

PALACKY UNIVERSITY OLOMOUČ

FACULTY OF EDUCATION

Institute of Education and Social Studies

MASTER THESIS

Bc. Bisola Christiana Adeleke

**Development of critical thinking skills in medical education
through teaching strategies: a perception of future teachers
of professional subject for medical schools**

Olomouc 2024

Supervisor: Mgr. Iva Koribská, Ph.D.

Declaration

The thesis entitled '*Development of critical thinking skills in medical education through teaching strategies: a perception of future teachers of professional subject for medical schools*' has been undertaken by me at the Faculty of Education, Palacky University Olomouc, under the supervision of Mgr. Iva Koribská, Ph.D.

I declare that the information in this thesis is the result of my own research, and it has not previously been submitted to any other institution. Any content derived from the work of others is properly referenced and cited.

Bisola Christiana Adeleke

Olomouc, 18 April 2024

Signature:

Acknowledgement

I extend my heartfelt gratitude to my supervisor, Mgr. Iva Koribská, Ph.D., whose unwavering support and guidance have been instrumental throughout this research journey. Her expertise and patience have genuinely contributed to the success of this study.

I am also thankful to Palacký University, Faculty of Education, and the entire academic staff of the Institute of Education and Social Studies, for providing me with the invaluable opportunity to pursue my research.

Furthermore, I express my sincere appreciation to all the participants of my study. Their willingness to share their experiences and insights has enriched my research and played a pivotal role in the accomplishment of this thesis. Your time and contributions are deeply valued.

Abstract

A contemporary issue in education revolves around cultivating critical thinking skills, fostering individuals who possess resilience and open-mindedness, along with unbiased judgment capabilities. Given the complex and varied nature of medical practice, the cultivation of critical thinking among medical students is of paramount importance. This research explored the intricate dynamics of fostering critical thinking skills, with a specific focus on the experiences and perspectives of future teachers who are on the cusp of shaping the next generation of medical practitioner's intellectual development. The current study was conducted among the first-year Master's degree students of the Department of Anthropology and Health Education, Palacky University in Olomouc, Czech Republic. Five (5) students, enrolled for 'Teaching professional subjects for medical schools' program were the participant of the study. The study made use of qualitative research methodology and grounded theory as the research design.

Keywords: Critical Thinking, Medical Education, Reflective practice, Problem-based learning

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INTRODUCTION

The 21st century is dominated by a rapid spread of information, while employment industries of this era require critical thinking skills in their employees. Ennis (2015) notes that critical thinking is a reasonable and reflective thinking focused on deciding what to believe or do. Hence, critical thinking dispositions and skills helps in the process of deciding what to believe or do. Critical thinking is a concept that is written a lot by individual experts, educational authorities, international organizations, e.g. the OECD, the EU, the UN, the World Bank, but there is no general agreement about what, precisely, it means (Kerr, 2022). For the purposes of this study, critical thinking is defined as “the use of those cognitive skills or strategies that increases the probability of a desirable outcome” (Halpern, 2014).

The increasing emphasis on critical thinking is a significant shift in continental European education with a long history of encyclopedic teaching (Vančíková & Hanesova, 2023). It involves teaching students to think critically and ensuring higher cognitive skills are been developed. Is there evidence that we need to learn how to think critically? Lots of it (Halpern, 2014). A brainpower and a workforce fully equipped with critical thinking skills and reflective thinking skills towards problem solving is the demand of our today and future society, therefore, the development of these thinking skills is one of the main common goals in education systems (Gogus et al, 2020). Historically, educational institutions have typically mandated students to learn, remember, make decisions, and address challenges without even teaching them how to do so. There has been a tacit assumption that adult students already know “how to think”, research has shown that this assumption is wrong (Halpern, 2014).

In an era marked by rapid technological advancements and evolving global challenges, the cultivation of critical thinking skills is increasingly recognized as an essential component of higher education. Teach people to make good decisions and you equip them to improve their own futures and become contributing members of society, rather than burdens on society (Facione, 2011). Critical thinking is of worldwide concern and it’s not only vital for academic excellence but also integral to personal and professional success. Becoming educated and practicing good judgment does not absolutely guarantee a life of happiness, virtue, or economic success, but it

surely offers a better chance at those things (Facione, 2011). According to Kaeppel (2021), the primary objective of education nowadays is to produce people who can think critically and learn on their own, rather than people who only possess basic knowledge. Currently, in the third decade of the 21st century, the development of critical thinking as one of the highest priorities of educators has become one of the inevitable components of the current curriculum and the goal of teaching methodology at all levels of education in many countries (Vančíková & Hanesova, 2023).

The field of medical education is widely recognized as an essential domain that plays a pivotal role in shaping competent healthcare professionals, and advancing the overall quality of patient care. The competences of these healthcare professionals lies in future teacher's capacity to empower medical students to approach complex problems with analytical rigor, evaluate information critically, and make informed decisions. Medical students should not learn just to get to know, but to find new information in the target medical concept and to think in it. Teachers of professional subjects for medical school needs to offer an educational environment in which medical students have the chance to use their cognitive abilities and create their own knowledge. Critical thinking and problem-solving skills are becoming more and more necessary in the increasingly complex healthcare system (Singh, & Butola, 2024). Therefore, the study of medical student's critical thinking skills has become important.

Medical educators have recognized the shortcomings of traditional teaching methods, so they try to use a variety of teaching methods to enhance students' critical thinking and autonomous learning ability, for example, problem-based learning (Yun et al.,2020). Recent studies has shown the correlation between critical thinking and problem-solving skills among nursing students. Majority of students were students who preferred self-study method (Singh, & Butola, 2024). Based on the principles of self-directed learning, reflective practice motivates students to do self-assessment, improves critical thinking skills, encourages professionalism, and even communication skills (Sandars, 2009). Problem-based learning has been widely used in medicine fields and educational context to promote critical thinking and problem-solving in authentic learning outcomes (Prosser & Sze, 2014). Consequently, it is necessary and practical to evaluate the impact of different teaching methods on the critical thinking ability of medical

students. Every student, irrespective of their field of study, needs to think critically when faced with a complex situation.

Students generally should be intellectually challenged to transform information, solve problems, discover meaning through critical and creative thinking. When creating meaning, students mainly use the following thinking skills: analyze, differentiate, organize, sort, compare, contrast, synthesize, guess, evaluate and create (Vančíková & Hanesova, 2023). This type of learning assists in developing flexibility in their thinking.

Reflections, as a vital dimension in experiential learning, has immense potential to prepare students to work on academic and professional challenges (Veine, et al., 2019). Reflection within the clinical setting provides an environment for fostering critical thinking skills. In graduate medical education, reflections are considered critical (Wittich et al., 2010). The incorporation of reflective practice is essential for comprehensive student training in medical education. Activities aimed at promoting reflective practice are now becoming part of the curriculum at all levels of medical education (Ménard & Ratnapalan, 2013).

Reflective practice for medical students may therefore positively impact humanism, professionalism and critical thinking in health-care training and delivery. The present global trend is that most of the educational bodies are advocating for medical graduates to be lifelong, self-directed learners (Simon & Al-Ghailani, 2023). This makes self-directed learning an important aspect, which enables the learners to adopt a metacognitive process to identify, monitor, and evaluate their approach to a particular task (Lucieer, et. al, 2016). Hence, it is crucial to instill the skill of reflective practice at the undergraduate level to guarantee lifelong learning and enhance productivity in healthcare delivery.

Despite the importance of critical thinking skills in academic and professional contexts, many medical students still struggle to develop these skills due to the lack of effective teaching strategies that promotes these skills. In the realm of education, where the next generation's intellectual growth is at stake, the ability to cultivate critical thinkers is of paramount importance. The study participants, who aspire to become medical educators, have a dual responsibility of fostering their students' critical thinking skills growth and topic knowledge dissemination. Thus, the development of teaching strategies that effectively nurture these skills becomes a crucial endeavor for educators and institutions.

Many studies have been conducted in order to improve student's critical thinking skills (Elder & Paul, 2010; Misrom et al., 2020). However, research on improving the critical thinking skills of medical students through teaching strategies is limited. Therefore, it needs to be studied more deeply. This research addresses the need to identify and explore teaching strategies that can improve critical thinking skills in medical students, who are often expected to analyze complex problems and make informed clinical decisions.

A: THEORETICAL BACKGROUND

1. Concept of Critical Thinking

1.1 Introduction to Critical Thinking

Critical thinking is a concept that has been defined by many authors and organizations. The critical thinking process consists of collecting appropriate information, precisely evaluating the information, and using it to come to a considered conclusion (Soltani et al, 2021). Critical thinking came before schooling was ever invented, it lies at the very roots of civilization (Facione, 2011). Marin & De la Pava (2017) mention that critical thinking impacts emotions, metacognition, argumentation, problem solving, decision-making, independent learning, and communication competence. Halpern (2014) emphasized the significance of critical thinking in education, advocating for its integration as a fundamental skill in higher education curricula. Critical thinking is a kind of thinking that has a purpose (proving a point, interpreting what something means, solving a problem), but critical thinking can be a collaborative, noncompetitive endeavor (Facione, 2011). It is a purposeful style of thinking which could be done in groups or individually, in order to make an appropriate decision.

Critical thinking involves intentional, higher-level thinking to define a client's problem, examine evidence-based practices, and make choices in care delivery (Alfaro-LeFevre, 2014). It is the necessary skills needed by healthcare professionals to contribute to public health effectively. Critical thinking is the intellectually disciplined process of skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information by observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Petress, 2004; Phan, 2011). In addition to providing a definition of the term, Facione (2011) and Halpern (2014) thorough examination of critical thinking outlines the important skills and dispositions connected to this cognitive process. For identifying critical thinking skill components, Facione (2011) summarizes the core critical thinking skills as interpretation, analysis, evaluation, inference, explanation and self-regulation. Likewise, Halpern (2014) suggests using six main dimensions:

verbal reasoning, argument analysis, thinking as hypothesis testing, using likelihood and uncertainty, decision making and problem solving. Aside from the components of critical thinking skills, these scholars have also proposed certain dispositions or attitude towards critical thinking skills. A more comprehensive view of critical thinking is the ‘disposition’, which is the ability to describe an individual’s inclination to use critical thinking when faced with problems to solve, ideas to evaluate, or decisions to make (Jeevanantham, 2012). Dispositions identified in literature include “tolerating ambiguity, willing to suspend judgment, being open-minded, inquisitive, and sensitive to other ideas; in short, a willingness to engage in sustained critical thinking” (McBride,Xiang, Wittenburg, 2014).

Facione (2011) and Halpern (2014) categorization of critical thinking skills serves as a basis for constructing a framework that guides the investigation into the pedagogical methods most conducive to fostering these skills in medical education settings.

1.2 Core Critical Thinking Skills

Interpretation: Interpretation is to comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures, or criteria (Facione, 1990). Interpretation is seen as the process of understanding and realizing the meaning of a context. Interpretation includes the sub-skills of categorization, decoding significance, and clarifying meaning (Facione 2011). For a problem to be interpreted, it has to be identified and described without being biased. It involves intentional, higher-level thinking to define a client's problem (Alfaro-LeFevre, 2014). Furthermore, interpretation includes reading a person’s intentions by their facial expressions and other non-verbal signs. This skill entails the understanding of information meanings, including the identification of key concept, assumptions, implications and outcomes. In critical thinking, the individual understands, interprets, and makes logical conclusions on her thoughts (Cansoy and Türkoğlu 2017). In order to make informed decisions about diagnosis and treatments, medical students must be able to interpret complex medical data, research findings, patient histories and gestures.

Analysis: Analysis is to identify the intended and actual inferential relationships among statements, questions, concepts, descriptions, or other forms of representation intended to express belief, judgment, experiences, reasons, information, or opinions (Facione, 1990). Analysis could

involve sorting out the differences between two or more methods of solving a certain problem. College education should support students' thinking skills to develop the habit of organized thinking and of rational analysis, the ability to distinguish the important concepts, and grasp the knowledge of organized solutions to perform better in any job (Gogus 2015; Harris, 2010; Williams, Zdravkovich, & Engleberg 2002). Examining ideas, detecting arguments, and analyzing arguments are sub-skills of analysis (Facione, 1990). Other examples of analysis includes "identifying unstated assumptions; constructing a way to represent a main conclusion and the various reasons given to support or criticize it" (Facione, 2011). Analysis involves breaking down complex information into various components, in order to understand their connections and how they contribute to the whole.

Evaluation: Evaluation is to assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgment, belief, or opinion; and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions or other forms of representation (Facione, 1990). Considering the credibility of a source of information is an important topic for developing critical thinking skills (Sadidi & Pospiech, 2021). Critical thinking, one of the skills associated with thinking, is the evaluation of others' ideas with no prejudices (Ibrahim et al., 2020). This includes scrutinizing the sources, examining the evidence, and considering the validity of arguments (JetLearn, 2024). Examples? How about judging an author's or speaker's credibility, comparing the strengths and weaknesses of alternative interpretations, determining the credibility of a source of information, judging if two statements contradict each other, or judging if the evidence at hand supports the conclusion being drawn (Facione, 2011). Evaluation entails determining the credibility, relevance, and importance of information and arguments. It involves verifying accuracy and factual content, resulting in patient-centered nursing actions (Singh, & Butola, 2024). Evaluation is the process of making a judgment (Gogus et al, 2020). In order to make judgments based on evidence, medical students are required to assess the reliability and validity of research studies, diagnostic tests, and treatment options.

Inference: Facione (1990) stated that inference is to identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to deduce the consequences flowing from data, statements, principles, evidence, judgments,

beliefs, opinions, concepts, descriptions, questions, or other forms of representation (Facione, 1990). Johnson and Keir (2010) state that inference-making, one of the higher-order comprehension skills, requires readers to combine text with prior knowledge (Johnson & Keir, 2010). Inference is an organized process of reaching conclusions that are logical from the available ideas and evidence. As sub-skills of inference, the experts list querying evidence, conjecturing alternatives, and drawing conclusions (Facione, 1990). When faced with a problem, developing a set of options for addressing it is an example of inference (Facione, 2011). Clinton (2015) proposes that when readers can infer, they are able to connect the text to themselves or to their world by using background knowledge; creating a meaningful representation of the text. Scenarios like understanding the effects of the viewpoint that someone is promoting, and making future predictions based on present knowledge are other examples of inference. Medical students need inference skill to formulate hypothesis, predict patient outcomes, and develop treatment plans based on clinical reasoning.

Explanation: Explanation is defined as being able to present in a cogent and coherent way the results of one's reasoning (Facione, 1990). This means to be able to give someone a full look at the big picture: both "to state and to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological, and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments (Facione, 2011). Articulating the reasoning behind conclusions or decisions is a crucial part of critical thinking (JetLearn, 2024). This skill entails expressing the reasoning behind one's judgments, decisions, and conclusions in a clear and concise manner. Good communication is a major factor in delivering high quality in care (Lutz, et al, 2016). The sub-skills under explanation are describing methods and results, justifying procedures, proposing and defending with good reasons one's causal and conceptual explanations of events or points of view, and presenting full and well-reasoned, arguments in the context of seeking the best understandings possible (Facione, 2011). Medical students are required to explain their diagnostic and treatment decisions to patients, colleagues, and other medical professionals by providing a rationale that is supported by clinical guidelines and evidence.

