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Innovation in Teaching and Learning through Problem Posing Tasks and Metacognitive Strategies

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Abstract: Problem posing and metacognitive activities in teaching-learning materials can be incorporated in student-centred teaching methods. In the other word , these tasks involve learners in specific learning process by shifting of responsibility generating new problem and reformulating given problem from teachers to students through "Inquiry - based -learning " environment. In this respect, teachers as facilitators of learning must be able to create tasks with suitable situations which engage their students in problem posing activities and improve them in this challenge via the scaffolding such as metacognitive approaches. Therefore, this paper discusses some initial findings of our research related to classification of problem posing and metacognitive activities. These effectiveness instructions may encourage educators for embedding pupils in problem posing and metacognition activities during classroom interactions.

Keywords: Innovation Teaching, Metacognitive Strategies

1. Introduction

Problem posing is a natural tendency for all people; so that human innate inquiry has led him to revolve his life by generate novel, original, ingenious problems, solutions and techniques. Most significant, this questioning capacity can be nurtured and developed by equipping teaching- learning materials to valid tasks that can carry on with a certain degree of expectancy, new ideas, fresh discoveries, and deepened interests. In this respect, it is required a novel trend in mathematics activities, so that students are asked to formulate problems from given situations and create new problems by modifying the conditions of a given problem. In the other word, appropriate problem posing or conjecturing activities should be associated in mathematics classrooms to enrich relevant assignments. In this approach, mathematicians' tasks were never finished, because it is almost always possible to generate further problems when looking back at the original problem or its solution. In order to gaining success in problem posing attempts, it is a proper habit to ask oneself the following questions in a continually manner whilst one comes across a mathematical problems, result or situation:"What … is changed?”,"What happens if …?" and "What if … not?”. These questioning practice is worthy ,even if the constructed problems be cosmetic or unsolvable, due to it can nurture the formulation of new conjectures and problem posing abilities in learners. In this regard , Md.Nor and Ilfi (2012) found that if these attempts are equipped to metacognitive questions(e.g., What is the problem all about? ,What are the strategies/tactics/principles appropriate for solving the problem and why?, Does the solution make sense?) as scaffolding, then can develop creative problem posing.

Due to importance this significant issue in education approaches, problem posing has defined as a means of instruction where the students construct questions in response to different circumstances, namely real life situations, another mathematical problem, or the teacher. Meanwhile, the shift of responsibility problem posing from teachers to students could embed pupils in metacognitive strategies during face to face (FTF) interactions in classroom settings and led them to be independent learner. In other word, problem posing activities can stimulates metacognition skills which is called helpful control skills for applying problem solving strategies successfully. On the other hand, this situation can provide opportunities for engaging pupils in higher level of the hierarchical nature of knowledge including "Analyzing, Evaluating ,and Creating"(Anderson & Krathwohl, 2001) which encourage higher-order-thinking among learners. This view indirectly informed that the mathematical problem posing tasks have the most important following criteria for promoting high-order-thinking:

1) Students should be involved in the transformation of knowledge and understanding.
2) Teacher should create a communicating environment for students' effective interaction, encouraging them to verify, question, criticize, and assess others 'arguments, engaging in constructing knowledge through various processes, and generating new knowledge through self-exploration.
3) Students need to be aware that they must be an active learner taking initiatives and responsibilities in their own learning.

From the other point of view, this innovation in mathematics classroom activities can altered students' misconception about the nature of mathematics as just a drill and practice activity, and develop their motivation in mathematics learning by guiding them to experience the fascination of exploration in math and make a much better sense of ownership through problem posing tasks whilst in traditional teaching , the ownership of creating and generating problems would be given to either teacher or textbook (English 2003).

