

# The Impact of Questions Raised In the Development of Critical Thinking Skills Among Students

Ahmed Hussein Ahmed

Teacher In Al Russafi Secondary School, Al Diywania Iraq

## Abstract

*Critical thinking happens at whatever point you judge, choose or tackle a problem. As a rule, critical thinking happens when you should make sense of what to accept or what to do, and do as such in a sensible and intelligent way. Critical thinking is imperative since it empowers us to analyze, evaluate, explain and restructure our thinking, in this manner diminishing the danger of embracing, following up on or thinking with a false conviction. The way to seeing the centrality of critical thinking in the classroom lies in understanding the noteworthiness of critical thinking in learning. Critical thinking is regularly a coveted competency for alumni of a technology program. Organizational individuals have expressed worry about students' powerlessness to think critically. Albeit conventional educational strategies, for example, addresses and examinations, focus on knowledge acquisition, discusses in the technology classroom can viably encourage critical thinking.*

*The reason for this examination was to assemble through polls the impression of technology students on the verbal confrontation process utilized as a part of the classroom to increment critical thinking. In general, the students trusted that the verbal confrontation process was a helpful learning movement. The aftereffects of the poll uncovered that students trusted that the level headed discussions helped them comprehend the subject better, learn new knowledge, and pick up a comprehension of the civil argument process. What's more, students believed that the verbal confrontations expanded their critical thinking abilities. The investigation likewise discovered that there was no centrality sexual orientation contrast in Mathematics*

*performance test . Critical Thinking Skills was likewise a compelling methods for improving students' comprehension of Mathematics ideas. It in this way prescribed in showing Mathematics in auxiliary schools, Critical thinking aptitudes ought to be inject in the educational modules of educators instruction to enhance students' performance in Mathematics.*

*Key words: Critical Thinking, Critical Thinking skill, Gender and Mathematics.*

## Introduction

These days, the advancement of instructing approaches in Mathematics Education has been changed. Changing from the repetition learning, remembrance and other conventional techniques in educating, right now students are required to be more engaged with the instructing and learning forms and also graduate enhanced and prepared to be effective in the present worldwide economy. So as to accomplish this thought, students must take in the fundamental abilities, for example problem understanding and coordinated effort aptitudes inside their setting of center course knowledge, for example, material science. This worry turns into the fundamental concentration in the system for 21st century learning. This structure builds up a few aptitudes, for example, learning and development abilities, data, media, and technology aptitudes, and life and profession aptitudes that must be aced by students to be effective in work and life.

The craft of computation is as old as man and Critical Thinking has been one of the instruments utilized as a part of our day by day life's to manage the difficulties for



survival. On an everyday bases individuals were confronted with choices that require thinking, understanding, translating, breaking down and assessing data before them. This procedure includes Critical Thinking since it would empower one to take dependable and legitimate choices, act morally, and have the capacity to adjust to changes in any given condition. Critical Thinking is a mind boggling idea that includes subjective aptitudes and full of feeling attitudes, and this has influenced the way a few educators give the idea to the students. It additionally creates the impression that a few instructors think that its hard to inject the idea into their instructing with the goal that students can learn what to think as well as how to think critically, in this way students think that its hard to appreciate the idea and perform underneath normal in arithmetic test and examinations.

Critical Thinking requires one's push to gather, translate, analyze and evaluate data with the end goal of touching base at a solid and legitimate conclusion. In showing Mathematics in schools, Critical Thinking should be coordinated and underlined in the educational programs with the goal that students can take in the aptitudes and apply it to enhance their performance and thinking capacity. In this unique circumstance, if instructors should implant Critical Thinking Skills to show Mathematics in their classrooms, at that point educator training project ought to likewise assign more courses for Critical Thinking with the goal that imminent educators would progress toward becoming models of thinking procedures who thusly will make the subject less demanding for the students. Critical Thinking may likewise include legitimate thinking and capacity to isolate realities from sentiment, look at data critically with confirm before tolerating or dismissing thoughts and inquiries in connection to the current issue.

As such, it makes people to think, question issues, challenge thoughts, create answers for problems and take savvy choices when confronted with challenges. Critical Thinking likewise includes profound thinking and a thought of what we got instead of a straightforward acknowledgment of various thoughts (Mansoor, and Pezeshki , 2012). This implies thoughts and recommendations from individuals about a marvel can't be completely acknowledged on the off chance that it doesn't experience the efficient and coherent procedure of finding reality, In applying Critical Thinking in school settings, it is important to create thinking abilities since individuals who figure Critical would have the capacity to comprehend the sensible associations between thoughts, develop and evaluate contentions, distinguish regular oversights in thinking and taking care of problems methodically. Facione (2001) (1) recognized six psychological abilities as integral to the idea of Critical Thinking.