Self-regulation: Self-regulation means to self-consciously monitor one's cognitive activities, the elements used in those activities, and the results deduced, particularly by applying skills in

analysis, and evaluation to one's own inferential judgments with a view toward questioning, confirming, validating, or correcting either one's reasoning or one's results (Facione, 1990). Self-regulation involves monitoring and adjusting one's approach to thinking to ensure objectivity and accuracy (JetLearn, 2024). In order to enhance reasoning and decision-making, self-regulation helps in monitoring one's own thought processes by identifying biases and assumptions, and modifying strategies as needed. Self-regulation is a complex term that has multiple components, which includes using feedback, monitoring comprehension, assessing progress towards a goal, and making judgement about how well something is learned (Bednall & Keheo, 2011). The two sub-skills here are self-examination and self-correction (Facione, 2011). Self-examination has to be made before the need for self-correction arises. It is the evaluation of our own ideas with no prejudices (Ibrahim et al., 2020). In order to strengthen critical thinking skills in medical education settings, students need to reflect on their clinical experiences, ask mentors or teachers for comments, and keep up with current developments in science and medicine. There are quite a number of literatures indicating the relevance of self-regulation in learning. Researchers taught college students how to use self-regulatory behaviours, and they found that when compared with control groups, students who learned how to self-regulate performed better on a test that required detecting and explaining thinking fallacies (Bednall & Keheo, 2011). Without doubts, critical thinkers are self-regulated learners.

Verbal reasoning: Reasoning is a type of skill that could be used to make valid conclusions even when dealing with an emotional and complex information. Reasoning is the best way to decide who and what to believe (Halpern, 2014). When we reason, we use our knowledge about one or more related statements that we can reasonably believe is true to determine if another statement, the conclusion, is true (Halpern, 2014). The capacity to reason well is a critical thinking skill that is highly necessary to forecast and diagnose. Reasoning is the process of developing logic for an issue (Gogus et al, 2020). Trowbridge, Joseph, & Durning (2015) defined clinical reasoning as “the cognitive and non-cognitive process by which a health care professional consciously and unconsciously interacts with the patient and environment to collect and interpret data, weigh the benefits and risks of actions, and understand patients’ preferences to determine a working diagnostic and therapeutic management plan whose purpose is to improve a patient’s well-being. It’s a means for developing information obtained from examples in the known to the unknown.

Argument analysis: More technically, an argument consists of one or more statements that are used to provide support for a conclusion (Halpern, 2014). In an argument, there has to be at least one premise and one conclusion. The statements that provide the support for a conclusion are called reasons or premises of the arguments (Halpern, 2014). The purpose of presenting the reasons is to convince the listener or reader that the condition is true or most likely true. Argumentation skills are crucial for students to be able to defend data, claims, and ideas that deviate from their thinking to be able to argue (Songsil et al., 2019), as well as be involved in discussions so that students can make decisions in solving scientific problems (Fakhriyah et al., 2021). In the usual daily arguments, it's unfortunate that the premises and conclusions are not always labeled. Halpern (2014) identified premise indicator examples as; because, for, the reasons are, whereas, and lots more. The conclusion is the purpose or the "what" of an argument (Halpern, 2014). Halpern (2014) identified certain premise indicators which includes; therefore, hence, so, consequently, as a result, and lots more. Aldahmash and Omar (2021) state that there are several aspects in conducting the Argument-Driven Inquiry activities: a) question (involving students in scientifically oriented questions), b) evidence (asking students to prioritize evidence), c) student explanation (asking students to provide explanations based on data or evidence), d) scientific theories (asking students to connect explanations with scientific knowledge), e) argumentation, communication, and justification (asking students to express opinions), f) analysis (asking students to analyze the evidence), g) connection (involving students to connect explanations with scientific knowledge), h) investigation reports (asking students to make reports based on the results of investigations or learning), and i) reflection (asking students to reflect on the investigation and learning process).

Thinking as hypothesis testing: A hypothesis is mostly a guess about the relationship between variables. In order to understand the world around us, we accumulate observations, formulate beliefs or hypotheses (singular is hypothesis), and then observe if our hypotheses are confirmed or disconfirmed (Halpern, 2014). According to Ferrés (2017), practical investigative work begins with the process of asking questions and formulating hypotheses, finding out the answers through data analysis and examining the relationship between various variables. In the inductive method, we devise hypotheses from our observations (Halpern, 2014). Statistical significance as denoted by $P < 0.05$ has become the cornerstone of decision-making in healthcare research; it is the gold standard for establishing if clinical significance exists—that is, if exposure to a personal

behaviour or lifestyle, aspect of the environment, inborn or inherited characteristic is a risk factor for the development of a disease or condition, or determining if a newly developed medical strategy, drug, device, surgical approach, or alternative way of using a known treatment is effective (Sedgwick, 2023).

In the deductive method, we collect observations that confirm or disconfirm our hypotheses (Halpern, 2014). There are quite a number of non-statistical examples of reasoning used in NHST (null hypothesis significance testing). Miller (2016), stated an instance, if you see an unusually large number of cars parked on the street where you live (pattern), you will probably conclude that something special is going on nearby. It is logically possible for all those cars to be there at the same time just by coincidence, but you know from your experience that this would be unlikely, so you reject the “just by chance” idea (Miller, 2016). Most thinking involves an interplay of the inductive and deductive method. An important step in hypothesis-testing is to define the variables operationally without bias. Hypothesis testing is the procedure that allows verifying an assertion regarding the value of a population parameter from data obtained in a sample (Pérez, 2023). A sample should be representative enough in order to avoid invalid conclusions. We need representative samples so that we can generalize our results and decide, on average, that one program is more successful than the other (Halpern, 2014). Its underlying logic—both in scientific research and in everyday life—is that chance can be rejected as an explanation of observed patterns that would rarely occur by coincidence (Miller, 2016). It is suggested that NHST is poorly understood because students are not taught the philosophical concepts and ideas that underpin statistical theory and statistical inference (Sedgwick, 2023). The classroom is undoubtedly the most ideal place to start, if this has to be changed.

Using likelihood and uncertainty: Likelihood and uncertainty in mathematics is mostly called probability. Probability is the study of likelihood and uncertainty (Halpern, 2014). High school students learn the necessary rules and skills to calculate probability in a mathematical context (Sadidi & Pospiech, 2021). However, it might be a bit challenging for students to utilize their mathematical knowledge about probability in other subject or other contexts of life. Critical thinking will require an understanding of probability (Halpern, 2014). The fact that few things are known with certainty is the reason why probability has to be used in many aspects of human lives. All medical diagnoses and treatment decisions are inherently probabilistic (Halpern, 2014).

Teaching students to use likelihood and uncertainty analysis (LU) skill for making a decision about uncertain events is very important (Sadidi & Pospiech, 2021). Consequences of an action might not be obviously known until it is done. As a result, Sadidi & Pospiech (2021) conducted a study about developing students' likelihood and uncertainty analysis in particle physics, students' dialogues showed that they used more frequently the words related to applying probability in making decision e.g. most likely, likely, unlikely. Probabilistic words are helpful for decisions, based on specific conditions.

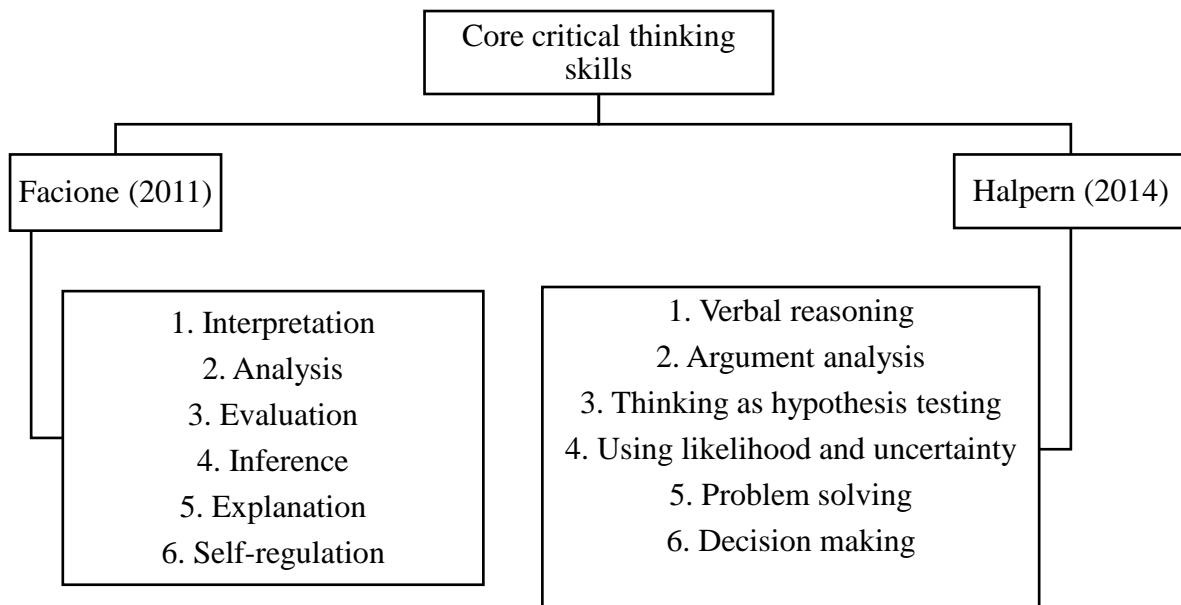
Decision making: Making a decision always entails selecting one option from a range of possible alternatives. The alternatives that people generate are tied to the way memory is structured and accessed (Halpern, 2014). Making decisions also entails uncertainty because we are unable to predict the results of our choices in advance. Halpern (2014), stated that the quality of a decision needs to be judged on the basis of what was known or should have been known at the time the decision was made; sometimes, good decisions will have undesirable outcomes, and sometimes poor decisions will have good outcomes (Halpern, 2014). Good decisions might sometimes yield an unpleasant result due to the uncertainty in the majority of crucial decisions.

Students are expected to apply classroom science to clinical areas and use the best available evidence to improve clinical decision-making and cognitive skills in the clinics and the wards (Fiset, et al, 2017). Various strategies have been introduced to improve clinical decision making (Croskerry, 2003). Reflective and critical thinking can enhance “long-life learning” and improve “clinical decision-making,”(Tsingos, et al. 2015, Tsingos, et al. 2014) also helps physicians to choose difficult or ethical decisions when encountering complicated cases in clinical practice (Bryan & Babelay, 2009). The results of good decision-making will be more favorable than those of poor decision-making. One way to improve on the way in which decisions are made is to frame the decision in several ways (Halpern, 2014). Clinical decision making, or clinical reasoning, has been described as being a foundation of effective clinical education (Dent & Harden 2009) and is a significant aspect of physician competence (Norman 2005).

Problem solving: Problem differs in many ways, including difficulty and where in the problem space the gap occurs (Halpern, 2014). The need for a problem to be solved is often triggered by a situation, which could take any form. An important dimension of critical thinking is problem

solving (Tapper, 2014). An individual who persists at a problem is much likely to solve it than an individual who give up (Halpern, 2014). In order to solve a problem, various strategies regarding the solution needs to be planned. The first stage in problem solving is the preparation of familiarization stage, which includes the time spent in understanding the nature of the problem, the desired goal and the givens (Halpern, 2014). Problem solving and critical thinking refers to the ability to use knowledge, facts, and data to effectively solve problems (Ibrahim, et al, 2020). The question on how best to develop more successful clinical problem-solving skill in nurses has become a very significant subject for nurse trainers (Yoo & Park, 2014). Assessing reflection can increase learning, and medical teachers can analyze “problem-solving” and clinical “decision-making” process of learners too (Daryazadeh, et al., 2020). The main target of qualified nursing education is to graduate nurses that could unite theory and practice, think critically in learning process, has effective problem-solving skills, and take correct clinical decisions (Shin et al., 2015).

Figure 1: Core critical thinking skills based on Facione (2011) and Halpern (2014) models



1.3 The disposition for effortful thinking and learning

Halpern (2014) notes that developing a critical thinking attitude and disposition is at least as important as developing the skills of critical thinking – the skills are useless if they are not used (Halpern, 2014). The disposition of a critical thinker is as essential as the skill. The ideal critical thinker can be characterized not merely by her or his cognitive skills but also by how she or he approaches life and living in general (Facione, 2011). Beyond the cognitive skills necessary for critical thinking, dispositions are the significant attitudes necessary for the development of these skills. These dispositions are necessary for medical students to engage in reflective and analytical thinking.

According to Halpern (2014), a critical thinker will exhibit the following dispositions or attitudes:

Willingness to plan: This disposition includes the capacity to realize the value of planning and being ready to engage in critical thinking activities. Planning seems to be an important component for changing many behaviours, especially health-related behaviours such as healthy eating and avoiding drug and alcohol abuse (Wiedemann, et al., 2011). Irrespective of the content, it is ideal to plan how to think and act. Teachers should emphasize the vital role of planning in clinical decision-making processes and problem-solving scenarios when teaching medical students. Teaching strategies could involve exercises that require students to plan their approach to diagnosing and treating patients.

Flexibility: An attitude of flexibility is marked by a willingness to consider new options, try new things a new way, and reconsider old problems (Halpern, 2014). Cognitive flexibility is the ability to change how we think about something - to see things from another person's point of view, consider multiple options, think of several ways to respond, and seek information that may not be readily available (Dennis &Wal, 2010). An open-minded person is willing to suspend judgement, gather more information, and attempt to clarify difficult issues (Halpern, 2014). It indicates that a critical thinker is willing to listen to new ideas, review evidences, and will not give up on a task until all viable possibilities have been explored. In medical education, students should be encouraged to think about other diagnosis or treatment options in light of new

information or evolving patient conditions. Teaching strategies should promote a mindset that values open-mindedness and exploration of diverse perspectives.

Persistence: There are many factors that influence academic and career success, but persistence may be the most important one (Andersson & Bergman, 2011). It is an important factor in the process of getting a problem solved without giving up. Purposeful thinking is equivalent to hard work which requires persistence. It can make you as tired as any physical labor, but can be much more rewarding (Halpern, 2014). Development of critical thinking skills often demands perseverance in order to solve complex problems. Medical students may encounter challenging clinical cases or research findings that requires effort to comprehend and analyze. In order to assist students overcome challenges and stay motivated, future medical teachers should encourage persistence by offering opportunities for structured practice, feedback, and reflection.

Willingness to self-correct, admit errors, and change your mind when the evidence changes: This is an attitude that involves complete honesty and humility, intellectually. Unfortunately, this is one attitude of critical thinking that is still all too rare (Halpern, 2014).

Being mindful: Critical thinkers are mindful of their own thought processes, personal prejudices, and preconceptions. Mindfulness in medical education can assist students in approaching patient care with increased empathy, acknowledging the ethical, social, and cultural aspects of healthcare practice.

Consensus seeking: Consensus-seekers need high-level communication skills, but they also need to find ways to compromise and to achieve agreement (Halpern, 2014). This disposition entails getting ideas from others, effective collaboration, and making efforts to reach shared understanding or agreements. In a study conducted by Sadidi & Pospiech (2021), when an idea came up in a group, students looked for reasons, discussed and reflected on their reasons to collect relevant and valid information to evaluate their interpretations. Some ideas were rejected and at the end the ideas reported in the worksheet remained as accepted ideas by the group (Sadidi & Pospiech, 2021). Without this disposition and related interpersonal skills, even the most brilliant thinkers will find that they cannot convert thoughts to actions (Halpern, 2014). Consensus-seeking is an openness in thinking that allows members of a group to agree on some aspects of a solution and disagree on others, but the goal is to allow other people and yourself to

express doubts while working toward a solution that can be achieved (Halpern, 2014). In order to provide high-quality patient care, cooperation and teamwork are crucial in medical education.