Despite of educational researchers, over the decades, have reached to consensus about effectiveness mathematical problem posing and metacognition activities, the recent classroom instruction is yet limited to problem solving tasks alone. Whereas, mathematics teachers should complete problem solving tasks by problem posing tasks for challenging learners to the quality problems whose solution strategies are not immediately known to each students. This could be due to lack of a comprehensive study that can assist teachers how these activities can be designed and implemented as a operational tasks in mathematics classrooms which are restricted in subject content and time . Consequently, the main objective of this study is classification of problem posing and metacognitive activities regard to their strategies, situations. We assert this communication can demonstrate a suitable pattern for planning these tasks to mathematics teachers.

2. Problem posing and Metacognition: Situations, Strategies

Problem posing situations are recommended to teachers for designing and implementing problem posing tasks regard to their instruction objectives of a particular subject. When students are involved in these situations, they could apply one or more problem posing strategies to formulate new appropriate problems in a flexibility method and develop their problem posing skills which are mental skills using the given conditions in the problems for reconstructing them. According to these views, these skills can lead mathematics teachers to measure students' understanding of mathematical concepts. Furthermore, educators may overlap metacognition situations to problem posing tasks to determine how students can be taught to better apply their cognitive resources through metacognitive control and develop problem posing skills. Hence, because metacognition skills play a critical role in successful problem posing activities, it is important to study metacognitive situations and strategies. In the next sections are conducted a review study related to problem posing and metacognition situations and strategies.

2.1 Problem Posing Situations

Problem posing situations emphasise to thinking about the relationship between mathematical ideas ,more than doing a mathematical activity ,as a result can stimulate high -order -thinking and divergent thinking in learners which are aimed in higher education as the mathematics' learning outcome. Researchers (Stoyanova, 2003) classified problem posing situations as:

1) Free situations: everyday life situations, free problem posing, problem I like, and problems written for a friend.
2) Semi-structured situations: problem similar to given problems, problems related to specific theorems, problems derived from given pictures, and word problems.
3) Structured situations : any mathematical problem consists of known data (given) and unknown (required)and students are asked pose problems by reformulating already solved problems or by varying the conditions or questions of given problems.

With regard to problem posing situations, Lowrie (2000) suggested that the students can pose problems for friends whom are at or near their own standard until they become more competent in generating problems. Then, the can ask individuals to indicate the type of understanding and strategies the problem solver will need to use in order to solve the problem successfully before a friend generates a solution. Continually, the peers can work cooperatively in solving the problems so that the problem generator gains feedback on the appropriateness of the problems they have designed. On the other hand, the teacher can encourage problem solving teams to discuss, with one another, the extent to which they found problems to be difficult, confusing, motivating or challenging. Consequently, Problem posing situations provide opportunities for less able students to work cooperatively with a peer who challenged the individual to engage in mathematics at a higher level than they are usually accustomed. In addition, these situations challenge students to move beyond traditional word problems by designing problems that are open-ended and associated with real life experiences. Finally, they encourage students to use technology such as, calculators and CD in developing their mathematical thinking skills, so they can use this technology to generate new mathematical situations.

2.2 Problem Posing Strategies

There exist various strategies that learners could apply one or more them to formulate new problems according to different problem posing situations as following strategies:

1) “What if” or “What if-not?” strategy that through the process of asking “What if” or “What if not?” can change each component of the problem, such as the numbers, the geometry, the operation and the objects under study (Brown & Walter, 2005).
2) Modifying givens strategy consist of paraphrasing, changing of statement’s data, analogy and generalization. In analogy and generalization are emphasized on replacement a condition, or add new conditions, remove or add context and repeat a process (Bairac, 2005).
3) Imitation strategy that exposes a learner with cases of problems and their generation processes, and it then had the learner engages in reproducing cases by following the processes (Kojima, Miwa, & Matsui, 2009).
4) Generative questions based on the sample of profitable questions' (English, 1997b) that can lead students in the generation of new questions from given mathematical tasks:
   - What are the important ideas in this problem?
   - Where else have we seen ideas like these?
   - Could we have used this information in a different way to solve the problem?
   - Do we have enough important information to solve the problem?
5) Cruz Ramirez (2006) proposed that a mathematical problem posing strategy consisting of six non-sequentially connected actions, namely selection, classification, association, searching, transformation and posing.