These were: Interpretation, Analysis, Explanation, Evaluation, Self-direction and Inference. Critical Thinking Skills in this way, are abilities that empower one to analyze and combine data to take care of problems in wide scope of regions (Facione, 1990). In guaranteeing sound contentions, certainties will be gathered, analyzed , evaluated and conclusion will be taken in view of accessible actualities previously them.

Critical Thinking showing procedures is a dynamic procedure in advancing and improving students performance in schools. Tuning in to addresses in the classroom, to most students is a latent movement since students just tuning in and won't have the chance to makes inquiries when the addresses is going and this influences the class to dull. The scholarly abilities of Critical Thinking- - investigation, blend,

reflection, and so on. - - must be learned by really performing them. Schafersman (1991) suggests the accompanying Critical Thinking procedures and classroom systems to class teachers.

Classroom guideline, homework, research papers, and examinations. In this way, the educator ought to underscore students' dynamic scholarly in instructing Mathematics. Arithmetic as a critical subject in present day society is valuable in schools, working environments, organizations and for individual basic leadership. Science apparently is a dialect for ordinary utilize whether in the commercial center, schools or even at home. Science is essential to national thriving in giving apparatuses to understanding Mathematics, Engineering, Technology and Economics.

Critical Thinking abilities by Ennis (1989) Ennis characterizes CT as "sensible intelligent thinking concentrated on choosing what to accept or do." In light of this definition, he builds up a CT scientific categorization that identifies with aptitudes that incorporates the scholarly perspective as well as the behavioral viewpoint too. Likewise, Ennis' scientific categorization incorporates aptitudes, miens and capacities. The subtle elements of this arrangement take after: Dispositions towards CT – A characterized scan for a proposal, inquiries and clarifications, being adequately educated, utilizing solid sources, considering the general circumstance, being applicable to the principle issue, searching for choices, genuinely considering other people groups' perspective, the suspension of judgment, standing firm, taking a stab at exactness, managing the segments of an issue in an organized manner, and affectability. Capacities in CT – concentrating on the inquiry, investigating contentions, bringing up issues, assessing the source's unwavering quality, reasoning,

enlistment, esteem judgments, idea definition, supposition distinguishing proof, taking activities, and interfacing with others. Ennis claims that CT is an intelligent (by critically thinking, one's own particular thinking action is analyzed) and down to earth action going for a direct activity or conviction. There are five key ideas and qualities characterizing CT as indicated by Ennis: commonsense, intelligent, direct, conviction and activity.

The Infusion approach (Swartz, 1992) There are two primary ways to deal with encouraging CT: the general skills approach which is characterized by planning unique courses for instructing CT skills, and the infusion approach which is characterized by giving these skills through educating the set learning material. As per Swartz, the Infusion approach goes for particular instruction of unique CT skills over the span of various subjects. As indicated by this approach there is a need to reprocess the set material keeping in mind the end goal to join it with thinking skills. This report is a depiction of an underlying investigation, a preview that concentrated on one session and shows the whole examination. In this report, we will indicate how the scientific substance of "likelihood in day by day life" was consolidated with CT skills from Ennis' taxonomy, reprocessed the educational programs, tried distinctive learning units and evaluated the subjects' CT skills. Also, one of the general research reasons for existing is to look at the effect of the Infusion approach on the improvement of critical thinking skills through likelihood sessions. The far reaching research reason will be to look at the effect of learning by the Infusion approach utilizing the Cornell examiners (a quantitative test) and quantitative means.

### **The importance and role of students' questions**



Most importantly, inquiries from students demonstrate that they have been thinking about the thoughts exhibited and have been attempting to connect them with different things they know. The wellspring of students' inquiries is a crevice or inconsistency in the students' knowledge or a want to expand their knowledge in some direction. The inquiries may come from interest about our general surroundings and in addition occasions and interactions with genuine issues. Students' inquiries might be activated by obscure words or irregularities between the students' knowledge and the new data, which at that point cause psychological discord (Festinger, 1957) or 'epistemic interest' (Berlyne, 1954). The estimation of students' inquiries has been accentuated by a few creators. Inquiries raised by students activate their earlier knowledge, center their learning endeavors, and enable them to expand on their knowledge (Schmidt, 1993). According to Rosenshine, Meister and Chapman said that the act of 'forming inquiries' concentrates the consideration of students on content, fundamental thoughts, and checking if content is comprehended.