Facione, 2011 states the approaches to life and living which characterize critical thinking, it includes:

- Inquisitiveness with regard to a wide range of issues
- Concern to become and remain well-informed: In a study conducted by Ibrahim, et al, (2020), truth-seeking, the student disposition of being eager to seek the best knowledge in a given context were the highest among nursing students
- Alertness to opportunities to use critical thinking
- Trust in the processes of reasoned inquiry
- Self-confidence in one's own abilities to reason
- Open-mindedness regarding divergent world views
- Flexibility in considering alternatives and opinions
- Understanding of the opinions of other people
- Fair-mindedness in appraising reasoning
- Honesty in facing one's own biases, prejudices, stereotypes, or egocentric tendencies
- Prudence in suspending, making or altering judgments
- Willingness to reconsider and revise views where honest reflection suggests that change is warranted.

Facione (2011) further classified the dispositions to critical thinking into: inquisitive, judicious, truth-seeking, confident in reasoning, open-minded, analytical, and systematic. These dispositions serve as attitudes or habits of mind that contribute to the capability to think critically.

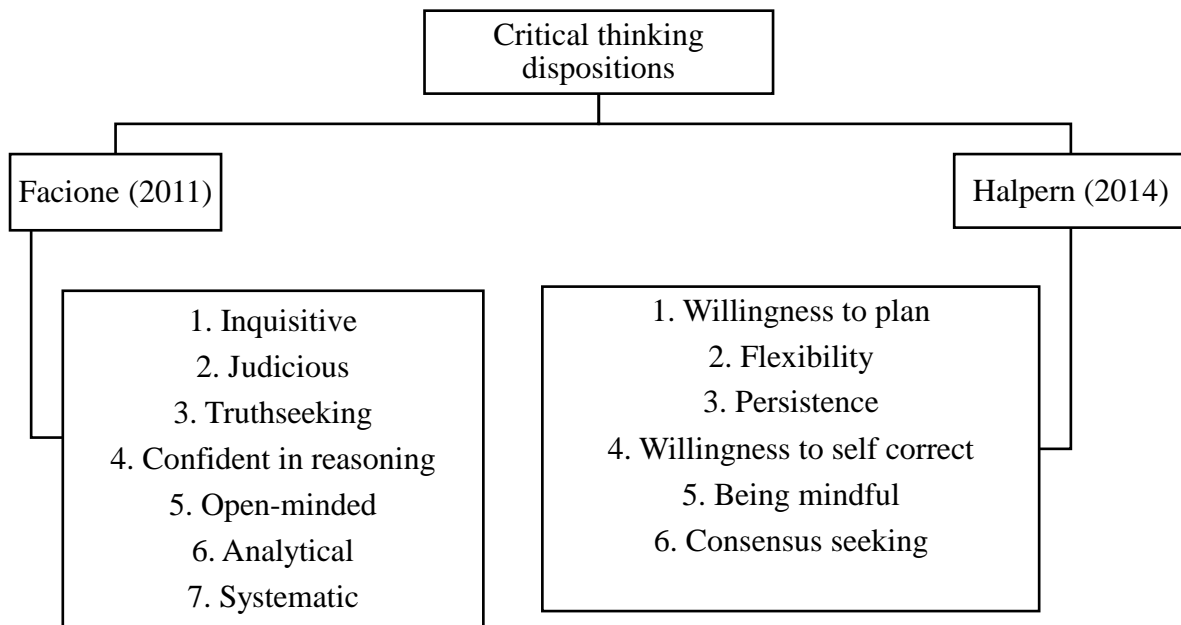


Figure 2: Dispositions for effortful thinking based on Facione (2011) and Halpern (2014) models.

2. Methods of Developing Critical Thinking Skills

The development of critical thinking in students is the basis for their development in society as professionals who own the skills of entrepreneurship, inquisition, creativity, and are able to correctly assess their behavior, have their own ideas, views, build and raise the foundation of our great future (Renatovna, 2021). Since education is seen as a tool for the development of the society, critical thinking skills is seen as a subset of education. In a study conducted by Adi & Lestari (2022), experiential learning can improve students' critical thinking because the learning model meets all the criteria of the learning model that can be used to improve students' critical thinking skills. Experiential learning involves the development of critical thinking skills through experiences. It could take the place of informal education, as in life experiences. Acquiring critical thinking helps individuals interact with other individuals with an independent, creative, scientific perspective, helps them evaluate events holistically, and helps them define the parameters, criteria and requirements they need in decision-making processes in social life (BiLgiÇ et al., 2021). Beyond the social life, critical thinking is also required in professional lives. Employees in the future workplace must be able to think in a digitally responsible manner (Mueller 2022) so that they can operate with client's data and digital technologies while consciously keeping ethical aspects in mind. In this context, it is necessary to examine the relationship between teaching and the basic skills that individuals need to learn in the century we live in. Looking at the 21st century competencies, it is seen that critical thinking is included in the 21st century skills. Critical thinking is not an innate feature, but a system that can be taught, explained and easily applied (BiLgiÇ et al., 2021).

2.1. Bloom's Taxonomy

A well-known framework for categorizing cognitive abilities, Bloom's Taxonomy classifies cognitive processes into six levels of hierarchy: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. Each level denotes a cognitive ability that is increasingly more complex with the latter stages signifying higher-order thinking. The taxonomy provides different levels of learning objectives, divided by complexity. Only after a student master one level of learning goals, through formative assessments, corrective activities, and other

enrichment exercises, can they move onto the next level (Guskey, 2005). Blooms taxonomy is mostly used by teachers to formulate learning objectives and evaluating learner's knowledge. Remembering, understanding and applying are fundamentally the process of acquiring and comprehending concepts and factual knowledge; these three levels are considered to be lower order thinking skills (LOT). Critical thinking skills are necessary to fulfil skills at analyzing, evaluating, and creating (Misrom et al., 2020; Purnami et al., 2021). Analyzing, evaluating and creating are considered to be higher order thinking skills as seen in figure 3. Students' thinking progresses from LOT to HOT as they age, implying that they must have a certain education, experience, practice, resources, and support to develop HOTs (Roets & Maritz, 2017). Higher-order thinking is complex and contains numerous components, allowing students to develop multiple ways of understanding and approaching a situation (Tanner, 2016). Certain teaching strategies can be used to promote the development of these critical thinking skills by encouraging students to actively engage with real-world problems and apply their knowledge in meaningful ways.

Higher order thinking has become one of the essential features for tomorrow's doctors for maintaining clinical competence and medical professionalism (Trowbridge, Joseph, & Durning, 2015; Victor-Chmil, 2013). HOTS help students acquire considerable abilities that enable them to deal with this new information and situations (Alkiyumi, 2023). Therefore, to improve students' critical thinking skills in medical education, it is necessary to practice solving Higher Order Thinking Skills (HOTS) questions as seen in table 1. Thus, the application of HOT in the classroom (and what makes students different from lower order thinking activities) also depends on the nature of the task and one's intellectual experience (Alexander et al., 2011). Future teachers must ensure the medical students are equipped with the capacity to critically evaluate information, arguments, and evidence, as well as generate new ideas and solutions to complex problems. Widana et al. (2018) reported that using HOTS-based questions can help teachers improve students' critical thinking skills. These higher-order thinking skills need to be cultivated in medical education by challenging students to asses many point of views, weigh evidence, and construct coherent arguments. Lesson objectives can be formulated by gradually moving towards the highest level of blooms taxonomy as shown in figure 2 and table 1.

Blooms Taxonomy - Revised

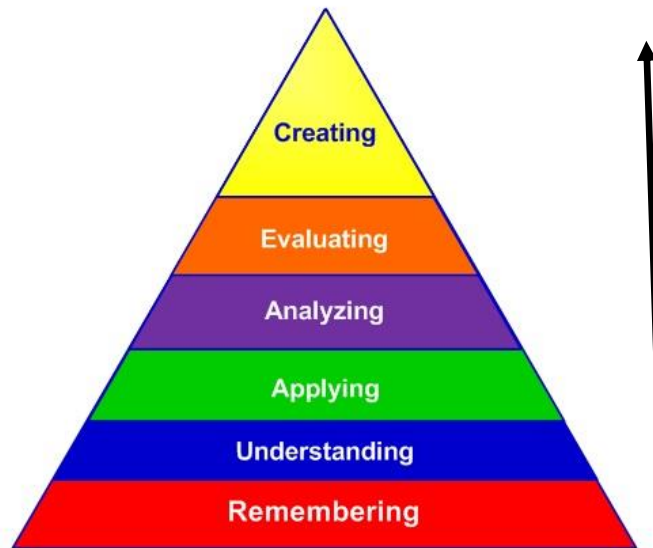


Figure 3: Blooms taxonomy, adapted from the peak performance center (2024).

The individual tiers of the cognitive model from bottom to top, are as follows:

Remembering: Recalling information or knowledge is the foundation of the pyramid and a precondition for all future levels (Simply Psychology, 2024). This is the first and basic level of cognitive development

Understanding: This is the second stage of cognitive development. It is sometimes regarded as comprehension. It deals with making sense out of information.

Applying: Learners are expected to use knowledge in a new but similar form, at this stage. This is about the ability to use some abstractions in specific situations, that is, to solve problems using learned concepts, ideas, rules, or procedures (Loveless, 2023).

Analyzing: At this stage, knowledge helps in exploring relationships. The teacher enables the learner to examine elements and the relationships between elements or the organizational principles undergirding an idea.

Evaluating: Critically examining relevant and available information to make judgments (Simply Psychology, 2024). This level enables learner to judge certain situations and sentences.

Creating: This level of objectives implies the ability to combine known elements and create a new whole, model, or structure that did not exist before. The core of achieving this category of goals lies in critical and creative thinking (Loveless, 2023).

Bloom's Level	Key Verbs (keywords)	Example in Learning Objective
Create	Design, formulate, build, invent, create, compose, generate, derive, modify, develop.	<i>By the end of this lesson, the student will be able to design an original homework problem dealing with the principle of conservation of energy.</i>
Evaluate	Choose, support, relate, determine, defend, judge, grade, compare, contrast, argue, justify, support, convince, select, evaluate.	<i>By the end of this lesson, the student will be able to determine whether using conservation of energy or conservation of momentum would be more appropriate for solving a dynamics problem.</i>
Analyze	Classify, break down, categorize, analyze, diagram, illustrate, criticize, simplify, associate.	<i>By the end of this lesson, the student will be able to differentiate between potential and kinetic energy</i>
Apply	Calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, perform, present.	<i>By the end of this lesson, the student will be able to calculate the kinetic energy of a projectile</i>
Understand	Describe, explain, paraphrase, restate, give original examples of, summarize, contrast, interpret, discuss.	<i>By the end of this lesson, the student will be able to describe Newton's three laws of motion in her/his own words</i>
Remember	List, recite, outline, define, name, match, quote, recall, identify, label, recognize.	<i>By the end of this lesson, the student will be able to recite Newton's three laws of motion.</i>

Table 1: Bloom's taxonomy key verbs and examples, adapted from Simply Psychology (2024).

The taxonomy explains that (Shabatura, 2013):

1. Before you can understand a concept, you need to remember it;
2. To apply a concept, you need to understand it first;
3. To evaluate a process, you need to analyze it first;
4. To create something new, you need to have completed a thorough evaluation

According to Simply Psychology (2024), this hierarchy takes students through a process of synthesizing information that allows them to think critically. Students start with a piece of information and are motivated to ask questions and seek out answers.

2.2. Teaching Strategies for Developing Critical Thinking Skills

Despite the undeniable role of critical thinking ability in medical education, it is challenging to choose the best approach to enhance critical thinking skills (Soltani et al, 2021). Samuel (2019) acknowledged the fact that teachers are not viewed as holy guides anymore; rather they function as facilitators encouraging learners to apply critical thinking and problem-solving skills. Paul (2005) suggests that educators can facilitate asking questions and accepting more than one reality to enhance deeper thinking and the finding of different perspectives. Encouraging contribution to decision-making process is one of the features of teaching strategy to promote critical thinking and problem-solving skills (Abdulazeez & Ali, 2021). Critical thinking skills can be promoted and developed by involving learners in complex activities that require questioning to find solutions (Abdulazeez & Ali, 2021). By understanding the cognitive processes that support the development of critical thinking skills, medical educators can modify their teaching strategies to promote the acquisition and refinement of these skills among students. To help learners develop these skills and come up with unique ideas and solutions, it is extremely important for teachers to recognize their roles as facilitators. In the recent years, more scientific, practical, and effective teaching strategies for medical students toward developing quality of care and critical thinking skills have been researched. Problem-based learning and reflective practice is among these effective strategies.

2.2.1. Problem-based learning: Torralba et al., (2020) address curricular formation and propose strategies employing a hermeneutic perspective with methodologies such as problem based

learning. The idea behind problem-based learning is that students will learn better if they were engaged in real-life problem solving (Halpern, 2014). Problems generally triggers people to think of solution within a specific time-frame. Furthermore, problem-based learning includes the involvement of students in research activities. Engaging students in research activities helps develop critical thinking and analytical skills (Lee, et al., 2021). When students are faced with real-life problem scenario within the classroom environment, they have the opportunity to utilize their previous knowledge of a specific content, in addition to analysing different approaches to create a new solution. To be successful, students enrolled in a problem-based curriculum need a knowledgeable tutor who can help them when they get stuck on a problem and assess their knowledge as they move through the problem to ensure that they are making adequate progress towards the knowledge and skills they will need (Halpern, 2014). Problems from a specific subject can also be integrated into another subject, thereby testing the students' knowledge, interpretation skill, analysis skill, and other dimensions of critical thinking skills. Integration enhances interdisciplinary collaboration and prepares students for the evolving healthcare landscape (Ahmed, Taha, & Khayal, 2024). By integrating medical courses with other disciplines, such as medical engineering, students gain a broader perspective and are better prepared to work in interdisciplinary teams (Lee, et al., 2021).

Incorporating hands-on, patient-focused research early in the medical school curriculum provides a valuable educational experience for students (Stacpoole et al., 2001). Students do not just learn in a problem-based learning scenario, but they are committed to achieve a goal. This commitment is fostered through the development of creative thinking, the capacity to solve complex problems, and an ethical awareness in their performance (Fu et al., 2023). Curriculum subjects, disciplines, tutors, and student organizations must intensify their efforts to increase motivation and participation of students in student scientific forums, thereby contributing to the further development of research skills (Alsalem et al., 2021). It is necessary to integrate research-related topics into the curriculum. This integration is crucial to produce well-rounded professionals capable of addressing health-related issues (Boelen, 2018). A PBL class requires students setting objectives, locate resources to help interpret each patient case, and learn from peer evaluation. Some students suggest that research should be interest-led and not a mandatory requirement in fulfilment of a course degree (Bhadoria, et al 2024), in contrast, others recommend that doing a certain minimum number of research projects should be a mandatory

requirement for every medical student in their academic year and their credits be added to their academic achievements (Bhadoria, et al 2024). Research is a crucial tool for problem-solving, as it involves the dimensions and disposition of critical thinking skills. Ibrahim et al. (2020) reported a study with aim to assess the relationship between critical thinking dispositions and problem solving abilities among nursing students; the study conclude that there were statistically significant positive correlation between total critical thinking dispositions and total problem solving abilities among nursing students with p- value = 0.001. The Guided PBL approach tested by Nargundkar et al. (2014), was found to be more effective for a required class than the traditional lecture approach, improving both overall learning as well as CT ability. Problem-based learning (PBL), an instructional method, enhances interaction and critical thinking among learners by utilizing structured problems closely linked to a specific subject and emphasizing a student-centered approach.