As mention earlier, implementing these strategies would able the students to be good problem posers, as a result deploy their abilities, difficulties, performances in the given problem posing tasks .In addition, students’ confidence in their posed problems can be related to some of the metacognitive strategies. Continually, different metacognitive aspects of problem posing are described.

2.3 Metacognitive Strategies

Metacognitive strategies are sequential processes that one uses to control cognitive activities, and to ensure that a cognitive goal (e.g., understanding a text) has been met. These processes help to regulate and oversee learning, and consist of planning and monitoring cognitive activities, as well as checking the outcomes of those activities. However, the majority of learners instinctively obtain metacognitive knowledge and skills from their relatives such as parents, classmates, and especially their teachers, metacognitive strategies instructions demand to enhance metacognition and learning in a wide spectrum of students, particularly low achievement learners. In a proposition to facilitate students in learning activities, many researchers have outlined a variety of metacognitive strategies that need to be taught. Although the names or descriptions may slightly differ, it is widely agreed by these researchers that these strategies need to be explicitly taught. Paris and Winograd (1990) also argues that “teaching such strategies has twin benefits in that (a) it transfers responsibility for monitoring learning from teachers to students themselves, and (b) it promotes positive self-perceptions, affect, and motivation among students in this manner, metacognition provides personal insight into one's own thinking and fosters independent learning."

Veenman (2011)stated that the "WWW&H" rule (What to-do, Why they are beneficial, When to use them, and How to use strategies) for a valid metacognitive strategies instruction based on three fundamental principles as :

1) Integrating this instruction in the content material to ensure connection between a purposed task and relevant metacognition skills.
2) Informing learners about the effectiveness of metacognitive activities for stimulating them to the initial extra effort during performing related tasks , and
3) Extended training to guarantee the use and maintained application of metacognitive activity.

In this respect, Lai (2011) asserted that the most effective instructional strategies included the textual-dissonance approach, self-questioning, and backward-forward search strategies, although the authors recommend using a variety of diverse techniques for best results. Furthermore, results suggest that instructional interventions involving fewer than 10 minutes of instruction per lesson are insufficient for producing these types of effects.

On the other hand, metacognition becomes more domain-specific as students age and acquire more specialized content knowledge, therefore self- report strategies which emphasize on general metacognition skills may be ineffective in older-students(tertiary level). Therefore, encouraging the students to ask questions themselves in a specific subject is one of the strategies which can be used for developing metacognition within the framework of constructivism learning. According this view, Hacker and Dunlosky (2003) stressed that teachers should ask the following questions as metacognitive strategy instruction in activating the thinking and contributing to the development of metacognitive abilities such as

- What about next?
- What do you think?
- Why do you think so?
- How can you prove this?

Most important, these effective questions are a type of scaffolding can build a good self- questioning habit as a common metacognitive comprehension monitoring strategy.

However, there exist several researches about the role of metacognition strategies in problem solving at different level of education, the metacognitive skills and strategies have yet reminded less- known in problem posing.

2.4 Metacognitive Situations

We engage in metacognitive situation every day. metacognition enables us to be successful learners, and has been associated with intelligence and stimulates higher- order -thinking which involves active control over the cognitive processes engaged in learning. metacognition situations encourage activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task. Due to students have shown a considerable variation in their metacognitive adequacy, it is important to expose learners in metacognitive situations to determine how students of various education levels can be taught to better apply their cognitive resources through metacognitive control. Therefore, educational researchers and teachers need to assess the learners' behaviors in proposed metacognition situations to can improve students' metacognitive skills.