The capacity to pose great thinking inquiries is likewise a vital segment of logical proficiency, where the objective of making people critical buyers of logical knowledge (Millar and Osborne, 1998) requires such an office. For students, offering their own conversation starters is an initial move towards filling their knowledge holes and settling puzzlement. The way toward making inquiries enables them to explain their present comprehension of a point, to make connections with different thoughts, and furthermore to wind up noticeably mindful of what they do or don't have a clue. In such manner, understudy produced questions are additionally an imperative aspect of both self-and companion appraisal.

The aptitude of addressing is additionally essential in problem-illuminating and basic leadership (Pizzini and Shepardson, 1991; Zoller, 1987). Moreover, it can possibly encourage productive thinking in students. (e.g. Gallas, 1995), improve innovativeness and higher request thinking (Shodell, 1995), and is additionally a logical propensity for mind.

The capacity to create intriguing, productive thoughts and answers is reliant on having the capacity to first think of good inquiries (Shodell, 1995). To be sure, as Graesser and Olde (2003) have commented, 'a fantastic litmus trial of profound appreciation is the nature of inquiries asked when [one is] defied with breakdown situations'. While students' inquiries serve valuable functions for students, they are likewise useful to instructors in provoking reflective idea and understudy engagement. In this manner, we look at the part of students' inquiries by recognizing the utilization of these inquiries in learning arithmetic and in instructing science. To start with, we consider how students' inquiries can profit students. Following this, we talk about the part of students' inquiries in instructing arithmetic.

### **Statement of the Problem**

The conventional method for showing Mathematics in some open optional schools are educator focus approach. This strategy in some cases includes reiteration and retention of already showed material by filling the students' psyches with knowledge of Mathematics without explaining in detail the way toward investigating, assessing and landing at a conclusion. Furthermore, these procedures may not make the students to be critical in thinking since some of them may think that its hard to apply the knowledge gained to tackle scientific problems in another circumstance. Critical Thinking Skills has been embraced in one of the country's instructive objectives to make students innovative. Notwithstanding, it has not been completely consolidated and given



wide acknowledgment as one of the real ideas in the school educational programs. Here explained that the disappointment rate in Mathematics may be ascribed among different motivations to absence of deciphering, explaining, breaking down and assessing arithmetic inquiries. In this way the examination mean to research the impact of Critical Thinking on Academic performance in Mathematics.

### **Theoretical framework**

Cognitive-field theory expresses that learning procedure includes steady association, restructuring, and association of boosts components into an important entire or example coming about because of many interacting impacts in the earth of the student. In this manner, we should see gaining from the perspective of problem unraveling. Wertheimer (1959) (1) hypothesizes that knowledge is gathered into components as indicated by the accompanying standards: closeness, comparability/separation, conclusion and straightforwardness. These standards are known as the laws of association and are utilized as a part of the setting of explaining discernment and problem-understanding. This theory would be helpful to this investigation in light of the fact that effective learning of Mathematics would be accomplished because of students' recognition or study of the problem through the cognitive procedures.

Infusion theory expressed that conventional educational programs material ought to be restructured to incorporate instructing for thinking into subject range with the goal that students would know about the skills, comprehend it, practice and apply it in other setting. As it were, if the instructing of thinking is unequivocal in subject range it would greatly affect the students' performance. Swartzts and Perkins (1994) (1) recognized different fixings in Infusion Theory as unwavering quality, causal

clarification, contention examination and the utilization of proof for inductions. This theory is applicable to this examination since it influences the students to comprehend and take in the substance and subject better, decipher significance of ideas, comprehend coherent structure, detect deceptive contentions and enhance scholastic performance in Mathematics.

### **Literature Review**

As indicated by Gokhale, Anuradha A. the idea of communitarian taking in, the gathering and blending of students with the end goal of accomplishing a scholarly objective, has been broadly researched and pushed all through the expert writing. The expression "community learning" alludes to an instruction technique in which students at different performance levels cooperate in little gatherings toward a shared objective. The students are in charge of each other's learning and in addition their own. Along these lines, the accomplishment of one understudy causes different students to be fruitful.

Advocates of collective learning claim that the active trade of thoughts inside little gatherings builds enthusiasm among the members as well as advances critical thinking. As indicated by Johnson and Johnson (1986) , there is convincing confirmation that agreeable groups accomplish at larger amounts of thought and hold data longer than students who work discreetly as people. The common learning gives students a chance to take part in exchange, assume liability for their own particular learning, and in this manner end up plainly critical masterminds.

In spite of these advantages, most of the research studies on collaborative learning



have been done at the primary and secondary levels. As yet, there is little empirical evidence on its effectiveness at the college level. However, the need for noncompetitive, collaborative group work is emphasized in much of the higher education literature. Also, majority of the research in collaborative learning has been done in non-technical disciplines.