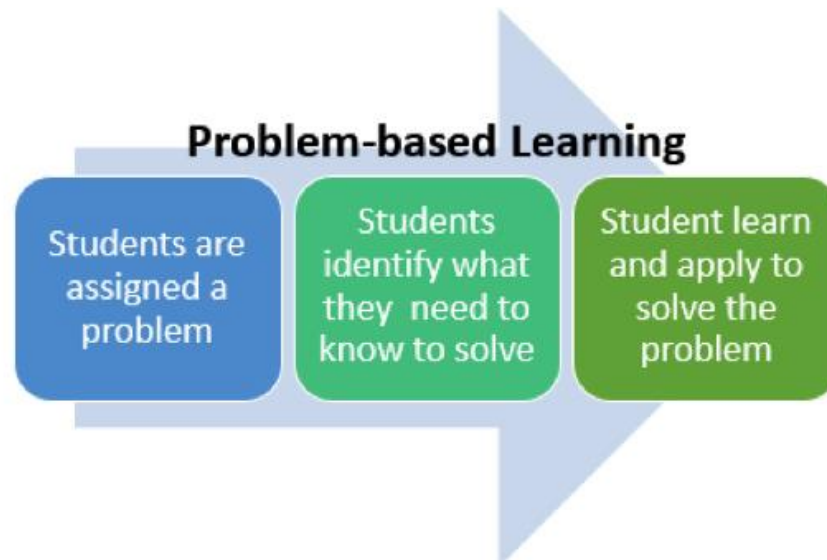


Figure 4: Problem-based learning, adapted from Schadt, (2021).

Learning principles applied to PBL

- (Patient) problems as stimulus for learning: In order to stimulate students' learning, students in PBL are confronted with problems (Dolmans, et al, 2005). As seen in figure 4, problems are assigned as the first step of PBL. These problems involve describing certain phenomena that require explanation. As students work on explaining the phenomena,

students will discover what they already know about the problem, likewise what they do not know yet. These problems serve as the main catalyst for learning in PBL, and are used to engage students actively in their own learning. By using problems in PBL, students are encouraged to actively build upon their existing knowledge and create new understandings closely connected to what they already know. The problem is the focus for acquiring knowledge and fosters flexible thinking (Hmelo-Silver, 2004). The flexibility in thinking brings forth new ideas.

- **Tutors as facilitators:** Another important feature of PBL is that teachers are facilitators who stimulate students towards problem solving and self-directed learning. In order to stimulate students towards self-directed learning, a tutor should not transmit his expert knowledge to the student, but should probe students' knowledge by encouraging specific kinds of cognitive activities (Hmelo-Silver, 2004). The teacher is responsible for managing the learning process, ensuring the students' understands the problem and active participation from all students, monitoring each student's progress within the group, and adjusting the difficulty level of the problem accordingly.
- **Group work as stimulus for interactions:** In PBL, problems may be discussed in small groups of students. In this collaborative learning environment, students learn from interacting with each other, e.g. by explaining the materials to another student and by asking and answering questions and by discussion (Hmelo-Silver, 2004). In PBL groups, students work together to develop collaborative explanations.

2.2.2. Reflective practice: Reflection means a process in a person's thoughts that is related to experience and can be decomposed and interpreted to make awareness (Daryazadeh, et al., 2020). Hence, the created understanding in this process can be used in the same condition in the future (Sandars, 2009). Consequently, reflection on past experiences and activities can increase learning and performance. Reflective practice can help physicians to choose difficult or ethical decisions when encountering complicated cases in clinical practice (Bryan & Babelay, 2009). This capacity is an important ability that lets the physicians be mindful, interested, aware, and prepared to identify and correct faults (Epstein & Hundert, 2002), therefore fostering reflection improves professionalism, which is a core competency in medicine (Sandars, 2009, Wald, et al, 2012). Research indicates that activities focusing on reflective practice facilitates personal and

professional learning, enhances application of theoretical concepts to practice and stimulates creative thinking (Simon & Al-Ghailani, 2023). Also, educators may require students to submit a short paper about the most important lesson they learnt during the lecture and a particular thing they don't understand after the lecture, but before the class closes (Negoescu, 2023). Request for the submission of this short paper will trigger a student to think outside the box, thereby evaluating his own learning process and experience.

With most medical schools currently transitioning toward a competence-based curriculum, reflections are being considered an essential aspect of lifelong self-directed learning (Mann, Gordon, & MacLeod, 2009). Based on the principles of self-directed learning, reflective practice motivates students to do self-assessment, improves critical thinking skills, encourages professionalism, and even communication skills (Sandars, 2009). Reflective practice can take a form of portfolio writing. Research indicates that portfolios allow medical students to reflect and better appreciate their clinical, research and academic experiences which promotes their personal and professional development (Tan, et al, 2022). Portfolio writing also contributes to the improvement of students' capacity for critical thinking, self-regulation, lateral thinking and evaluating evidence (Quitadamo & Kurtz, 2007). In a study conducted by Simon & Al-Ghailani (2023), students reported enhancement of self-directed learning while completing the reflective portfolio as part of their behavioural science course assignment. This is similar to other research findings. It was reported that their writing skills had improved and that they utilised varied resources beyond the prescribed course material (Elango, Jutti & Lee, 2005). Reflection is a kind of self-directed learning process, whereby the learner is in control of his learning experience. The student learns a new concept, evaluate his own thoughts by highlighting the most important information out of the whole concept, without ignoring his emotions.

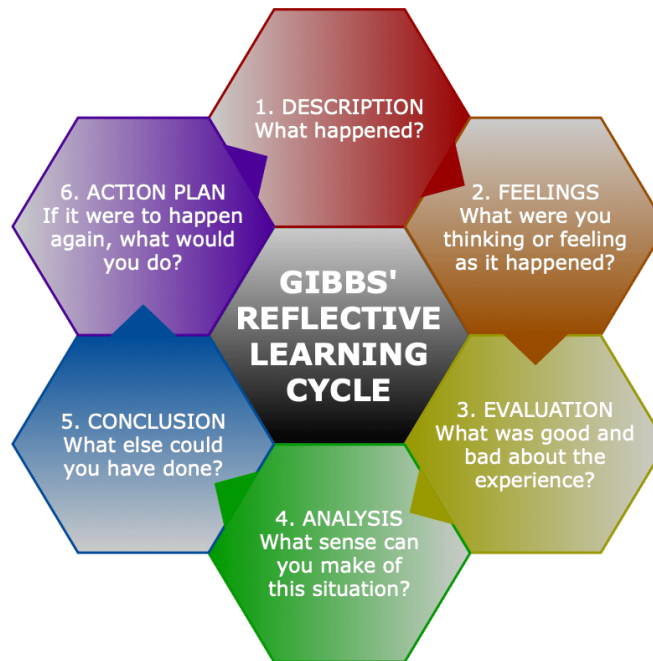


Figure 5: A visual representation of Graham Gibbs' Reflective Learning Cycle.

Reflection is a learnable process, so teaching methods can be used to foster it, and one of the teaching methods of reflection is reflective writing (Wald, et al, 2012; Levine, Kern, & Wright 2008). An important tip in this method is offering guidance and feedback to learners to make particular skills (Coulehan & Granek, 2012). Teaching reflective writing is conducted in “Reflective practice,” which is an approach in medical education and considers medical students’ and practitioner concerns (Daryazadeh, et al 2020). Reflective practice is an approach being used in medical education because of the evolving global healthcare. These practices are “the higher-order intellectual and affective activities” in practitioners that involve “to critically analyze and evaluate their experiences to lead to new understandings and appreciation of the way they think and operate in the clinical setting” (Daryazadeh, et al 2020). Gogus et al., (2020), conducted a study to investigate the relationship between critical thinking skills and the reflective thinking skills toward problem-solving; the study concludes that there were Positive correlations between reflective thinking and critical thinking skills. Reflective thinking offers opportunities for students to analyze and evaluate learning processes via using portfolios, interactive journal printing, reflective papers and developing concept maps (Ghanizadeh 2017).

Stages of reflection

Koshy, et al, 2017 identified five stages of reflection in healthcare, and they include:

- What, where, and who—the situation

Think about the situation in detail: What happened exactly and in what order, where were you at the time and who else was involved? What part did you have to play? What was the final outcome?

- How did it make you feel—your emotional state

What was running through your head and how did you feel about it? Be honest with yourself: were you afraid, confused, angry or scared? If you can understand how you were feeling at the time it will help you put together why things happened as they did, and help you to recognize similar situations in the future.

- Why did it happen—making sense of the situation

Now you have thought about the situation in greater detail, and probably recognized things that would have otherwise gone unnoticed, think about why things happened as they did. How did the situation, yourself, and others interact at the time. Did the situation go well or was there room for improvement?

- Could you have done anything differently—critical review and development of insight

With the help of hindsight how would you have managed the situation differently? Think about what factors you could have influenced: is there anything you could have tried that may have improved the situation, or is there anything you did that was particularly important in the situation? It is easy to remember the things that you did not do and it is often the things that you did well that are forgotten.

- What will you do differently in the future—how will this change your practice

This is arguably the most important stage in reflecting. You need to pull together everything you have thought of before to learn, change your own practice, and improve. Do not only think about what you would do differently in that specific situation, but think whether you have thought of any transferable knowledge or skills you can utilize elsewhere. For example:

if you reflect on a post procedural complication, do not only think of how you would manage this again but also how you would prevent it happening if you performed the procedure yourself! If you are a part of a well-led cardiac arrest do not think only of what you would do next to help, but also how you would lead an arrest in the future, or even how you would lead a team in any other situation!

- Re-enforcement—what happens when you put this into practice

Test your reflections: When comparable situations happen again, do things change as you would expect them to? This is a chance to repeat the reflective cycle to refine and develop your understanding.

3. Medical curriculum

3.1. Approach for Medical Education Curriculum

The design of learning and teaching activities is usually reflected in the curriculum and its structure integrated in a particular school or even in a whole education system (Majerník et al., 2021). In general, a curriculum should be developed in a way that is clear and understandable not only to the school management and teachers, but to the learners too (Majerník et al., 2021). Curriculum refers more in depth to the knowledge and skills management the learners are expected to master upon graduation (Majerník et al., 2021). It includes learning objectives, outcomes, teaching units and study materials used in the whole education process. Medical education must foster the skills and attitudes essential to lifelong learning and continuous professional development with curricula that are increasingly learner-driven, time-variable, and competency-based (Parsons, et al, 2021). Most teaching strategies should aim at developing students critical thinking skills. The inadequacy of these methods has led to curricular reforms in an attempt to add critical thinking to all levels of education (Soltani et al, 2021). As a result, medical schools are placing a major priority on assessing critical thinking, improving this ability using specialized teaching techniques, and providing sufficient educational opportunities (Burke, 2017).

3.1.1. Problem Identification and General Needs Assessment: This step begin with the identification and critical analysis of a health care or other problem need (Thomas et al., 2016). It may relate to qualities of the physician, such as the need for healthcare providers to develop as self-directed, lifelong learners who can provide effective care as medical knowledge and practice evolve (Thomas et al., 2016). Curriculums frequently suffered from an excess of basic and clinical science subjects, leaving limited space for research instruction and learning (Ahmed, Taha, & Khayal, 2024). In the domain of medical education, fostering critical thinking skills among students is crucial for preparing competent and proficient healthcare professionals. The ultimate purpose of a curriculum in medical education is to equip learners to address a problem that affects the health of the public or a given population (Thomas et al., 2016). Despite recognizing the relevance of critical thinking skills in clinical decision-making and problem-solving, medical students still encounter the challenge of cultivating these skills effectively. This is followed by identification of an ideal approach that describes how patients, practitioners, the

medical education system and society should be addressing the need (Thomas et al., 2016). The difference between the ideal approach and the current approach represents a general needs assessment (Thomas et al., 2016). The step involves identifying the need for enhancing critical thinking skills among medical students and understanding the challenges faced by educators in achieving this goal. Evidence shows that clinical clerkships and other forms of clinical experience provide the opportunity to enhance critical thinking through observation of more senior clinicians and gaining experience, but the impact of such experiences is insufficient (Huang, Newman, & Schwartzstein, 2014).

3.1.2. Targeted Needs Assessment: Building upon the general needs assessment, this step involves a more focused inquiry into specific preferences. For the local needs assessment, members of the group reviewed the list for potential addition and deletions (Tippit, Chi, & Servey, 2024). Subsequent discussion refined potential material to ensure enhancement of faculty understanding and appropriate allotment of time needed to complete the curriculum (Tippit, Chi, & Servey, 2024). Since healthcare involves inherent uncertainties and is prone to diagnostic and management errors, improving physicians' critical thinking could have a substantial effect on aspects of routine medical practice, such as choosing treatment plans, making an accurate diagnosis, and reducing medical errors (Chan, 2016). This step involves assessing the needs of one's targeted group of learners and their medical institution/learning environment, which may be different from the needs of learners and medical institutions in general (Thomas et al., 2016). It enables desired integration of a specific curriculum into an overall curriculum (Thomas et al., 2016). This process ensures that the curriculum development efforts are tailored to address the identified gaps and challenges effectively. Integrating research into the medical curriculum requires careful planning and curriculum design (Ahmed, Taha, & Khayal, 2024).

3.1.3. Goals and Objectives: Based on the insights gained from the targeted needs assessment, the curriculum goals and objectives need to be clearly stated, beginning with broad goals and progressing to specific and measurable objectives. According to Thomas et al., (2016), objectives may include cognitive (Knowledge), affective (attitudinal), or psychomotor (skill and behavioral) objectives for the learner. Critical thinking is a valuable skill for nurses to possess, which includes several constituents, such as attitude, knowledge, and skills (Davis, 2012). The Committee on Curriculum and Academic Policy (CCAP) of Stanford medicine highlights the

ability to “demonstrate the intellectual curiosity necessary for scientific discovery and self-discovery through active participation in research” as one of the objectives and competencies for medical student education (Stanford Medicine, 2024). In the context of fostering critical thinking skills, teachers of medical education aim to equip students with the ability to analyze complex clinical scenarios, evaluate evidence-based practices, and make informed decisions. The formulation of goals and objectives serves as basis for evaluation. The formulation of objectives is guided by the SMART criteria—ensuring that they are Specific, Measurable, Achievable, Relevant, and Time-bound. In a study conducted by Tippit, Chi, & Servey, (2024), four overarching goals were created for the curriculum to guide its individual objectives. By outlining specific learning outcomes, educators can design teaching strategies that are aligned with these goals and facilitate the acquisition of critical thinking competencies among students.