Lai (2011) stressed that assessment of metacognition is challenging for a number of reasons:

1) Metacognition is a complex construct, involving a number of different types of knowledge and skills.
2) It is not directly observable.
3) It may be confounded in practice with both verbal ability and working memory capacity.
4) Existing measures tend to be narrow in focus and decontextualized from in-school learning.

Therefore, considering the ambiguity of the definition and theory of metacognition, more difficulty is created in measuring metacognition. Briefly, metacognition is usually assessed in two principal ways: observations of students' performance or by self-report inventories. Therefore, few popular techniques used in measuring metacognitive knowledge and processes are ; self-report such as questionnaires or rating scales, error detection, interview (structured, semi structured, unstructured, open-ended, closed, introspective, and retrospective) and thinking-aloud. However, each technique has inherent weaknesses and strengths. In order to decide which method to use, researchers need to consider the constraints and try to eliminate drawbacks that might occur during specific activities; such as mathematical problem solving and posing tasks.

3. Classification of Problem Posing and Metacognitive Tasks

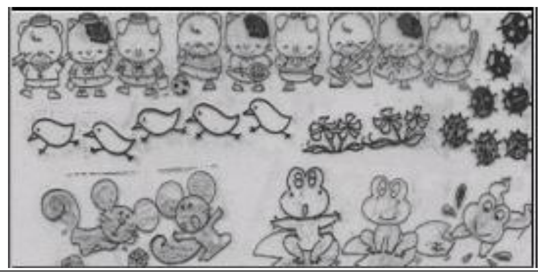
This section describes the classification of problem posing and metacognitive tasks. The presented tasks were designed by educational researchers or teachers for particular objectives .In this study ,cited activities are characterized based on proposed aims of their designers ,including examining and developing problem posing and solving abilities in schooling levels, pre-services teachers and first year undergraduates, stimulating mathematical problem posing skills, mathematical investigation, measuring each cognitive process , student's mathematics learning and thinking, improving mathematical knowledge and academic success . Most important, in order to establish scaffolding supports in generating problems, these tasks are reconstructed from “original textbook problems" or " everyday life problems” based on problem posing situations. In other word, these resources of problems can develop realistic context which would allow learners to have some control over the curriculum content and the type of learning activities presented in the classroom . On the other hand, question posing is a higher-order thinking skill, and as such it is linked to metacognitive knowledge, thus metacognitive activities would be involved in mathematical problem solving and posing in variation levels of education.

Most important , we assert that this collection of tasks may make a appropriate pattern for improving mathematical classroom activities in term of " inquiry-based- learning "environment that can actively engage learners in significant process of learning including: creating questions of their own, obtaining supporting evidence to answer the question(s), explaining the evidence collected, connecting the explanation to the knowledge obtained from the investigative process and creating an argument and justification for the explanation.

3.1 Classification of Problem Posing Tasks

Teachers design problem posing tasks which require students to generate one or more word problems in order to understand students’ mathematical learning (Lin, 2004). Table 1 reveals the types of problem posing tasks designed by those teachers.

Table 1: Types of problem posing tasks(Lin, 2004).

Tasks
Number sentence
If you were a teacher, how would you give your students a problem situation represented by 1 x 5 = ( ). Write it down in words.
Pictorial representation
This is a picture about the princess and dwarfs. If you were a teacher, what word problems would you like to formulate? 
Mathematics language
Draw a picture and create a word problem for “6 sets of5”.
Student’s solutions
Using mathematical expressions represent your solutions. The three solutions were: Yee: 39 – 25 = ( ) 30 – 20 = 10 9 – 5 = 4 10 + 4 =14 Mei: 39 – 25 = ( ) 39 – 20 = 19 19 – 5 = 14 Tai: 39 – 25 = ( ) 29 -25 = 4 10 + 4 =14

Christou,et.al(2005) proposed four types of problem posing tasks in order to measure each cognitive process, namely editing, selecting, comprehending, as well as translating quantitative information as shown in Table 2.

Table 2: Task corresponding to each cognitive process (Christou,et.al, 2005).