Regardless of these points of interest, the greater part of the research considers on community oriented learning have been done at the essential and optional levels. So far, there is minimal exact proof on its effectiveness at the school level. In any case, the requirement for noncompetitive, community oriented gathering work is stressed in a significant part of the advanced education writing. Additionally, lion's share of the research in collaborative learning has been done in non-technical controls.

As indicated by Gay, Geneva, and Kipchoge Kirkland. In this article, the writers contend that creating individual and expert critical cognizance about racial, social, and ethnic assorted variety ought to be a noteworthy part of pre-service instructor training. They examine a few moves educator training students use to abstain from drawing in with racial issues in instruction, and recommend a few methodologies for counteracting them. The resistance procedures incorporate quiet, preoccupation, blame, and big-hearted radicalism. Procedures to balance these and create critical social awareness and self-reflection incorporate making learning expectations of criticalness, demonstrating, giving chances to practice critical cognizance, and making an interpretation of reasonable multicultural training into K-12

instructional conceivable outcomes. Woven all through the particular proposals is the general directive that critical awareness learning encounters should happen inside the setting of guided practice, legitimate cases, and reasonable circumstances.

Concurring Facione, Peter A to Using a subjective research system, known as the Delphi Method, an interactive board of specialists was met to progress in the direction of an agreement on the part of critical thinking (CT) in instructive evaluation and instruction. In Delphi research, specialists take an interest in a few rounds of inquiries that require mindful and point by point reactions. Specialists move in the direction of accord by imparting contemplated insights and rethinking the suppositions concerning remarks, objections, and contentions offered by different specialists.

A sum of 46 researchers, instructors, and driving figures in CT theory and CT evaluation research were assembled for the board gatherings. About portion of the ranelists were fundamentally subsidiary with rationality divisions; the others were partnered with training, social arithmetic, or physical science. Suggestions coming about because of the exchange rounds address the cognitive aptitude measurement of CT, the dispositional measurement of CT, and particular proposals on CT instruction and evaluation, including advancement of a CT educational modules. An exchange of industrially accessible CT appraisal devices, a catalog with an accentuation on evaluation, and an arrangement of letters which account the advance of the Delphi research aggregate are affixed.



As indicated by Ernst, Julie, and Martha Monroe this examination analyzed the connection between environment-based instruction and secondary school students' critical thinking skills and manner toward critical thinking. Four hundred four ninth and twelfth grade students from 11 Florida secondary schools took an interest in the examination.

A Pretest-Posttest Nonequivalent Comparison Group Design (ninth grade) and a Posttest Only Nonequivalent Comparison Group Design (twelfth grade) were utilized. Meetings of students and instructors were utilized as a part of the great feeling of triangulation. Information collection occurred over the 2001– 2002 school year. While controlling for pretest score, review point normal (GPA), sex, and ethnicity, environment-based programs positively affected ninth grade students' critical thinking skills ( $p=.002$ ). While controlling for GPA, sexual orientation, and ethnicity, environment-based programs positively affected 12th grade students' critical thinking skills ( $p < .001$ ) and air toward critical thinking ( $p < .001$ ). The aftereffects of this examination bolster the utilization of environment-based training for enhancing critical thinking and can be utilized to control future usage.

As indicated by Abrami, Philip C., et al Critical thinking (CT), or the capacity to participate in deliberate, self-administrative judgment, is broadly perceived as an imperative, even fundamental, expertise. This article portrays a continuous meta-investigation that abridges the accessible exact proof on the impact of instruction on the advancement and improvement of

critical thinking skills and demeanors. We discovered 117 investigations in light of 20,698 members, which yielded 161 effects with a normal effect measure ( $g+$ ) of 0.341 and a standard deviation of 0.610. The dispersion was profoundly heterogeneous ( $QT = 1,767.86, p < .001$ ).

There was, however, little variation due to research design, so we neither separated studies according to their methodological quality nor used any statistical adjustment for the corresponding effect sizes. Sort of CT mediation and instructive establishing were significantly identified with fluctuations in CT effects sizes, together representing 32% of the change. These discoveries influence it to clear that change in students' CT skills and manners can't involve certain expectation. As imperative as the advancement of CT skills is thought to be, teachers must find a way to make CT objectives express in courses and furthermore to incorporate them in both preservice and in-benefit preparing and workforce improvement.