3.1.4. Educational Strategies: Once the objectives have been clearly stated, the content of instruction becomes chosen. The next step involves selecting appropriate educational strategies and methods to achieve the desired learning objectives. Students are most likely to benefit from learning critical thinking skills when they are delivered through specific educational modules within their curriculum (Behar-Horenstein & Niu, 2011). Being able to discuss about a topic, even an unfamiliar one, and also making connections between topics helps students grow as critical thinkers (Negoescu, 2023). Educators recommend debates, role-plays, oral conversations and presentations about interesting subjects, project-based activities, problem-solving tasks, decision-making tasks, essays, and self-evaluation activities as the best methods for promoting critical thinking (Marin & De la Pava, 2017). The longer simulation allowed for self-reflection and peer feed-back as additional educational strategies (Tippit et al., 2024). In the context of developing critical thinking skills, medical educators may employ problem-based learning approach and reflective exercises to engage students in clinical reasoning skills, which is equivalent to the higher order of thinking. According to DeVoe et al. (2018), involvement in research activities facilitates the abilities of critical thinking, problem-solving approaches, and analytical skills. By incorporating diverse instructional strategies that promote inquiry, analysis, and synthesis of information, educators can create a dynamic learning environment conducive to the development of critical thinking skills. Moge (2022), states that critical thinking may be taught or stressed in all aspects of the classroom, including lectures, assignments, term papers, and tests. During lectures it is not necessary nor recommended to teach critical thinking

explicitly, instead educators can ask students questions that demand not only that they comprehend the content but also that they can evaluate it and apply it to new scenarios (Negoescu, 2023). The selection of these strategies is informed by the identified needs, learning preferences, and the overall goals of the curriculum.

3.1.5. Implementation: The implementation phase is the delivery of the curriculum. According to Thomas et al. (2016), it has several components: obtaining political support; identifying and procuring resources; identifying and addressing barriers to implementation; introducing the curriculum (e.g. piloting the curriculum on a friendly audience before presenting it to all targeted learners, phasing in the curriculum one part at a time); administering the curriculum; and refining the curriculum over successful cycles. Implementation is vital for the success of a curriculum. According to Marin & De la Pava (2017), students need to be given opportunities to exercise critical thought, besides the thinking abilities, attitudes, and other components mentioned in the specialized literature. It is crucial to ensure that the chosen teaching strategies are effectively executed, fostering active engagement and critical reflection. In order to provide students a model for critical thinking, and to foster a relationship of trust between educators and students, instructors must model critical thinking while carrying out all of these tasks in the classroom (Saleh, 2019).

3.1.6. Evaluation and Feedback: Finally, the curriculum's efficacy and effect on critical thinking skill development are assessed through evaluation and feedback mechanisms. For an effective evaluation, it is advisable to assess the critical thinking skills performance in both individuals (individual assessment) and the curriculum itself (program evaluation). Wright and Mynett (2019) assessed their medical school curriculum context and concluded that the evaluation was useful in enabling them to visualise the strengths and opportunities for improvement in terms of teaching resilience and resourcefulness they focused on. Evaluation is a process that involves gathering feedback from students, other educators, and stakeholders. Even if the curriculum is well designed, approved by statutory authorities and successfully implemented into educational practice, it has to be regularly re-evaluated (Majernik et al., 2021). Thomas et al. (2016), suggested the purpose of evaluation to be formative (to provide ongoing feedback so that the learners or curriculum can improve) or summative (to provide final “grade” or evaluation of the performance of the learner or curriculum). This entails collecting data on

learners' performance, satisfaction, and perceptions, as well as evaluating the attainment of predetermined objectives. Modi et al. (2015), recommend that clinical reasoning must be taught at all levels of medical training and assessment should be done throughout the course. They reviewed teaching and assessment of clinical reasoning skills (CRS) and documented that the problems with critical reasoning occur due to inadequate knowledge, flaws in data gathering, and improper approach to information processing (Modi et al., 2015). Assessments have a strong effect on student learning and also provide feedback on the effectiveness of the teaching-learning methods and programs (Kelkar et al., 2022). The tests used for the assessments should be objective, reproducible (reliable), and valid (Kelkar et al., 2022).

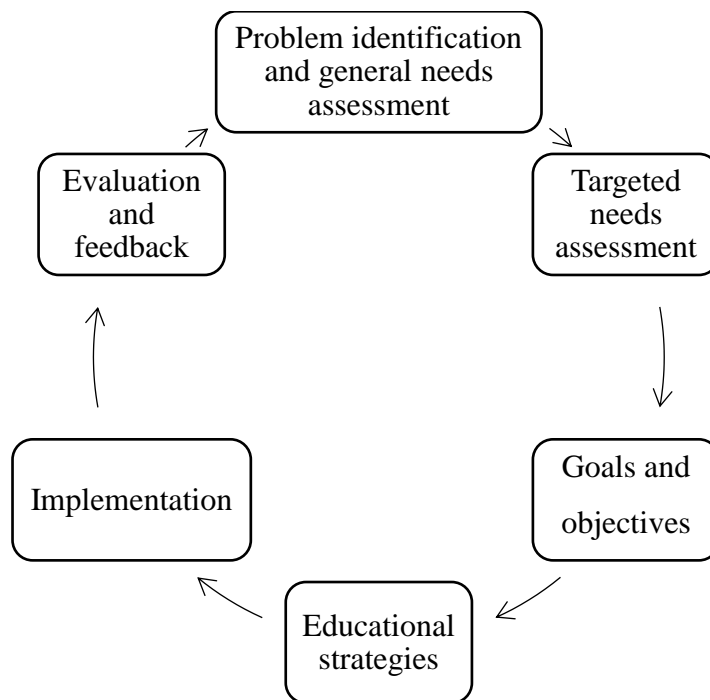


Figure 6: six step approach for medical education curriculum development

3.2. Challenges of Promoting Critical Thinking Skills in Medical Education through Teaching Strategies

3.2.1. Society and Family Culture: In a study conducted by Abdulazeez & Ali (2021), a participant (T1) response was “In my opinion, promoting critical thinking in our schools is highly significant but there are some obvious obstacles for its application. For example, students’ family background and educational environment can play negative role. They are hesitant and lack self-confidence to express their thoughts and opinions due to the dominant environment they were brought up with.” One of the challenges is traditional values, which could prohibit students from expressing objections with their elders' opinions. As a result, students may find it difficult to see critical thinking skills as a means of expressing their opinions.

3.2.2. School Environment and Resources: Limited resources, including funding, infrastructure, and faculty time, pose significant challenges in integrating research and teaching in medical education (Van et al, 2020; Siddaiah-Subramanya et al., 2017; Oliveira et al., 2014). In a study conducted by Abdulazeez & Ali (2021), a participant (T3) response was “School environment is another obstacle faced in developing critical thinking skills such as limited time, teachers overloaded working hours, insufficient classrooms, access to internet, air-conditioning and electric power, ...etc.” It is evident that lack of adequate teaching time and resources dedicated to research and other teaching strategies can pose a detrimental effect on the development of critical thinking skills in the school environment. PBL facilitators have to model problem solving and reasoning processes and guide students’ learning processes, which demands a great amount of time and preparation (Hung, 2011). The pre-service teachers in Jusoh’s study (2013) mentioned a long list of problems that they experienced during the teaching practicum, such as their inability to apply the theory learned into practice and lack of professional support.

3.2.3 Evaluation and Assessment: In a study conducted by Abdulazeez & Ali (2021), a participant (T7) response was “Critical thinking skills are inapplicable teaching techniques in our classes due to unsuccessful assessment tools and grading patterns. These are massive factors that debilitate developing teachings skills because students are more concerned with their grades and markings rather than developing critical thinking skills.” The development of appropriate assessment tools, measuring complex learning outcomes, capturing the long-term impact, and

defining meaningful metrics for success, are definite genuine challenges (Ahmed, Taha, & Khayal, 2024).

3.2.4. Student Perspectives: Enhancing student interest, engagement and motivation in research are critical in fostering a research-oriented learning environment (Ahmed, Taha, & Khayal, 2024). Motivation assists in initiating and maintain effort towards the achievement of certain goals. In a recent study conducted by Bhadoria, et al (2024), potential suggestions included providing motivational sessions to boost students' interest in research. Extrinsic motivation can be done by teachers, but student's intrinsic motivation might be really low. In order to engage students in critical thinking activities, these two kinds of motivation has to work together. Successful learning is directly proportional to the learner passion (Beg, 2021). Another discouraging experience is a group that is faced with some group members who do not prepare for the meeting and let others do the work in the group, which might lead to less involvement from those students who were motivated initially (Dolmans et al, 2005). Motivation fluctuates and it is actually a challenge for teachers to keep learner's motivation high all the time. Similarly, Taylor and Miflin (2008) indicated in their review of PBL implementations that it was a challenge to maintain students' interest in pursuing and engaging in the necessary cognitive processes such as generating learning issues. The reluctance may be due to the fear of showing vulnerability (Mhurchú & Cantillon, 2023). Students are likely to be demotivated in terms of expressing their personal thought about an experience.

B. EMPIRICAL PART

4. Methodology

This chapter put into consideration all possible and available data as well as the method adopted for the gathering of information under this project.

1. Research aim
2. Research questions
3. Research design
4. Research instrument
5. Validity of instrument
6. Sampling strategy
7. Ethical consideration
8. Participants of study
9. Procedure for data collection
10. Procedure for data analysis
11. Limitations of the study
12. Research timeline

4.1. Research Aim

This research study aims to generate a theory with explanatory power of how teaching strategies can promote the development of critical thinking skills in medical students, who are at the verge of becoming medical professionals. This involved explaining and exploring different methods of instruction, such as problem-based learning and reflective practice. By examining the experiences, insights, and beliefs of those aspiring to become medical educators, this study seeks to offer valuable insights that can inform the development of effective medical education practices which will lead to better clinical outcomes in healthcare.

4.2. Research Questions

1. What do future teachers understand by “Critical thinking skills”?

2. How does problem-based learning and reflective practice resonate with the development of critical thinking skills in medical students?
3. What challenges do future medical teachers foresee in implementing these teaching strategies?

4.3. Research Design

This study used qualitative research methodology. Qualitative research is a type of research that explores and provides deeper insights into real-world problems (Moser & Korstjens, 2017). Grounded theory was considered suitable for a study of this nature because of the theory generation that is grounded in the insights, perspectives and beliefs of the participants. Grounded theory research is inductive and therefore lends itself to research that is aiming to study social interactions or experiences (Foley & Timonen, 2015). The researcher used grounded theory as its design which involved the use of interviews to elicit relevant data from selected participants.

4.4. Research Instrument

This study administered self-designed semi-structured interviews, alongside inspiration from Q-methodology. Q methodology is achieved by having participants rank and sort a series of statements (Sandling, 2023). Some part of the interview questions had a series of statement, which the participants could rank and give justifications for their ranking. These statements were written on sticky notes for physical interview and SmartArt on Microsoft power point presentation for virtual interviews. Semi-structured interviews are based on using predetermined questions; however, the interviewers are also free to ask more questions for clarifications when required (Taherdoost, 2022). The interviews covered participants' views, experience, qualities, preferences, thoughts, opinions and plans regarding teaching critical thinking skills among medical students. The questions covered five (5) research areas. First research area was centered on what future teachers understand by critical thinking skills. Second research area focused on the curriculum and lesson plan that promotes critical thinking skills. Third research area focused on critical thinking dispositions and classroom climate. Fourth research area focused on the relationship between problem-based learning and critical thinking skills. Lastly, the fifth research area focused on the relationship between reflective practice and critical thinking skills. The questions were streamered with much simplicity and clarity in order to avoid difficulty in

comprehension by the participants. The main research instrument was in English language, however, the same instrument was also made available in Czech language, for the purpose of absolute comprehension by some of the participants.

4.5. Validity of Instrument

The semi-structured questions were constructed along the line of the research questions and presented to specialists in the field including the project supervisor for validation.

4.6. Sampling Technique

A purposive and convenience non-random sampling strategy was adopted for this study because the participants were selected based on specific criteria relevant to the research questions and objectives. The specific criteria included academic program and year of study. The sample size was five (n=5). According to Taherdoost (2022), it is important to consider the insights and preciseness of the participants about the topic, and keep the sample size small, since qualitative research does not necessarily intend to generalize the findings. The researcher decided to feature a small number of participants in order to generate in-depth data for efficient analysis.

4.7. Ethical Consideration

Ethical approval was obtained from the concerned authority. Written informed consent was approved by the subjects. The study participants were assured that the obtained findings would be used for research purpose only.

4.8. Participants of the study

The participants of this study were future teachers of professional subject for medical schools, these are master's degree students of Palacky University, enrolled in the study program - Teaching professional subjects for medical schools. These participants are health professionals with diverse medical backgrounds, and have chosen to become future teachers of secondary medical schools. The diversity in the participant's academic medical background enriches their understanding of critical thinking skills in medical education, enabling them to approach these challenges with an efficient perspective. In addition, all participants were in the first year of their master's degree program. They were at the beginning of their 'teaching' study program, as

master's degree program in Czech Republic takes two years. However, all participants had gone through healthcare practice in a medical setting, but not all participants had gone through teaching practice. In terms of nationality, the participants were natives of Czech and Slovak Republic. Hence, the participant's first languages were Czech and Slovak.

Participant	Gender	Bc. Study Program	Teaching Practice	Healthcare Practice
A	Male	Paramedics	No	Yes
B	Female	Paramedics	Yes	Yes
C	Female	Nursing	Yes	Yes
D	Female	General Nursing	Yes	Yes
E	Female	General Nursing	Yes	Yes

Table 2: Information of the participants.

4.9. Data Collection Procedure

Before conducting the actual semi-structured interviews, the researcher contacted the coordinator of the participants study program via email to discuss the classroom schedule of the participants. The researcher visited the participant's classroom on several occasions to seek the participant's approval. During the first classroom visit, only one participant volunteered to take part in the research. During the second classroom visit with the researcher's supervisor, five participants volunteered for an online interview, as they were going for teaching practice and will be out of the city for that period of time. The researcher tried to recruit more participants, and visited the participant classroom for the third time, together with the participants study coordinator, and the researcher's supervisor, but none of the population volunteered to take part in the research.

During the interviews, questions were read out to each participant. One of the participant's interview was conducted physically. The other four interviews were conducted virtually, with one of the participant answering in Slovak language, DeepL software was used for the translation, alongside human translator who understood Czech and English language. The human translator could correct the grammatical errors from the translation software, due to the similarities between Czech and Slovak language. Remote interviews are suitable when there are

geographical limits between the participants and interviewers (Taherdoost, 2022). The highest duration of the interview was Seventy minutes, while the lowest duration was forty minutes. The interviewees presented effective data because the semi-structured interview offered a considerable amount of flexibility to probe the future teacher’ perspectives along with maintaining basic interview structure and themes. There was note-taking and the interviews were audio-taped. Pictures, videos, notes, and transcripts are different ways of documentation (Karlina, 2022).

Interviewee	Date	Venue	Language	Duration
A	26th February, 2024	Faculty of Education relaxation area	English	1 hour, 6 minutes
B	13th March, 2024	Online (Google meet)	English	1 hour, 10 minutes
C	19th March, 2024	Online (Google meet)	Slovak	50 minutes
D	25th March, 2024	Online (Google meet)	English	40 minutes
E	25th March, 2024	Online (Google meet)	English & Czech	40 minutes

Table 3: Data collection procedure.

4.10 Procedure for Data Analysis

In analysing the responses from the semi-structured questions, effort was made to make sure that all relevant information gathered from the participants are theorized. Therefore, this enabled the use of Grounded theory. Open coding, axial coding and selective coding was used to analyze the data. Concepts were identified by their properties which were discovered in the data. Systematic comparisons were made for concepts to be categorized. The categories that emerge, along with their relationships, are the foundations for developing theory (Strauss & corbin,, 1998). A coding paradigm model which involved context, causal conditions, action, consequences and intervening conditions were applied to generate the result of the axial coding.