Tasks (Process)
EDITING *Write a problem based on the following story:* In 1492 A.D. Columbus started his long journey to India. In his first ship, Santa Maria, he had 250 kg of meat, 600 kg of flour and 1200 kg of potatoes. Unfortunately, due to an accident, 245 kg of potatoes were damaged. In his second boat, Pinta, he had 300 kg more meat than in Santa Maria. Columbus did the greatest discovery in the history. He discovered America!
SELECTING *Write a question to the following story so that the answer to the problem is "385 pencils".* "Alex has 180 pencils while Chris has 25 pencils more than Alex".
COMPREHENDING *Write an appropriate problem for the following:* (2300+1100)-790=n 5100–(2400+780)=n
TRANSLATING *Write a problem based on the following table whose solution would require one addition and one subtraction:* Children — Bank savings John — 340 Helen — 120 Joanne — 220 Andrews — 110 George — 280

Stoyanova (2003) invited students to pose problems on the basis of the following problem posing prompt as revealed in Table 3.

Table 3: Problem posing prompt (Stoyanova, 2003).

Make up as many problems as you can using the following calculation: 3 × 25 + 15 ÷ 5 – 4

Yeo and Yeap (2009) adopted mathematical investigation task as a open situation for both their problem posing and problem solving activities as revealed in Table 4.

Table 4: Open investigative task(Yeo & Yeap, 2009).

Task 1: Powers of 3 Powers of 3 are 3^1, 3^2, 3^3, 3^4, 3^5, … Investigate.

Table 5 reveals examples of addition and subtraction problem posing problems given in Year 2 and Year 3 Mathematics textbooks (Rohana, Munirah, & Ayminsyadora, 2009):

Table 5: Additional and subtraction problem posing (Rohana, Munirah, & Ayminsyadora, 2009).

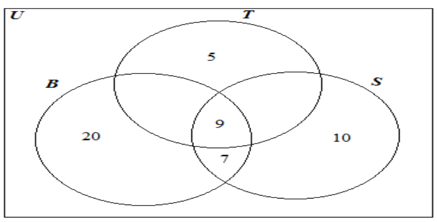
Question	Solution
Make up a number story for the number sentence: 45+39=84.	I have 45 fruit stickers. My brother has 39 animal stickers. We have 84 stickers altogether.
Make up number stories for the number sentence 40-8=32	My mother is 40 years old. I am 8 years old. Mother is 32 years older than I. There are 40 pupils in Class Tekun. 8 pupils walk to school and 32 come by bus.
Make up a number story from the number sentence 4236+3412=7648.	IKhwan Furniture produced 4236 chairs in April and 3412 chairs in May .The company produce 7648 chairs for both months.
Make up a number story for the number sentence 1243-856=387.	1243 participants took part in a Jonathon. 856 of them were adults and 387 were children.

Md. Nor and Ilfi (2012)investigated secondary school students' abilities through problem posing activities, by asking students to generate "Uno problem" and "Due problem" respectively. Table 6 reveals an example of "Uno problem" as well as "Due problem" for the study.

Table 6: Example of "Uno problem" and "Due problem" (Md. Nor & Ilfi, 2012).

Original textbook problem

"Venn Diagram" below shows the number of Form 4 students who like to play soccer, badminton and tennis.



Given

T = {Students who play tennis}

S = {Students who play soccer}

B = {Students who play badminton}

What game is played by 9 students?

Conditions:________________________

Demand:__________________________

First posed problem, when we add extra conditions (Uno problem)

New conditions:___________________

New demand:_____________________

Second posed problem, when we remove some conditions (Due problem).

