ISSN No.: 2454- 2024 (online)

International Journal of Technical Research & Science

ACTIVITY BASED LEARNING OF MATHEMATICS IN METACOGNITIVE LEARNING STRATEGIES: REVIEW OF EFFEVTIVE ACTIVITIES AND THE IMPACTS TO THE STUDENTS

Mohamad Ariffin Abu Bakar[1], Norulhuda Ismail[2]
E-Mail Id: mohamadariffin6299@gmail.com
School of Education, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia (UTM), Skudai, Malaysia

Abstract-A new interest in the implementation of Metacognitive Learning Strategies (MLS) to effective activities in mathematics teaching has emerged and a number of claims are made regarding to the effectiveness of students understanding. These literacies are considered as instructional with great potential. The suggested positive outcomes and effects have been mentioned repeatedly. In this review the effective activities are learned in order to gain more insights into conditions where methods can be used, effectively and give positive impact to students in mathematics learning. Systematic literature search in databases was conducted. Some studies reported effective activities that have a positive impact on learning, students' concept understanding and students' thinking skills.

Key words: metacognitive, metacognitive learning strategies, activity-based learning in mathematics, impacts

2. INTRODUCTION

One of the factors that cause of low mathematical mastery among students was the learning approach (Du Toit & Du Toit, 2013). Since mathematics is about reasoning and abstract knowledge, the teaching and learning approach should also use the thinking potential of the students (Menz & Cindy Xin,2016;Cera, Mancini & Antonietti,2013;Kumar,2018). Among the constraints in current teaching approaches are the lack of exposure to the intellectual ability and thinking skills of students. Therefore, this approach should be refined with the emphasis on student thinking skills that drive the improvement of student metacognitive aspects. Metacognitive according to Schraw & Moshman (1995) is the skill of managing thoughts, monitoring thoughts and taking action in the right order. Metacognitive learning strategies are strategy that employs students' metacognitive skills and behaviour, where students naturally, regulate themselves to be active, learn how to learn, realize their strengths and weaknesses, planning, monitoring and evaluating their learning. In conjunction with mathematical learning to improve students' mastery, metacognitive learning strategies should be practiced by teachers. To implement metacognitive learning strategies, one of the solutions is activity-based learning approached. The effectiveness of mathematical learning activities in order to enhance the student's metacognitive skills has needs to study and explore it.

Activity based learning is an approach from understanding of the active and effective learning theories. This approach is also actually from the development of philosophical constructivism. This activity learning approach was first introduced by David Horsburgh. Known as Activity Based Learning (ABL) but in mathematical learning purposes, it is termed an Activity Based Learning of Mathematics which involves students doing activities such as reading, writing, discussing, practical activities, problem solving activities, analysis, synthesis and evaluation (Festus, 2013). According to Pokhrel (2018) the activities involved in this approach are like the use of materials, models, shapes, charts, pictures, posters, games and experiments.

For the purpose of applying and using the ABL approach to transform the student's learning of mathematics, Bonwell & Eison (1991) has outlined some of the features of ABL as a guide:

- involves learning activities that enable students to develop their potentials and skills that are more than just listening to, not just receiving or transferring information
- involving students in high-level thinking skills e.g analysis, synthesis and evaluation
- More likely to be exploring the students to their own attitudes and self-values.

In relevant, the ABL principle is directly to the development of metacognitive regulation through metacognitive learning strategies. According to Hasbullah (2015) activity is a medium or tool that can be a moderator of metacognitive regulation. Accordingly, there are four principles of ABL, Experience, Reflection, Application, and Consolidation (ERAC). Raj (2015) describes ERAC as:

2.1 Experience

The initial stage of activity-based learning, the term experience symbolizing new experiences, new challenges,

new environments gained through deep observation during the learning process and understanding the objectives of the topic and the students need to be ready to apply in the next topic or situation (next learning).

2.2 Reflection

A self-assessment by thinking and giving insights into the impression of a new experience. The appreciation of the new experience will be more meaningful by the more focused questions on the effects and challenges that will be received.

2.3 Application

At this stage students will apply the experience through partnership with other students. Teachers are only acting as observers, giving little guidance when needed, ensuring that students do activities according to the procedure and not formulating the findings. Students are given the opportunity to accept new terms with self-regulated first

2.4 Consolidation

The final step of activity-based learning is mergers or conclusions. In this section students should have achieved goals based on organizer and activity management. Here also can be used as a measure of how far the objectives of learning are achieved.

Applying this approach as a teaching and learning practice is essential to achieving effective learning goals. The features and principles of ABL are also conceptualized by active learning and metacognitive development. Through the activities, students will evaluate and look at something from the point of view, find similarities, evaluate causality, make predictions and estimates, not just memorizing and even to responsible for new experiences and knowledge (Raj, 2015). This coincides with the recommendation by Singh(2017) and Su, Ricci & Mnatsakanian (2015) which proposes a strategy that allows students to think, regulate and coordinate their thinking to achieve mathematical learning outcomes.