4.11 Limitations of the Study

The sample size was limited by the availability of time to conduct a larger research because this study did not involve larger numbers of future medical teachers. It is also possible that outcomes would vary if measured over more participants. Furthermore, language barrier was a limitation, as the population of study participants were not confident in their spoken English. This led to delay in data collection procedure.

4.12. Research Timeline

	Timetable	Progress
1.	September 2023- October 2023	Searching and studying publications related to the thesis title.
2.	October 2023 - December 2024	Refining the objectives, research questions and subsequent processing of the theoretical part.
3.	December 2023 – March 2024	Seeking volunteers for participation, gradually conducted semi-structured interviews.
4.	March 2024 – April 2024	Completion of theoretical parts, analysis of data and discussion of findings.

Table 4: Research timeline

5. Analysis and Interpretation of Data

This chapter introduces the open, axial, and selective coding data analysis. Subsequent categories and subcategories are listed in a table for greater clarity. Based on the data obtained, six categories were created to represent individual codes. These categories list the individual factors that facilitates or reduces the development of critical thinking skills in medical education. For the purpose of comprehension, the participants (n=5) are labeled ‘A, B, C, D, & E’.

The following categories and concepts were created during the analysis:

Table 5: Categorization of concepts

Categories	Sub-categories	Concepts
Professional responsibilities	<ul style="list-style-type: none"> • Job challenges • Crucial Skills 	<ul style="list-style-type: none"> • Medical Problems • Collaboration • Risk mitigation • Ethics
Thoughts on critical thinking skills	<ul style="list-style-type: none"> • Qualities 	<ul style="list-style-type: none"> • Information processing • Research
Teaching strategies	<ul style="list-style-type: none"> • Specifics 	<ul style="list-style-type: none"> • Curriculum • Lesson • Subject
Teachers responsibilities	<ul style="list-style-type: none"> • Motivational techniques 	<ul style="list-style-type: none"> • Goal alignment • Leadership style • Innovation
Critical thinking skills developed through teaching		<ul style="list-style-type: none"> • Interpersonal • Intra-personal • Process
Challenges of teaching	<ul style="list-style-type: none"> • School 	<ul style="list-style-type: none"> • Students • Lesson & curriculum • Resource • Teacher

5.1. Open coding

Professional responsibilities

The first category that emerged during analysis process was the participant's perception of the job responsibilities and challenges attached to medical professionals. These questions were supposed to bring up memories of what it was like when they went for practical training in healthcare settings. The questions also probed the reason why critical thinking skills is important for medical students

The participants offered significant data through their answers, comments and suggestions. The answers cited below provide the most significant quotes by the participants.

A: I think it's really important generally, but in terms of Healthcare practice, it's important if medical practitioners see something on a computer like vital signs of a patient, they have to do more findings about the patient health, which could be non-physiological, they don't have to only rely on the monitor's result from the medical test. If the monitor keeps insisting the patient is not medically alright, then the medical practitioner has to use his critical thinking skills to decide and assume there's something wrong with the monitor, if the patient really looks great and it has been confirmed that the patient is totally all right through other measures. Then, he has to make the right decision if his observations are different from the monitor's result.

Critical thinking skills is being recognized as an important aspect of clinical decision making. Monitors are man-made products and are prone to malfunctioning. Hence, it is the medical practitioner's duty to highlight faults from medical equipment's and devices. Also, it is the medical practitioner's duty to employ various method of health assessment before concluding.

B: It is important in healthcare, they have to think quickly when patients are in critical condition, to think of best option for patient without waiting for other people to help.

This participant's response highlights the critical nature of decision-making in healthcare, particularly in emergency situations. The emphasis on the importance of quick thinking underscores the necessity for healthcare professionals to be adept at making rapid and effective decisions to ensure the best outcomes for patients, especially in critical conditions. This perspective offers valuable insight into the demands and challenges faced by healthcare providers, shedding light on the complex decision-making processes involved in patient care.

C: Alertness to opportunities to use critical thinking is important, because we have to think about the patient's allergies and his wellbeing, so that the one pill we give the patient does not just cure the 1 symptom and does not harm the patient in the long run

This point underscores the crucial balance between addressing immediate symptoms and considering the broader impact on the patient's health. It's more than just a quick fix; it's about ensuring comprehensive care that prioritizes both short-term relief and long-term well-being.

C: In medicine you have to learn from mistakes because it is vital there. There are certain responsibilities and the failure can lead to trial and imprisonment at worst, in cases of bad measurements and bad diagnosis – and we are risking peoples 'lives

Indeed, the stakes in medicine are incredibly high, making the importance of learning from mistakes paramount. Not only does it impact individual lives, but it also involves legal and ethical responsibilities. This recognition underscores the gravity of the profession and the necessity of continuous improvement to ensure the best outcomes for patients.

Thoughts on critical thinking skills

Another category that was discussed with the participants was their definition of critical thinking skills and the sub-category was the qualities of a good critical thinker.

The participants offered significant data through their answers, comments and suggestions. The answers cited below provide the most significant quotes by the participants

A: I think critical thinking skills is like, when you have some information from many of sources, but you have to confirm if it's legit, it's something intellectual, from the "mind"

Critical thinking as a process of discerning the legitimacy of information from various sources was highlighted. It is an intellectual exercise, requiring careful analysis and evaluation to separate fact from fiction. This perspective mentions the cognitive aspect of critical thinking and its vital role in navigating the abundance of information encountered daily.

E: Critical thinking is the formation of personal opinion based on the opinion of others and research

Critical thinking as a process of synthesizing personal opinion with insights from others and research is insightful. This perspective emphasizes the collaborative aspect of critical

thinking, where individual perspectives are enriched by diverse viewpoints and empirical evidence. This approach not only fosters informed decision-making but also encourages open-mindedness.

C: He is communicative, intelligent, accept other opinions, experienced and be a problem solver, to go deeply into the problem.

This participant highlights effective communication, intelligence, open-mindedness, and problem-solving as important qualities of a good critical thinker,

Implementation of teaching strategies

This category was the participant's perception of implementing teaching strategies for the development of critical thinking skills in medical education. The questions probed their preferred teaching strategies, classroom instruction plans, and lesson objectives. The answers cited below provide the most significant quotes by the participants

B: I will try to get to the top of the pyramid of blooms taxonomy, because we don't remember for a long time, healthcare is very practical, so they need to create post & material for layman to understand healthcare concept

An enthusiastic feeling to develop higher order thinking skills in students. 'Remembering' as the foundational level of blooms taxonomy is not enough for medical students. The fact that healthcare is practical and the medical practitioners will be in contact with diverse patients, it is imperative that medical students needs to be taught up to the creative level. Moreover, the participant views developing these skills as part of teachers' responsibility.

C: I will implement case studies for critical thinking skills development in my classroom, I could ask my students to analyze a patient's health as a whole and do the diagnoses, and everyone in the class discusses the diagnosis - is it right or not? Which symptoms lead us to the diagnosis?

This participant sees the benefit of problem-based learning in form of case study as a means of developing critical thinking skills, and plans to implement it in future practice.

E: I think I'm going to implement reflective practice into my lesson, because it's important that we know what the students made out of the lesson, to ensure they are able to transform meaning on their own, and the lesson content wasn't wasted

An important aspect of reflective practice in the classroom is interpretation and self-regulation, through the student's conceptualization of the lesson content. Reflection yields deeper learning and understanding.

D: I think you can learn critical thinking in the whole life. Also, studying at the high school or college can improve the necessary critical thinking skills and I think I learned critical thinking skills at the college. I think my degree just help me refined it. Critical thinking is what you can learn even without the school in your life. So I don't think school is the most important place for critical thinking training. You can learn critical thinking at work or from experience in life.

Unlike others, this participant highlights experiential learning and work as a means of developing critical thinking skills, rather than school only.

A: I think we can teach it in some project Lessons. I don't think we have, the capacity to create an exact subject, but if we are going to teach this curriculum, An example is this - maybe have one lesson from Czech language, and one lesson from, for example, physics, and we connect these two lessons and have a project Lesson and we can develop the critical thinking skills of the students through this.

It should be integrated into existing curricula or subject, but it should have its own special time, not the whole academic year.

For example, in one year it could be 5 project hours and the students will do some exercises or tasks for critical thinking, because I think it's a good topic rather than a subject.

This participant foresees the possibility of teaching critical thinking skills in an interdisciplinary lesson, through projects, which is a form of problem-based learning. This implies solving problems with the knowledge of one subject in another subject context. This participant does not support critical thinking been an independent subject in the curriculum.

D: I think it should be implemented as a new subject. It will be better for this topic to have its own subject because not so many people are able to think critically and I think it will help with improvement of the necessary skills needed for critical thinking

In contradiction, this participant suggests the creation of a new subject solely for critical thinking skills in the curriculum.

Teacher's responsibilities

This category was focused on the role of teachers in the development of critical thinking skills. The motivation techniques were also discussed.

B: I can give them emotional and playful expressions like 'look, this patient is dying, do something about it, we don't want this patient to die! Something like that. Just to make it fun.

This participant approach to injecting emotional and playful expressions into urgent situations like a patient's critical condition is intriguing. It reflects a unique blend of empathy and creativity in communication style as a teacher.

C: Have an interesting environment – if you like kids, go to kids ward, other team likes ARO, they would go there – it is motivating to do what they like

Interest is a way of motivating students when trying to teach critical thinking skills. Interest is an intrinsic motivation that can be driven by the teacher's classroom climate and leadership style.

A: I don't really want to give them a bad condition, I don't really know if I should give them the chance to choose between a normal lessons or problem-based lesson, because I think it's not really good for them in the end if they choose normal lesson. And I would like to explain to them that if they are going to try it, they could know so many more information's if they feel it on their own and do it with their hands.

But how do I motivate them? I also wouldn't like to give them some extra grades. It's not a good motivation. I wouldn't like to give them the 'F' grade because they didn't raise their hand.

I would like to create a friendly classroom atmosphere. It will be better. They would feel good and if they make mistake, I'm definitely not going to shout at them. So "feel cool and let's try it"

This participant ponders how to motivate students without resorting to external rewards or punishments, indicating a desire for intrinsic motivation. Furthermore, the idea of offering extra grades as motivation was rejected, implying a belief in the importance of genuine engagement over external incentives. Instead, the participant plans to cultivate a friendly and supportive classroom environment, emphasizing the importance of students feeling comfortable and valued.

Critical thinking skills developed through teaching

This category was centered on questions that probed the relationship between PBL, critical thinking skills, and reflective practice

E: I think both group and single student problem solving is necessary. But I think the group is better because they solve the case together in groups by evaluating procedures and deciding which course of action would be the best

Problem-based learning can either be implemented in groups or personally. Team-working skills will be developed in group problem-solving. Furthermore, evaluation and decision making was identified as critical thinking skills.

B: I think Inference, because the information and knowledge they have gained from other subjects can be used in a real situation like anatomy, first aid, Pharmaceutic in one situational example. And they need to think about whole thing in a bigger picture.

Analysis too, because they need to analyze the situation before providing a final solution.

Verbal reasoning, problem solving and decision making, because when there's a problem, they need to Communicate what will they do, They need to analyze things, think and then make the decision. And when they make this decision, they are solving some problem.

This participant's insight into the multifaceted skills necessary for medical students is smart, considering the fact that medical students are soon-to-be medical practitioners. Indeed, inference allows them to draw upon diverse knowledge bases, while analysis ensures a comprehensive understanding of complex situations. Verbal reasoning, problem-solving, and decision-making are indispensable in the dynamic healthcare environment, where effective communication and timely action are crucial.

A: An important part of critical thinking skills in reflective practice is Self-regulation: to monitor one's own thoughts. Like what are their thoughts about the lesson, then they are going to verify it and say it loud, so it's important. Also analyzing the teaching process, what they have learned. Evaluation is also important. The most important is going to be self-regulation and Explanation, because they're going to be presenting it to me, as a teacher or the group.

This participant's emphasis on self-regulation as a cornerstone of critical thinking in reflective practice is insightful. Monitoring and articulating one's own thoughts not only fosters deeper understanding but also facilitates effective communication of ideas. Additionally, analyzing the teaching process and evaluating one's learning are essential components in honing critical thinking skills.

Challenges of teaching

D: The problem can be the student's motivation. And I think it will be the main problem. Maybe the students are individualized people, where everyone deals with problems differently and everyone is studying differently. Each student are different.

The participant highlights student's motivation and diversity as challenging factors of teaching critical thinking skills

B: I think there won't be enough time to do this in all classes

Thinking of the actual problem myself can be a challenge

Sometimes I may need some special equipment for this like the first aid, resuscitation model, Automatic external defibrillator for learning and the other things.

A: I think the students which not would like to participate is a challenge. Then, also time pressure because this type of teaching is really challenging and time consuming. And also for my preparation, it's going to be sometimes tough to create a real problem scenario that can be managed within the classroom. And helping the students to find the correct way.

Concerns about time constraints and resource availability in implementing hands-on learning experiences are valid considerations. Balancing the demands of various classes while ensuring adequate time for practical activities can indeed pose a challenge. Additionally, the need for specialized equipment like first aid and resuscitation models, as well as Automatic External Defibrillators (AEDs), underscores the importance of infrastructure support for effective learning and critical thinking skills development.

5.2. Axial coding

Axial coding is the second phase of the constant comparative analysis technique for analyzing qualitative data inductively for purposes of theory development (Scott & Medaugh, 2017). This is the next stage of continuous comparison and relationships. According to Strauss and Corbin (1998), the paradigmatic model contains the following elements: causal conditions, context, intervening conditions, action, and outcome. Teaching strategies was chosen as the central phenomenon and action. It is a key element which it is linked to all other categories and aligns directly with the research problem.

Causal conditions: These are the conditions that causes a certain action to occur. In this study, these conditions include the professional responsibilities of medical practitioners, not only the responsibilities, but the skills needed to perform these responsibilities, likewise the challenges faced while performing these responsibilities. The professional responsibilities and skills mentioned by the participants includes holistic medication approach, continuous monitoring, inquisitiveness and probabilistic skills amongst others. Also, some of the medical professional challenges mentioned includes patient's resistance to change, stress and emotional response, misinterpretation of patient's information, and lack of deep medical examination.