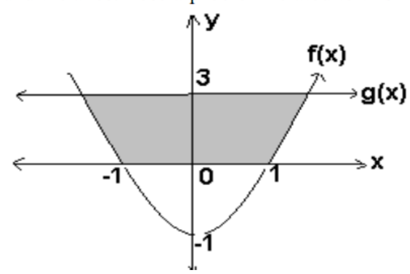
New conditions:___________________

New demand:_____________________

Akay and Boz's (2010) examined the effect of problem posing instruction on the attitudes toward mathematics and mathematics self-efficacy of elementary prospective mathematics. Figure 1 shows some examples of problem posing activities adopted in study.

Activity 1. Write a fractional function of at least third degree and which has three different roots and has nominator degree greater than its denominator degree then find its indefinite integral.

Activity 3. As can be seen in the figure below there is a region bounded by the parabolas $f(x)$ and line $g(x)$ and the axes. Pose a problem related to this figure.



Activity 5. In order to compute the volume of a solid figure that is not surface of a revolution, try to pose an Integral problem. Then discuss whether or not you can approximately compute the volume of an item or an object you use in daily life. Explain!

Activity 6. You will get engaged when you graduated from the university. If you are going to design your engagement ring, how would you design the ring and determine its cost?

Figure 1: Some problem posing activities used in the experimental group (Akay & Boz, 2010).

According to vital role learning mathematics, high-order- thinking, and metacognition skills in future career opportunities of undergraduates, we suggest to collaborate problem posing tasks in high education materials. In this respect, we designed problem posing tasks based on "original textbook problems" and " everyday life "resources related to realistic content issue. Table 7 points out two example of designed problem posing activities that are reconstructed from problems of " calculus 1" by " change the problem context " and " Add or Remove condition "strategies. In addition, undergraduates' problem posing abilities, related difficulties, preferences strategies can be investigated through these tasks.

Table 7: Two problem posing tasks designed for undergraduates.

1 (a)	Calculate $\int_{-1}^{4} \lvert x-3 \rvert dx$ by drawing the graph. i. Determine problem's Condittions exactly,then solve it. ii. $\lvert X-3 \rvert$ is differentiable everywhere except for $x = 3$, how do you justify its integrability in $[-1,4]$.
b)	Construct a definite integral problem for " piecewise continuous function". i. Determine problem's Condittions exactly. ii. Solve the new problem . iii. How do you justify integrability of posed problem by connention to theory " characterizations of integrability concerned to continuity".
2 a)	Find the volume of the solid generated by revolving about x-axis the region bounded by curve y= e^{-x} ,y=0,y=1 i. Determine problem's Condittions exactly, then solve it.
b)	Generate a problem involving definite integral that compute the volume of a solid item that you use in daily life. (Note: items same Birthday hat,a vase, a ring,a ball,,,,) i. Determine problem's Condittions exactly. and explain how evaluate new conditions. ii. Solve the new problem .

Most important, we assert that it will be helpful if these activities are implemented in metacognitively oriented science classrooms that enable successful learning. Therefore, next section reviews metacognitive activities as well as variety levels of metacognitive skills involved in mathematical problem solving and posing.

3.2 Classification of Metacognition Tasks

Learners can acquire metacognitive experiences through metacognitive activities which are commonly characterized regard to a sensitivity on the use of heuristics , learning strategies and any activity that students employ or are asked to employ. Most important, the distinction between metacognition and cognition needs to be acknowledged and considered in relation to this ‘metacognitive activities’ approach, namely the use of this approach should be involved with opportunities for students to reflect consciously on the metacognitive experience that accompanies their use of the strategies/heuristics.