In this context, metacognitive learning strategies refer to methods or technics of learning that promote the development of metacognitive aspects (Menz & Cindy Xin, 2016). In fact, using previous knowledge, student's awareness, and student's thinking skills to shape new experiences and knowledge. According to Noorzeliana, Norazilawati & Saniah (2015) a metacognitive learning strategy of mathematics is a way to set up the awareness about the thinking process during learning. This awareness is exists, when students are able to manage their thoughts by planning, monitoring and evaluating while completing tasks. In mathematical learning using metacognitive learning strategies, according to Panaoura, Gagatsis & Demetriou (2009) there are six things to emphasize:

- Understand phenomena in research (learning), relationship activity, situation with learning environment
- Construct the aspects of activities, relationships and circumstances with learning situations
- Doing activity based on rules or method to get learning result (objective)
- Interpret the work systematically to achieve problem solving in the actual situation exposed in the activity
- Evaluate the activity by examining whether the mathematical results obtained, are appropriate and reasonable in the real problem
- Connect with real problem solving

In addition, for more specific teaching strategies (Veenman et al., 2006), as cited in Menz & Cindy Xin (2016) has listed the basic principles to ensure the success of metacognitive strategy teaching: i) metacognitive strategies are applied in learning materials to ensure interrelationships , ii) informing students about the use of metacognitive activities to encourage them to always work, and iii) prolonged training that is practiced to ensure smooth and continuous metacognitive use.

3. METHODOLOGY

The present study purpose to determine the learning activities conceptualized of Activity Based Learning (ABL) and based on Metacognitive Learning Strategies. The aim of the study also to look for the impact of activities to student's learning in mathematics. Therefore, the research question was formed to achieve the objectives:

- What are the effective learning activities that implied metacognitive learning strategies?
- What is the impact of activities to the student's learning in mathematics?

Next, the related articles and journals search is in two steps; i) looking for articles related to metacognitive strategies to identify what the principles and features of metacognitive learning strategies, ii) searching articles based on activity-based learning to determine what activities the teacher is doing and see the impact on student's mathematical learning. Research articles are based on search using key words, metacognitive, metacognitive learning strategies and activity-based learning in mathematics from Google Scholar, ERIC, ScienceDirect, Researchgate, and other index journals.

The following table is an analysis of metacognitive learning strategies.

Table-3.1 Analysis of Elements of Metacognitive Learning Strategies

Researcher/Title	Objective	Elements Of Metacognitive Learning Strategies
Cera,Mancini & Antonietti (2013) Relationship Between Metacognition, Self-Efficacy And Self-Regulation In Learning ECPS-Journal 7/2013	To Study the relationship between metacognition, self-efficacy and self-regulation in learning	i. The ability of students to monitor their own learning process ii. Can improve sensitivity to feedback content iii. Higher skill to choose strategies iv. May identify relevant information as necessary v. Students can manage time more effectively vi. Self-assessment by linking the previous knowledge to the learning process vii.Can connect existing knowledge with new ones
Petra Menz and Cindy Xin (2016) Making Students' Metacognitive Knowledge Visible through Reflective Writing in a Mathematics-for-Teachers Course Collected Essays on Learning and Teaching, Vol. IX	To describes the rationale,implementation, and assessment of a weekly online reflection activity based on instructor prompts designed for post-secondary students who aspire to be elementary school teachers.	i. Help students to form a new habit of thinking ii. Can successfully implement metacognitive knowledge for the learning of mathematics, such as planning learning tasks, monitoring comprehension, evaluating progress, accessing self-possessed knowledge, and dealing with the feelings of the self specifically during mathematical learning.
Tony Karnain, Md Nor Bakar, Seyed Yaser Mousavi Siamakani, Hossein Mohammadikia & Muhammad Candra (2014) Exploring the Metacognitive Skills of Secondary School Students' Use During Problem Posing Jurnal Teknologi (Social Sciences) 67:1 (2014), 27–32	To explore students' use of metacognitive skills during problem posing activities.	i. Planning revealed the following metacognitive skills: making sense of the task, extracting the given information, being aware of the goal, seeking any examples used in the past, and mapping a solution. ii. Three types of metacognitive monitoring emerged from our analysis of the thinking aloud protocol transcripts: screening, and justification and a little revision. iii. Two levels of evaluation: intuition and reason
Julie M. Smith & Rebecca Mancy (2018) Exploring the relationship between metacognitive and collaborative talk during group mathematical problem-solving – what do we mean by collaborative metacognition? Journal of Research in Mathematics Education, 20:1, 14-36	To enhance our understanding of the relationship between collaborative talk and metacognitive talk during group mathematical problem solving	i. To identify the metacognitive content of student interactions ii. Metacognitive talk-discussion include of planning, monitoring and evaluating about the problem or about the problem-solving process
Mary Jarratt Smith (2013) An exploration of metacognition and its effect on mathematical performance in differential equations	To study of the metacognitive levels for two classes of differential equations students	i. Planning is being more effective during learning process such us understanding how to use past strategies and knowing which strategy is most effective