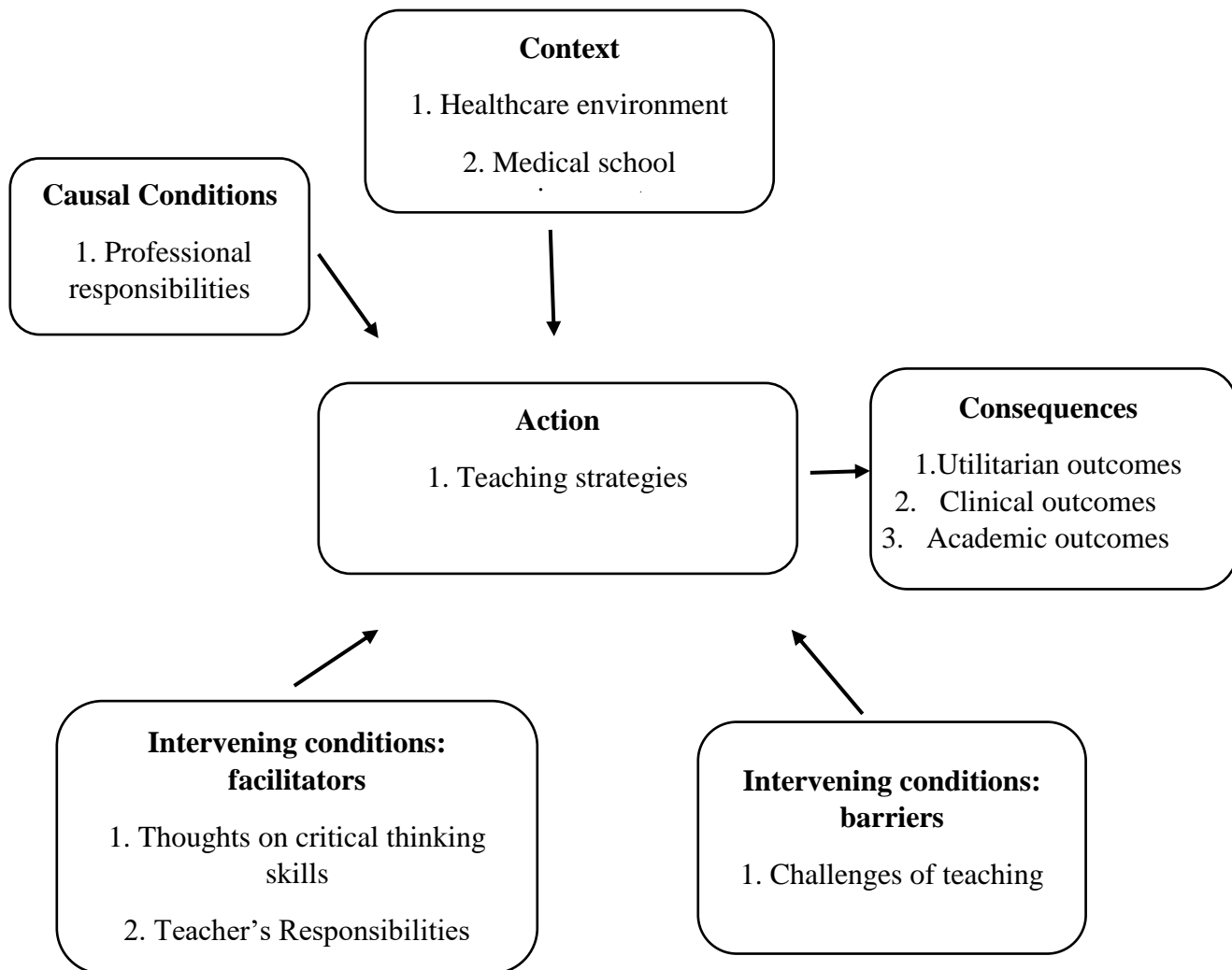
Context: The context is a set of condition where the actions are applicable. The context includes the healthcare and medical school environment. The medical school environment is where the critical thinking skills should be developed, while the healthcare environment is the future workplace of the graduates of medical school, where the critical thinking skills developed will be put into utilization.

Intervening conditions: These are broad and general influencing factors. Intervening conditions could be seen as facilitators of the action or barriers of the action. This aspect includes thoughts on critical thinking skills, responsibilities of teachers and challenges of teaching. Some of the responsibilities of teachers mentioned by the participants includes acting as facilitator and guardian rather than a lecturer, class discussion dynamics, leading students to independence, and technology enhanced learning.

Action: Action represents response to certain factors which interferes with it. This aspect is the teaching strategies involved in developing critical thinking skills. Some of the teaching strategies mentioned by the study participants includes reflective writing, oral reflection, case study, role-play, and interdisciplinary teaching strategy.

Consequences: These are the final stages and outcomes of the paradigmatic scheme. They are the results or products of the action. It includes the critical thinking skills developed in PBL and reflective practice, which is vital for the learner's personal, academic and professional life.

Figure 7: A paradigmatic model of axial coding



5.3. Selective Coding

This sub-chapter focuses on data analysis according to selective coding. In the process of grounded theory, selective coding precedes axial coding. In selective coding, information about the relationships between individual categories are searched and there is a review of the data and their individual codes. In the Straussian selective coding, core category is selected and related with other categories depending on the type of the relationships. In the process of selective coding, a main category was selected which searched for relationships with other categories. These were then verified and deepened. The central category was ‘critical thinking skills developed’. This category was chosen because it connects all categories. This central category serves as the basis of the theory.

The storyline

Phenomenon: The phenomenon was represented by ‘critical thinking skills developed’, with concepts of intra-personal, process, and interpersonal skills. Participant A expressed “*Critical thinking skills is really important for all medical students. I can't say that critical thinking is more important for some of them and not all of them*”. This indicate the universal relevance of critical thinking skills across the medical field. Critical thinking skills was highly highlighted by future medical teachers, and every other categories were connected to it. The critical thinking skills developed, as highlighted by all participants were self-correction, planning, interpretation, flexibility, inquisitiveness, interpretation, self-confidence to reason, open-mindedness, evaluation, verification, communication, problem-solving, independence, collaboration, creativity, and analysis.

...it's an important attitude because the healthcare sector is teamwork and there are so many perspectives (participant A).

... He is communicative, intelligent, experienced and a problem solver (participant C).

I think the important skill is open-mindedness because it helps to the deal with medical issue and problems...you just need creativity in thinking, to be able to deal with problems (participant D).

Critical thinking, one of the skills associated with thinking, is the evaluation of others’ ideas with no prejudices (Ibrahim et al., 2020). All participants believed that critical thinking is

necessary in problem solving and clinical decision making, due to their practical experiences in healthcare settings.

...they will find out that every person is different and what works for one person may not work for all. So they have to be creative when they don't have some ready-made information (participant E)

Causal condition: All participants noted the relationship between the job duties of medical practitioners and critical thinking skills. Furthermore, participants noted connections between their medical experiences and critical thinking skills, with emphasis on how these two aspects mutually influence each other.

...For example, I had an experience when I was undergoing my healthcare practice at the ambulance section, a patient came there saying 'I have no infection and I'm alright'. We transferred her to hospital and she was diagnosed with influenza type C, but she didn't tell us. Hence, medical professionals have to really pay attention even when the patient keeps insisting he's totally okay (participant A).

If the doctor-to-be does not have critical thinking skills, he will not make a good doctor.... there are healthcare responsibilities and the failure can lead to trial and imprisonment (participant C).

...nursing and medical job requires teamwork and you need to be able to work in teams (participant D).

Although, there are different kinds of medical practitioners with different roles, most of the interviewees have once performed their duties as nurses and paramedics in a healthcare settings. For them, there are certain duties attached to the medical profession, and critical thinking skills is required to diligently execute tasks in the medical field. Critical thinking involves intentional, higher-level thinking to define a client's problem, examine evidence-based practices, and make choices in care delivery (Alfaro-LeFevre, 2014). There are healthcare rules that should not be breached by medical professionals, as it could result to legal actions. Healthcare has to do with human life, all actions taken by medical practitioners has to be carefully selected and evaluated. One way to improve on the way in which decisions are made is to frame the decision in several ways (Halpern, 2014). During the process of decision-making, some participants noted that collaborative skill is required in healthcare.

They need to know how to communicate because communication is key to everything. During our practical training, we communicated every day with people from different cultures, from different social spheres. Students need to be able to communicate with different people. I think critical thinking skills are needed in

every industry, at every career level and good critical thinkers can work both independently and with others to solve difficult problems. And students need to be able to think critically (participant D).

Good communication is a major factor in delivering high quality in care (Lutz et al., 2016).

Looking ahead, employees in the future workplace must be able to think in a digitally responsible manner (Mueller 2022) so that they can operate with client's data and digital technologies while consciously keeping ethical aspects in mind.

Contexts: Classroom lesson, medical school curriculum, and healthcare environment were mostly the contexts mentioned by all participants. Curriculum refers more in depth to the knowledge and skills management the learners are expected to master upon graduation (Majerník et al., 2021). In addition, all participants noted a connection between critical thinking skills, medical school curriculum, and healthcare environment. Critical thinking and problem-solving skills are becoming more and more necessary in the increasingly complex healthcare system (Singh, & Butola, 2024).

Critical thinking skills is important in healthcare...it is necessary to identify critical thinking skills as a problem to be addressed in the medical curriculum...all medical students needs a curriculum that fosters critical thinking skills, because doctors are not always with the patients, but nurses and paramedical staffs (participant B).

It's necessary to be in the curriculum because they are likely to be faced by different medical challenges or situations where they'll need to decide on what to do (participant E).

The participants emphasized the importance of critical thinking skills in healthcare, highlighting it's essence to all medical professionals in order to make informed decisions, especially in situations where physicians may not be directly present with the patients. Clinical decision making, or clinical reasoning, has been described as being a foundation of effective clinical education (Dent & Harden, 2009) and is a significant aspect of physician competence (Norman, 2005). The integration of critical thinking skills into the medical school curriculum was stated by most of the participants. Having recognized the evolving challenges and complexities within the healthcare system, this study participants suggested that such skills should be explicitly addressed as part of medical education.

Intervening conditions: There were other factors that led to the development of critical thinking skills. Based on the perception of some of the participants, critical thinking skills was developed through lifelong learning, workplace, and experiential learning.

... You can learn critical thinking in the whole life... you can learn critical thinking at work or from experience in life (participant D).

... They can learn from various situations, even from my own practice and experience as a teacher– I can tell them what I missed as a medical student in training (participant C).

In a study conducted by Adi & Lestari (2022), experiential learning can improve students' critical thinking because the learning model meets all the criteria of the learning model that can be used to improve students' critical thinking skills. Critical thinking enables employees to think, observe and analyse situations and also the consequences and then proceed to draw a steadfast conclusion necessary for effective communication (Tripathy, 2020). Workplaces are complex places where different kinds of people come together to work towards achieving the same goal. They might be from different backgrounds, cultures, or have different experiences. They talk to each other to make the company successful and meet the needs of the business world. Communication between different people and departments is really important for the workplace to run smoothly.

Action: Most participants believed it's their responsibility to teach critical thinking skills to their medical students. Medical education must foster the skills and attitudes essential to lifelong learning and continuous professional development with curricula that are increasingly learner-driven, time-variable, and competency-based (Parsons, et al, 2021). The participants had the knowledge of critical thinking skills and were aware of the facts that these skills are trainable.

...Medical students need to be taught how to analyze, evaluate, & create, even though it seems difficult, but it is needed. Give them the opportunity for higher order thinking skills. Teachers should give students opportunity to make decisions in their own space, so they learn more. Teachers should not yell at them, so they don't get demotivated (participant B)

Participant B emphasized the importance of teaching medical students how to analyze, evaluate, and create, even though it may appear challenging. This statement aligns with existing research, which highlights the crucial role of critical thinking skills in medical education. According to Misrom et al. (2020) and Purnami et al. (2021), critical thinking skills are necessary to fulfil skills

at analyzing, evaluating, and creating. The society requires a shift towards a more student-centered approach to education, where learners are actively engaged in problem-solving and decision-making processes. Widana et al. (2018) reported that using HOTS-based questions can help teachers improve students' critical thinking skills. By creating an environment that fosters autonomy and encourages independent thinking, educators can better prepare medical students for the challenges they will face in their careers. Furthermore, teaching strategies that developed critical thinking skills were mentioned by the participants. Forms of PBL mentioned by the participants were simulations, roleplay, interdisciplinary teaching strategy, project-based lessons, individual and team-based problem solving, case study, gamification, and the incorporation of AI models.

The teaching strategy includes the use of games. As a future teacher, I can create games with healthcare information (participant B)

There should be more case studies and practical classes (participant C)

The idea behind problem-based learning is that students will learn better if they were engaged in real-life problem solving (Halpern, 2014). Problem based learning is not just about learning better, but also developing the 21st century skills.

In my perspective, Problem solving is going to really improve in problem based learning, also thinking as hypothesis testing, when they have two options, they can choose one, then think like - if the outcome doesn't seem right, let's choose the 2nd method to solve it. Decision making is also achieved (participant A)

Ibrahim et al. (2020), reported a study with aim to assess the relationship between critical thinking dispositions and problem solving abilities among nursing students, the study conclude that there were statistically significant positive correlation between total critical thinking dispositions and total problem solving abilities among nursing students.

Gogus et al. (2020), conducted a study to investigate the relationship between critical thinking skills and the reflective thinking skills toward problem-solving; the study concludes that there were Positive correlations between reflective thinking and critical thinking skills.

An important part of critical thinking skills in reflective practice is Self-regulation: to monitor one's own thoughts. Like what are their thoughts about the lesson, then they will verify it and say it loud. Also analyzing the teaching process, what they have learned (participant A).

Based on the principles of self-directed learning, reflective practice motivates students to do self-assessment, improves critical thinking skills, encourages professionalism, and even communication skills (Sandars, 2009). Reflective practice offers opportunities for students to analyze and evaluate learning processes. College education should support students' thinking skills to develop the habit of organized thinking and of rational analysis, the ability to distinguish the important concepts, and grasp the knowledge of organized solutions to perform better in any job (Gogus 2015; Harris, 2010; Williams, Zdravkovich, & Engleberg 2002).

Aside from the critical thinking skills developed in reflective practice, the benefits of reflective practice in learning process was also highlighted by the participants. It includes the provision of learning feedback, increased focus and concentration on teaching and learning, understanding through revision, peer learning, independence and knowledge transformation.

Consequences: Participants stated relationship between teaching strategies, critical thinking skills developed, and overcoming the challenges of medical profession. Higher order thinking has become one of the essential features for tomorrow's doctors for maintaining clinical competence and medical professionalism (Trowbridge, Joseph, & Durning, 2015; Victor-Chmil, 2013). Higher order thinking skills are included in critical thinking skills necessary for the 21st century, all participants stated the importance of critical thinking skills in medical students as a tool needed to overcome the challenges of their future medical profession.