Therefore, the development students’ metacognition requires that they undertake conscious reflection on the efficacy of the learning processes, cognitive processes and using means of assisting; such as concept maps, reading charts, Venn diagrams, theory-evidence coordination rubrics and inquiry flowcharts which improve and represent students' understandings of science. On the other hand, if one is to accept that metacognitive processes can only happen under conscious awareness, any automatic thinking processes or subconscious metacognitive knowledge will be disregarded , whilst, many ‘regulatory good habits’ (e.g., the activity of checking oneself subconsciously) are considered as metacognitive activities which usually run in the ‘background’ of the cognitive processes. In addition, it is argued that only after an error is detected, rightfully or not, the system becomes alerted, and then overt metacognitive activities can be observed. However, one possibility in which metacognitive activities may happen without consciousness is when an ‘expert’ is so skilful in a particular area of problem-solving that s/he does not require attention and awareness in executing the metacognitive process (e.g., error detection, monitoring, controlling, etc.). In short, it points out that the relationship between metacognition and consciousness is a complex one. According this challenge, Kayashima and Inaba (2003)supposed that there exist two layers in a learner’s working memory: cognitive layer and metacognitive layer that metacognitive problem-solving process uses both of them . Furthermore, the metacognitive activity includes observing, evaluating, and regulating the cognitive activity. Hence, during metacognitive activity is needed a learner to recognize the goals of the cognitive activity, the constraints of it, and the process of the learner's cognitive activity at the cognitive layer for encoding them to the metacognitive layer.

As mention earlier, the distinction between cognitive and metacognitive processes has been discussed as being problematic because cognition is inherent in any metacognitive activity and metacognition may be present in many cognitive activities. It is difficult to classify behaviours as exactly cognitive or metacognitive processes. Therefore, it is necessary to carefully consider this literature related to this construct in order to understand how metacognition is involved in the problem solving process. For this objective, recently, Gok (2010) concluded that some metacognitive skills- planning, monitoring, and evaluating- should be incorporated into the problem solving instruction to further refine students` problem solving skill in tertiary level of education . On the other hand, performing metacognitive tasks can build structured knowledge and develop desirable habits of mind, and guide first year undergraduates through the stages of cognitive development.

Most important ,the reviewing related articles to metacognition approaches demonstrate that the attentions have been directed to metacognition levels in problem solving , whilst question posing is a higher-order thinking skill, and as such it is linked to metacognitive knowledge . Md.Nor and Ilfi (2012) indicated metacognition stages , namely "Reading , planning , interpreting and checking" can be involved in problem posing tasks and led learners in generating solvable problems. On the other side, students' guidance in these stages via metacognitive cues can be considered as scaffolding for mathematical problem posing tasks. Furthermore, they analyzed Malaysian mathematics textbooks for Form 1 to Form 5 of secondary school settings based on the metacognitive elements as follows, though they did not recognized which one of these practices can promote problem posing abilities among secondary school students.

1) "Activity, Discovery Activity, Exploring Mathematics and Exploration" guide the student to the required mathematical concepts and skills
2) "Spreadsheet, Calculator/Computer, Calculator Activity, Using Technology, Calculator and Math's Tool " help to learners using calculator or computer in findings solutions ,
3) "Titbit, Handy Info, Tip and Quick Review "provide an additional explanation about the required concept, and
4) "Activity, Speedy Recall, Recall and Remember" remind with regard to prior knowledge.

According to problem posing tasks as a stimulus metacogntion skills and complement of problem solving tasks, it is needed to these tasks integrate to teaching -learning materials of universities for supporting undergraduates in mathematics learning. Consequently, it can be argued that how problem posing tasks can share some likeness with problem solving activities in terms of metacognition stages involved in.

4. Conclusion

This article describes an innovation in teaching and learning through problem posing tasks and metacognition strategies. In order to active of metacognition skills, educators can change the learning environment and provide new and alternative tasks that help pupils to think about subject material, its organisation and its manipulation in ways they had previously not considered.

Teachers can generate these tasks based on teaching and learning objective related to particular subject and content by problem posing situations. Furthermore, they can lead learners to applying relevance strategies for generating new themselves problems in an active learning environment with reference to peers' appropriate metacognition level. These conditions can encourage peers to discussion together or their teacher and query in which they are asked to engage with adequate levels of control cognitive processes.

It can be recommended implementing problem posing and metacognitive activities in science classroom, due to can facilitate successful learning and establish high levels of emotional support and trust between the teacher and students in complex subjects of science.

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