As per Sezer, Renan, Critical thinking gets expanding accentuation from instructors hoping to imbue logical thinking skills into the educational programs. Numerous instructors are enticed to liken critical thinking with higher request thinking skills inside the last strides of Bloom's taxonomy: examination, union and assessment. Ennis contends that this taxonomy is deficient. He trusts that neither gives enough direction to instruct and take in these skills. R. Paul (1985) agrees with Ennis that the taxonomy has served teachers, concurring that it is a helpful "structure for the instructive procedure" (Paul, 1985, 36), however contends that it is constrained. One constraint is its various leveled nature which

dictates a uni-directional stream between strata. Blossom shows that the taxonomy was planned "as a technique for arranging the objectives, encounters, learning forms, assessment inquiries and problems of training, [but] did not mean to give a limitation on instructive rationality, showing strategies, or educational modules advancement." (Paul, 1985, 39.)

Attempts have been made to characterize critical thinking. Critical thinking is depicted as sane thinking reflected in actions and choices (Ennis, 1981; Hitchcock, 1983). It is utilized to take care of problems, pick amongst options, and make judgments (Beyer, 1995). It imparts affinities to inventive thinking and basic leadership. Lipman characterizes critical thinking as skillful, capable thinking encouraging good judgment since it 1) depends upon criteria [at hand], 2) is self-correcting, and 3) is touchy to setting. Trustworthiness, he says, is just conceivable through great thinking skills, which expect equipped request, idea arrangement, and interpretation skills.

Ennis (1985) characterizes critical thinking as "reflective and sensible thinking that is centered around choosing what to accept or do" (45), paralleling Lipman's detailing. These definitions feature proclivities and additionally capacities. Ennis' rundown incorporates the accompanying characteristics as principal to the craft of critical thinking: exactness, illumination, intellect, receptiveness, looking for reasons and managing all parts of the problem. Critical thinking is not just an arrangement of skills to be adapted, yet skills which should be joined by sets of practices keeping in mind the end goal to make them effective, for example, thinking critically in day by day life, checking and thinking about one's own points of view, and acting harmoniously with one's critical thinking (Sternberg, 1983; Paul, 1985; Norris, 1985).

Once critical thinking skills and going with practices are characterized, one can take a gander at the significance of critical thinking in instruction. The accentuation in the present instruction is moving from the acquisition of facts to the way toward thinking. The contemporary objective is to have students have a problem solving attitude (Lipman, 1988). For some teachers and rationalists, critical thinking is not an approach to instruction but rather an essential (Norris, 1985; McPeck, 1981; Siegel, 1980). One favorable position referred to is the making of a group of request, where every part screens his/her thinking, and additionally studies other individuals' strategies and techniques; consequently, people self correct thinking forms, as well as contribute by and large to amass thinking skills (Lipman, 1988.)

In such a group where addressing turns into a method for reflection, students are urged to scrutinize the legitimacy of wellsprings of data, including educators (Siegel, 1980). In addition, the instructors need to pass on to students these skills, since research shows that numerous secondary school and undergrads don't exhibit solid critical thinking skills (Norris, 1985). Two temperance's of critical thinking in training are enormously upgraded perusing appreciation and the capacity to impart the inside and out recognition picked up from expanded comprehension (Lipman, 1988). However the advantages of critical thinking skills are not constrained to the above. Beneficial outcomes can be seen in the territory of problem unraveling too.

One examination separated the problem-illuminating methodologies of people in light of involvement. The distinctions in problem-fathoming were not restricted to the master knowledge or having a "mechanized" way to deal with specific problems. The distinction additionally lay in



the selection of heuristics utilized. More experienced people give more noteworthy idea to the approach that they will utilize, and the pertinence of each snippet of data, given in the problem. The accomplished give careful consideration to system, yet invest less energy in actual problem-comprehending. The turn around is valid for the less experienced (Larkin et. al, 1980; Norris, 1985).

Many research projects have been conducted on the transferability of critical thinking skills to different trains and how critical thinking might be educated (Norris, 1985). There are various examinations on instructing critical thinking, yet none influences utilization of a control to

gathering or endeavored to evaluate courses in which students' critical thinking skills have enhanced. In evaluating critical

As indicated by my perceptions and the consequence of the performance test, students' critical thinking right now was low in Mathematics. This condition could be the impact of executing customary techniques in showing material science, for example, repetition learning and remembrance. Those strategies were not sufficiently giving space to students to build up their multi-dimensional expertise, mental procedures and also widespread symphonious esteems. Students were not used to working agreeably, valuing their assorted variety, and effectively examining. Furthermore, they additionally were not encouraged to evaluate confirmation, contentions, and option perspectives before judging a choice and taking care of different sorts of problems with both ordinary and imaginative techniques. At the end of the day, students were not ready to exchange their knowledge to tackle problems, all things considered, deductively.

thinking skills, research repeats that skills are profoundly setting subordinate, since hidden knowledge in the range will effect suspicions made. Therefore, it is essential to evaluate the thinking procedure and not just the result arrangements .