... is to make medical students better professionals that can evaluate their own thoughts and learn more than they were taught in the classroom (participant B)

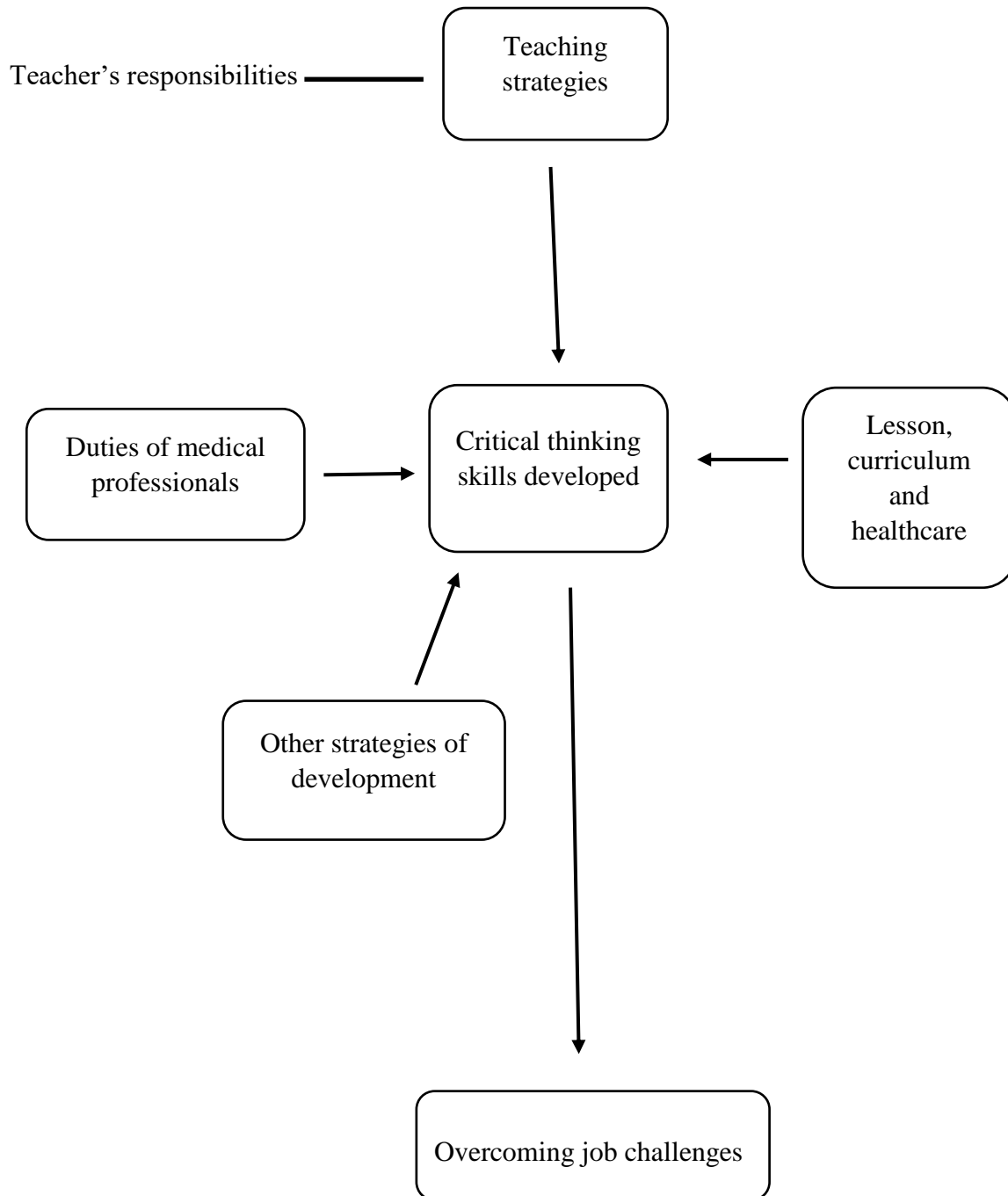
...the doctor has to evaluate the diagnosis as a whole – it is not just one problem, but a complex diagnosis with the patient in mind... (participant C)

Medical professionals are expected to be lifelong learners while practicing their profession. Critical thinking skills from reflection is crucial in the course of being a medical lifelong learner. Reflective practice can help physicians to choose difficult or ethical decisions when encountering complicated cases in clinical practice (Bryan & Babelay, 2009). This capacity is an important ability that lets the physicians be mindful, interested, aware, and prepared to identify and correct faults (Epstein & Hundert, 2002), therefore fostering reflection improves professionalism, which is a core competency in medicine (Sandars, 2009; Wald et al., 2012).

...we do not want the students to only memorise the skills, but we want them to utilize it in everyday life and work (participant C)

Incorporating hands-on, patient-focused research early in the medical school curriculum provides a valuable educational experience for students (Stacpoole et al., 2001). Development and utilization of these skills are vital in both personal and professional life. The clinical outcomes of the critical thinking skills developed, according to the participants of this study were necessary in consultation with patients, and includes improved future clinical problem-solving, and questioning information sources when in doubt.

Figure 8: A paradigmatic model of selective coding



6. Discussion of Research Findings

This chapter discusses the results of the research investigation and consequently answered the research questions.

Research questions

1. *What do future teachers understand by critical thinking skills?*

The answers given by the respondents cannot be generalized. Each of the participant, gave a new thought on critical thinking skills, perceives the importance of critical thinking skills differently. Some participant stated that critical thinking skills is the sorting, verification and evaluation of information and its sources, in order to make a decision. This definition aligns with Soltani et al. (2021) conceptualization of critical thinking as a process that consists of collecting appropriate information, precisely evaluating the information, and using it to come to a considered conclusion. However, other participants stated that critical thinking skills is the formation of personal opinion based on the opinion of others and research. This is similar to Lee et al. (2021) findings that “engaging students in research activities helps develop critical thinking and analytical skills”. Furthermore, all participants stated that open-mindedness, flexibility, inquisitiveness, problem-solving and creativity are important aspects of critical thinking skills. However, Facione (2011) highlighted inquisitiveness, flexibility and open-mindedness as critical thinking dispositions. This is also in accordance with the dimensions of critical thinking skills by Halpern (2014), problem-solving and creative thinking are important parts of critical thinking skills.

2. *How does Problem-based learning and Reflective practice resonate with the development of critical thinking skills in medical students?*

All participant’s reported problem-solving as a critical thinking skill to be developed in problem-based learning. An important dimension of critical thinking is problem solving (Tapper, 2014). Aside from problem-solving, some participants reported self-regulation, decision making, explanation, inference, analysis, verbal reasoning, interpretation, and evaluation as critical thinking skill developed in problem-based learning. The Guided PBL approach tested by Nargundkar et al. (2014), was found to be more effective for a required class than the traditional

lecture approach, improving both overall learning as well as CT ability. Problem-based learning (PBL), an instructional method, enhances interaction and critical thinking among learners by utilizing structured problems closely linked to a specific subject and emphasizing a student-centered approach. Typically, these problems are presented in a structured or complex format, as they lack a single solution and encourages exploration.

Some participant's suggested the implementation of problem-based learning in form of interdisciplinary learning, in order to develop critical thinking skills. Integration enhances interdisciplinary collaboration and prepares students for the evolving healthcare landscape (Ahmed et al., 2024). By integrating medical courses with other disciplines, such as medical engineering, students gain a broader perspective and are better prepared to work in interdisciplinary teams (Lee et al., 2021).

In addition to PBL as a tool for developing critical thinking skills, most participants reported self-regulation as a critical thinking skill developed in reflective practice. Reflection means a process in a person's thoughts that is related to experience and can be decomposed and interpreted to make awareness (Daryazadeh et al., 2020). Some participants reported analysis, evaluation, inference, explanation, verbal reasoning, thinking as hypothesis testing, and problem-solving as critical thinking skills developed in reflective practice. The critical thinking skills developed in reflective practice are similar to the categorization of critical thinking skills by Facione (2011) and Halpern (2014). Assessing reflection can increase learning, and medical teachers can analyze "problem-solving" and clinical "decision-making" process of learners too (Daryazadeh et al., 2020). The present study's outcomes align with those of the investigation conducted by Bryan & Babelay, (2009), as reflective practice can help physicians to choose difficult or ethical decisions when encountering complicated cases in clinical practice. Consequently, reflection on past experiences and activities can increase learning and performance.

3. What challenges do future medical teachers foresee in implementing these teaching strategies?

Most of the participants stated student's motivation, the unwillingness to participate in problem-based activities as a challenge. Successful learning is directly proportional to the learner

passion (Beg, 2021). Likewise, some participants stated student diversity within the classroom as a challenge of implementing critical thinking skills through PBL, as student responds to problems differently. Another discouraging experience is a group that is faced with some group members who do not prepare for the meeting and let others do the work in the group, which might lead to less involvement from those students who were motivated initially (Dolmans et al, 2005). Motivation fluctuates and it is actually a challenge for teachers to keep learner's motivation high all the time. Similarly, Taylor and Miflin (2008) indicated in their review of PBL implementations that it was a challenge to maintain students' interest in pursuing and engaging in the necessary cognitive processes such as generating learning issues. Some of the participants stated that problem-based learning is time consuming while other participants perceived difficulty in the creation of medical problems that could be carried out within the classroom. PBL facilitators have to model problem solving and reasoning processes and guide students' learning processes, which demands a great amount of time and preparation (Hung, 2011). Moreover, some participant mentioned the unavailability of medical equipment for the purpose of classroom instruction.

In implementing reflective practice, some participants reported motivation and reluctance to respond to reflective questions as a challenge. The reluctance may be due to the fear of showing vulnerability (Mhurchú & Cantillon, 2023). Students are likely to be demotivated in terms of expressing their personal thought about an experience. Some participants stated the creation of reflective exercise as a problem from the teacher's end, alongside the limitation in teacher's knowledge to respond appropriately to student's reflections. The pre-service teachers in Jusoh's study (2013) mentioned a long list of problems that they experienced during the teaching practicum, such as their inability to apply the theory learned into practice and lack of professional support. While academic grades may sound like a motivation, some participants refused to attach grades to student's participation, because students may just want to get good grades. In a study conducted by Abdulazeez & Ali (2021), a participant (T7) response was "Critical thinking skills are inapplicable teaching techniques in our classes due to unsuccessful assessment tools and grading patterns. The development of appropriate assessment tools, measuring complex learning outcomes, capturing the long-term impact, and defining meaningful metrics for success, are definite genuine challenges (Ahmed et al., 2024). Some participants of this study perceived reflective practice as a time-consuming teaching strategy.

This findings are similar to the investigations conducted by (Van et al, 2020; Siddaiah-Subramanya et al, 2017; Oliveira et al, 2014), in which it was observed that limited resources, including funding, infrastructure, and faculty time, pose significant challenges in integrating research and teaching in medical education. The main target of qualified nursing education is to graduate nurses that could unite theory and practice, think critically in learning process, has effective problem-solving skills, and take correct clinical decisions (Shin et al., 2015).

7. Summary, Conclusions and Recommendations

This chapter summarizes the aim, procedure and result of this study, with suggestions for future research and pedagogical practice.

7.1. Summary

The purpose of this study was to generate a theory with explanatory power on how future teachers perceives the development of critical thinking skills through teaching strategies in medical education. Reflective practice and problem-based learning was explained and explored, in relation to the development of critical thinking skills. The study made use of qualitative research methodology. Furthermore, Grounded theory was used as its research design. A purposive and convenience non-random sampling strategy was adopted for this study because the participants were selected based on specific criteria relevant to the research questions and objectives. The specific criteria included academic program and year of study. The sample of the study consisted of five (n=5) selected post-graduate students of teaching professional subjects for medical school, at Palacky University. A self-developed semi structured interview was used as an instrument for data collection, alongside an inspiration from Q methodology. Open coding, axial coding and selective coding was used to analyze the data, as the study employed grounded theory as a strong inductive method for discovering new theories.

Findings from the study indicated that:

- 1.** Critical thinking skills is the sorting, verification and evaluation of information and its sources, in order to make a decision. In addition, critical thinking skills is the formation of personal opinion based on the opinion of others and research. Open-mindedness, flexibility, inquisitiveness, problem-solving and creativity are important aspects of critical thinking skills.
- 2.** Problem-solving, self-regulation, decision making, explanation, inference, analysis, verbal reasoning, interpretation, and evaluation were the core critical thinking skills developed in problem-based learning. Consequently, self-regulation, analysis, evaluation, inference, explanation, verbal reasoning, thinking as hypothesis testing, and problem-solving were the core critical thinking skills developed in reflective practice.

3. Student's motivation, student diversity, time consumption, creation of medical problems that could be carried out within the classroom, and the unavailability of medical equipment for the purpose of classroom instruction, were the challenges future teachers foresee in implementing problem-based learning. Additionally, creation of reflective exercise, limitation in teacher's knowledge to respond appropriately to student's reflections, assessment tools and grading patterns, time-consumption and students motivation were the challenges future teachers foresee in implementing reflective practice as a teaching strategy.

7.2. Conclusion

Although, there are different kinds of medical practitioners with different roles, most of those interviewed have once performed their duties as nurses and paramedics in a healthcare settings. For them, there are common challenges faced by those in the medical field, alongside pinpointing essential skill-sets crucial for the execution of medical job responsibilities. The participants have the knowledge of critical thinking skills and are aware of the facts that these skills are trainable in formal education settings. However, some participants perceived the development of critical thinking skills through lifelong learning, workplace, and experiential learning. Moreover, the participants explained the teaching strategies that could be used for the development of these skills. This is an important step in the development, for it enabled them to challenge their teaching skills and take control of certain aspects of their student's lives. Looking back now as future teachers, they can say that their academic and professional experience demonstrated their ability to make choices, solve problems and take measures to reduce risks. However, the participants foresees challenges in implementing these teaching strategies. These challenges arouse from students, teachers, resources, lessons and curriculum. Nevertheless, these challenges could be minimized through the teacher's responsibilities and motivational strategies. Based on the findings, it was concluded that critical thinking skills was developed through teaching strategies, specifically reflective practice and problem-based learning.

7.3. Recommendations

Based on the conclusion and findings of this study, the recommendations are as follows:

1. **Integration of Reflective Practice and Problem-Based Learning:** Encourage the integration of reflective practice and problem-based learning into medical education curricula. Problems from a specific subject can also be integrated into another subject, thereby testing the students' knowledge, interpretation skill, analysis skill, and other dimensions of critical thinking skills. Integration enhances interdisciplinary collaboration and prepares students for the evolving healthcare landscape (Ahmed, Taha, & Khayal, 2024). By integrating medical courses with other disciplines, such as medical engineering, students gain a broader perspective and are better prepared to work in interdisciplinary teams (Lee, et al., 2021). Medical curriculum should be reviewed with the incorporation of reflective practice and PBL at the educational strategy phase, and should be followed-up with implementation phase.
2. **Resources:** Allocate resources to address challenges related to student motivation, diversity, time constraints, and the availability of medical equipment. In a recent study conducted by Bhadoria, et al (2024), potential suggestions included providing motivational sessions to boost students' interest in research. This may involve investing in appropriate classroom resources, creating a supportive learning environment. Provide faculty members with support to effectively implement these teaching strategies. This may include providing additional support for creating reflective and PBL exercises, improving assessment tools and grading patterns.
3. **Continuous Professional Development:** Implement teacher training programs focused on enhancing awareness and understanding of critical thinking skills. To be successful, students enrolled in a problem-based curriculum need a knowledgeable tutor who can help them when they get stuck on a problem and assess their knowledge as they move through the problem to ensure that they are making adequate progress towards the knowledge and skills they will need (Halpern, 2014). Hence, lifelong learning and continuous professional development should be promoted among teachers to enhance their ability to facilitate the development of critical thinking skills in students. This may

involve providing opportunities for teachers to engage in reflective practice, participate in workshops or seminars, and collaborate with colleagues to share best practices.

4. **Research and Evaluation:** Encourage further research and evaluation of teaching strategies aimed at developing critical thinking skills in medical education. This may involve conducting longitudinal studies to assess the long-term impact of reflective practice and problem-based learning on students' critical thinking abilities. Wright and Mynett (2019) assessed their medical school curriculum context and concluded that the evaluation was useful in enabling them to visualise the strengths and opportunities for improvement in terms of teaching resilience and resourcefulness they focused on. Evaluation is a process that involves gathering feedback from students, other educators, and stakeholders. Even if the curriculum is well designed, approved by statutory authorities and successfully implemented into educational practice, it has to be regularly re-evaluated (Majerník et al., 2021).

In addition, the findings of this study will be useful in educational psychology, which is a branch of psychology that studies how people learn. Hence, placing the medical students at the center of learning and discovering the student's outcomes.

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List of Abbreviations

PBL- problem-based learning

HOTs- Higher order thinking skills

LOTs – Low order thinking skills

CT – Critical thinking skills

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