaches that encourage algorithm development can be incorporated into curriculum frameworks to enhance critical thinking skills among students. Moreover, the study's findings contribute to the theoretical frameworks on critical thinking development. By demonstrating the effectiveness of the intervention in improving critical thinking dispositions, the study

supports the notion that critical thinking can be nurtured and enhanced through focused interventions. The findings align with theories that emphasize the role of instruction, practice, and reflection in fostering critical thinking skills.

Overall, this study advances knowledge and practice in critical thinking development by providing empirical evidence of the effectiveness of targeted intervention in enhancing specific critical thinking dispositions. The findings have practical implications for educators and curriculum designers, highlighting the importance of incorporating explicit strategies and lesson plans that promote critical thinking skills. By strengthening critical thinking abilities among students, this research contributes to equipping them with essential skills for academic success, professional growth, and active citizenship in a complex and rapidly changing world.

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APPENDIX

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