No.	Aspect of Critical Thinking	Percentage of Student's Performance
1.	Identifying problem correctly	11.11%
2.	Distinguish Knowledgge and Opinion	37.03%
3.	Providing possible solution	18.51%
4.	Making decision	22.22%
5.	Identify the impact of the implementation of their solution	11.11%

Accordingly, educating and learning activities now were not getting ready students to adjust and get by and in addition to prevail in work and life.

### Methodology

Research plan of this investigation is class action research with two cycles. The fundamental reason for this investigation is creating critical thinking of center students utilizing PBL4C demonstrate. This investigation is applicable to the focal thought of action research which is to intercede deliberate in the problematic circumstance keeping in mind the end goal to achieve changes, and far superior, enhancements in practice. This investigation has been conducted on Students. These students were scholastically solid which implies this school just acknowledges students in light of the abnormal state of students' scholarly performance. In light of consequences of the national examination Year 2016. Students for the most part have

normal age, monetary, social, and intellectual capacity foundation in this manner will diminish or limit the impact of these foundations on their critical thinking skills.

### **Planning**

In this section, the steps to be implemented in this action research are planned. The researcher reviews the standard competency and basic competency in Curriculum 2016. After reviewing those competencies, especially for the topics of force and motion, the researcher determines the study objectives, learning experience, indicator of achievement, and teaching methodology, in this case, PBL4C. The next step, the researcher will design the lesson plans comprised of learning objectives, two scenarios, learning resources, and instruments of assessment. Integrating PBL4C in lesson plans in the mathematics classroom is based on the main principle of PBL which is that “all lesson begins with a contextual problem” where it provides a new dimension, direction and motivation for learning. Thus, the learning activities will start with a contextual problem as the first stage. The contextual problem is delivered to all groups in the classroom. This contextual problem provides the opportunities to examine and try out what they know and what they need to know, discover what did they learn, develop skills for achieving higher performance in teams, and improve the communication skills [10].

Students are given a worksheet and they have to fill in the blank columns to identify the problem and the fact list. In addition students need to list what they need to know to make inferences, and what they need to know to identify implicit assumptions and possible solutions based on the contextual problem. The second stage is that students

are given two scenarios. A scenario is a unique component of PBL that is especially suited to introduce challenge and thereby provide good opportunities to solve the problem. Appropriate management of change is by no means an inborn skill but one that needs knowledge, observation, communication, accommodation, personal practice and evaluations.

In scenario 1, each group test their decision or model on how to solve the problem through experiment. They determine the strength and weaknesses of the decision or model of the problem and whether it works or not in solving the problem. In situation 2, they show their arrangement or model, its quality and shortcomings on taking care of the problem, or potentially proposal to take care of the problem to their gathering and their colleagues. This presentation covers the recognized problem, questions, information collection, information investigations, conceivable arrangements and proposals in view of the information examinations. In their arrangement, they take in the substance knowledge, thinking forms, as well as practice the skills and qualities in basic leadership to make sense of the conceivable arrangement and utilized higher-arrange thinking skills. Through these processes, students discuss, analyze, and argue, as well as provide possible solutions in order to obtain the mutual understanding about the contextual problem. Those processes develop students' ability to identify the problem correctly, analyze arguments, ask clarifying questions, judge the credibility of a source or observation report, make inferences, identify implicit assumptions, and decide strategies and tactics to solve the problem. Through these activities, students are able to improve their critical thinking on those sub skills.

Research Question	Data to be Collected	Instrument
Howto develop Students critical thinking skills using problems based learning 4 core Areas (PBL4C) Model	Data that indicated students attitude towards Critical thinking Skills 1. Identifying problems Correctly. 2. Distinguish knowledge and opinon. 3. Making decision. 4. Identifying the impact of the usage of their answer	Self-Assessment Peer Assessment Rating Scale Checklist
What are the problems that students have in developing their critical thinking skills	Data that indicated students difficulties in developing critical thinking skills. 1. Identifying problems 2. Distinguishing knowledge and opinion. 3. Providing possible solution 4. Making decision 5. Identifying the impact of the usage of their answer	Self-Assessment Peer Assessment Rating Scale Checklist

**Table 2.** Research questions, data to be collected, and instrument that will be used to collect the data.

**Results and conclusion**

**Description of the first cycle**

Target observation of this research is students’ activities in learning process in cognitive and affective aspects. Results from self-assessment and observation as well as learning objectives are appropriate with the research instruments in planning, main activities and closure. Aftereffects of the students' critical thinking skills accomplishment sub aptitude: Identifying problem of the trial correctly. Information from peer evaluation perform 57.69% students can distinguish the problem correctly. This finding is supported by the data from observation (checklist) that indicate 50% students are able to identify correctly. Therefore, there is an increasing critical thinking skills compare to the data from initial research. The achievement increases from 11.11% (initial research) to 50%. Data from observation also indicate the 73.07% students have sensitivity to the feelings, level knowledge of others in various level yet only 15.38% students look

for explanation and reasons and uses and cites credible sources.

Results of the achievement of students’ critical thinking skills sub skill: Distinguish knowledge and opinion. Data from peer assessment indicate that students perform better in providing facts from the problem compare to mentioning opinion about the problem. There are 38.46% students always able to provide facts from problem and 23.07% students always mention the problem when groups share their results. Data from observation (checklist) also indicate that 38.46% students look for explanation and reason when they distinguish knowledge and opinion. Therefore, there is a development of critical thinking skills compare to the data from initial research. There is a slightly increase of achievement from 37.03% (initial research) to 38.46%. Data from observation also indicate the all student use and cite credible sources yet there is only 30.76% students who are able to be open minded and keep to the main relevant point.



Results of the achievement of students' critical thinking skills sub skill: Provided possible solution. Data from peer assessment indicate that students perform better in what they need to solve the problem rather than mention possible solution to solve the problem. All students always able to mention what they need to solve the problem and 30.76% students always mention possible solution to solve the problem when groups share their results. Therefore, there is an increasing of critical thinking skills compare to the data from initial research. There is an enhancement of students' ability to provide possible solution from 18.51% (initial research) to 30.76%. Data from observation also indicate 73.07% students are sensitive to the feelings, level knowledge of others yet there is only 30.76% students who are able to look for alternative when they provide possible solution.

Results of the achievement of students' critical thinking skills sub skill: Making decision. Data from peer assessment indicate that students perform better in making a decision towards the problem rather than providing logical reason in making a decision. About 50% students always able to make a decision towards the problem yet only 15.38% students sometimes provide logical reason when they make the decision. This finding is supported by the data from observation; 53.84% students look for alternatives when they make a decision. Therefore, there is an increasing of critical thinking skills compare to the data from initial research. There is an enhancement of students' ability to make a decision from 22.22% (initial research) to 50%. Data from observation (checklist) also indicate that all students take a position of an issue yet only 42.30% who change a position of an issue with good reason(s).

Results of the achievement of students' critical thinking skills sub skill: Identify the

impact of the implementation of their solution. Data from peer assessment indicate that students perform better in mentioning whether the solution work properly in solving problem and mentioning the weakness of their model compare to mentioning the strength of their model. There are 61.53% students always able to both mention whether the solution work properly in solving problem and mention the weakness and 19.23% students always mention the strength of their model when groups share their results. Therefore, there is a development of critical thinking skills compare to the data from initial research. There is a slightly increase of achievement from 11.11% (initial research) to 61.53%. Data from observation also indicate the all student take a position of an issue and sensitive to the feeling, level knowledge of others but only 57.69% students are open-minded.

Results from the first cycle reveal that there is a development of students' critical thinking skills for all aspects compare to the preliminary data. The largest development of students' critical thinking skills is in sub skill: Identifying the problem correctly. In these sub skills, students have significant development from 11.11% to 50%. Some other sub skills also have significant development for example making a decision towards a problem and identifying the impact of the implementation of their solution. However these developments are only occurred in basic level. In the sub skill: Making decision, about 50% students always able to make a decision towards the problem yet only 15.38% students sometimes provide logical reason when they make the decision. This data implies that students are able to make a decision of a problem but their proposed solution may not have scientific explanation or logical reason behind it.

Data from sub skill: Identifying the impact of the implementation of their solution also



reveals a similar case. Students just ace the essential level of critical thinking skills. 61.53% students constantly ready to both specify whether the arrangement work appropriately in taking care of problem and say the shortcoming yet just 19.23% students dependably say the quality of their model when groups share their outcomes. This finding implies that students are struggling to identify the strength of their model. They only focus in the final goal that is whether the solution works properly or not. They also give more attention to provide explanation and suggestion to overcome the weakness of their model rather than boost the strength of it. These findings disclose that students' critical thinking skills need to be improved to the advanced level in the next second cycle.

Description of the second cycle Results from self-assessment and observation as well as learning objectives are appropriate with the research instruments in planning, main activities and closure. Results of the achievement of students' critical thinking skills sub skill: Identifying problem of the experiment correctly. Data from selfassessment perform 92.30% students are able to identify the problem correctly. This finding is supported by the data from observation (checklist) that indicate 88.45% students stated the main idea or thesis clearly, enthusiastically, and interestingly, for the audience. Therefore, there is an increasing critical thinking skills compare to the data from cycle 1. The achievement increases from 50% (initial research) to 88.45%. Results of the achievement of students' critical thinking skills sub skill: Distinguish knowledge and opinion. Data from self-assessment indicate that 76.92 % students are excellent in recognizing the difference between knowledge and opinion. Data from observation (checklist) also indicate that 88.45% students give highly appropriate facts, excellent generalizations from facts, that support the thesis, sources

of facts are credible, facts used well in making the argument. Therefore, there is a development of critical thinking skills compare to the data from cycle 1. There is an enhancement of achievement from 38.46% (cycle 1) to 76.92%. Results of the achievement of students' critical thinking skills sub skill: Provided possible solution. Data from self-assessment indicate that 80.76% students are excellent in thinking of the possible solution toward the problem. Data from observation also indicate 65.38 % students actively look and encourage others to express points of view different from or opposing own. There is an enhancement of students' ability to provide possible solution from 30.76% (cycle 1) to 65.38%. However, data from checklist also reveal that 30.76% students mention all relevant and important alternative positions, present it fairly, and evaluate it properly. There are also 19.23% students attempting to rebut the alternative position but they are ineffective or incomplete. These findings imply that although students perform excellent in providing solution, they still need to develop the abilities to evaluate and rebut those possible solutions fairly.

Results of the achievement of students' critical thinking skills sub skill: Making decision. Data from observation indicate that 69.23% students give excellent supporting reasons, good diversity, directly applicable. Therefore, there is an increasing of critical thinking skills compare to the data from cycle 1. There is an enhancement of students' ability to make a decision from 50% (cycle 1) to 69.23%. Results of the achievement of students' critical thinking skills sub skill: Identify the impact of the implementation of their solution. Data from self-assessment indicate that 69.23% students are excellent in providing new information. Furthermore, 69.23 % students are very clear in organizing and enhancing the argument and keep the audience interest focused on the main issues.

Therefore, there is a development of critical thinking skills compare to the data from cycle 1. There is an enhancement of achievement from 61.53% (cycle 1) to 69.23%. Results from the second cycle reveal that there is a development of students' critical thinking skills for all aspects compare to the data from cycle 1. The largest development of students' critical thinking skills is in sub skill: Identifying the problem correctly. In these sub skills, students have significant development from 50% to 88.45%. The advancement for sub skills recognize knowledge and supposition is from 38.46% to 76.92%. The improvement for sub skills giving conceivable arrangement is from 30.76% to 65.38%. Some other sub skills also have slightly development for example making a decision towards a problem and identifying the impact of the implementation of their solution. The development for sub skills making decision is from 50% to 69.23%. The development for sub skills identifying the impact of the implementation of their solution is from 61.53% to 69.23%. Data from checklist also reveal that 30.76% students mention all relevant and important alternative positions, present it fairly, and evaluate it properly, 15.38% students mention some of the relevant alternative positions, portray it properly, and evaluate it properly, and 53.84% students mention alternative positions but they are either not portrayed fairly, not evaluate it properly, or not relevant to the thesis. There also 19.23% students attempt to rebut the alternative position but they are ineffective or incomplete, 80.76% students do not attempt to rebut the alternative position. This data implies that students are struggling to evaluate and rebut alternative solutions properly.

Conclusion Based on the analysis and the things that have been raised in advance, it can be concluded as follows: • PBL4C

model is a learning approach that can stimulate students' critical thinking • The role of teachers in mathematics learning process using PBL4C model is as a facilitator and learning resources that can guide and direct students to find solutions with respect to the provided problems. • The courage and the ability to think critically is the basis for students in using PBL4C model to be more successful. • The results showed that the use of PBL4C model develop students' critical thinking skills significantly.

Students encounter advancement from 11.11% to 88.45% in recognizing the problem correctly, from 37.03% to 76.92% for sub skills recognize knowledge and conclusion, from 18.51% to 65.38% for sub skills giving conceivable arrangement is, from 22.22% to 69.23% for sub skills settling on choice, and from 11.11% to 69.23% for sub skills distinguishing the impact of the usage of their answer. This research study can further proposed some suggestions as follows: • Teachers should be a facilitator and learning resources that can help students to study the learning material. • Teachers conduct an analysis of the various issues involved, so it can be solved immediately. Students should be more active in implementing PBL4C model to increase their critical thinking skills. • Students should be able to analyze a sharp, accurate and appropriate for any problems that occur to immediately be able to find a solution.

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