Journal of the Scholarship of Teaching and Learning, Vol. 13, No. 1, February 2013, pp. 100 – 111.		
Ihdi Amin & Sukestiyarno (2015) Analysis Metacognitive Skills On Learning Mathematics In High School International Journal of Education and Research Vol. 3 No. 3 March 2015	To study the influence of metacognitive awareness of the cognitive skills ; the influence of metacognitive awareness of the metacognitive skills ; and how the relationship `between cognitive skills and metacognitive skills?	i. The student has a good ability in planning, goal setting, and allocate resources before learning ii. The awareness of students reading instruction carefully before starting the task, while the weakest part is the student's ability to regulate the current study in order to have a longer learning time iii. The student has sufficient ability to perform self-assessment of learning or in assessing the strategies it uses. iv. Ability of students to consider some alternative settlement before answering v. The awareness of students to stop regularly to check for understanding vi. Students is to ask themselves about how well they have achieved the goal (after the task has been completed)
Adnan & Arsad Bahri (2018) Beyond effective teaching: Enhancing students' metacognitive skill through guided inquiry IOP Conf. Series: Journal of Physics: Conf. Series 954 (2018) 012022	To compare metacognitive skill of students between thought by guided inquiry and traditional teaching.	i. Will train skill of student on how plan, manage, and evaluate their learning ii. The students explore their thoughts to find out what previous knowledge they have, that will help them to complete the task iii. The students know what needs to be done first in order to help in completing the task iv. The students plans the time management in planning the task v. Students take action to solve the problems, remember important information, and check whether it is on the right track vi. The student will ask himself or herself what related information is important to remember and what to do to solve the problem vii. Students can ask themselves how well they have solved the problem
Sd Du Toit & Gf Du Toit (2013) Learner metacognition and mathematics achievement during problem-solving in a mathematics classroom TD The Journal for Transdisciplinary Research in Southern Africa, 9(3), Special edition, December 2013, pp. 505-518.	To investigate the level of learner metacognition as well as the level of mathematics achievement during problem-solving in a mathematics classroom	i. Relate mathematical achievement in solving mathematical problems by comparing planning, monitoring and evaluation elements in accordance with the sequence of Polya's Problem Solving Model

Ackerman, R., & Leiser, D. (2014) The Effect Of Concrete Supplements On Metacognitive Regulation During Learning And Open-Book Test Taking British Journal of Educational Psychology, 84(2), 329–348.	i. examined how being led astray by uninformative concrete supplements in expository texts affects achievement	i. The elements of time planning and action when completing tasks are very important in influencing achievement. ii. Evaluation needs to be made to ensure that new knowledge is built up in line with the original source of knowledge
Ariya Suriyon, Maitree Inprasitha & Kiat Sangaroon (2013) Students' Metacognitive Strategies in the Mathematics Classroom Using Open Approach Psychology 2013. Vol.4, No.7, 585-591	investigating students' metacognitive behaviour and abilities in the mathematic class using the open approach	i. Metacognitive strategies could be defined as thinking ability causing behaviour that a problem solver can control, monitor, and reflect his own thinking process, based on an idea or a way which he values from existent resources
Hasbullah (2015) The Effect Of Ideal Metacognitive Strategy on Achievement In Mathematic International Journal of Educational Research and Technology 6[4] 2015; 42-45	to determine the effect metacognitive ideal strategy on achievement in math class	i. Emphasizes the provision of project or task, which is expected to be focused on the learning materials that are considered important and can stimulate students' sense of responsibility in carrying out the project that has been given by the teacher in accordance with the group. ii. Stimulate the students to understand the situational problem by using a specific form of representation, discuss and evaluate the problem solving.

As a result of the analysis of Table 3.1 above, it can be concluded that the most important elements of metacognitive learning strategies are planning, monitoring and evaluating that will shape metacognitive behaviour and metacognitive skills as required in the learning process. If this element can be formed and developed during the learning process, it will affect the learning of the students. Specifically these three aspects can be described as follows:

Table-3.2 Meta-Analysis: Metacognitive Skills and Metacognitive Behaviour

Metacognitive Regulation's Components	**Behaviour/Students Skills**	**References**
Planning	1. Knowing the purpose of learning about topics, set up the goals	Schraw & Moshman (1995), Smith (2013), Cera, Mancini & Antonietti (2013), Tony Karnain et al (2014), Ihdi Amin & Sukestiyarno (2015), Du Toit & Du Toit (2013)
	2. Know the source of information	Smith (2013), Tony Karnain et al (2014), Smith & Mancy (2018), Ihdi Amin & Sukestiyarno (2015)
	3. Recall/study previous knowledge to understand what's new	Cera, Mancini & Antonietti (2013), Adnan & Arsad (2018), Du Toit & Du Toit (2013)
	4. Set some strategies that can be used	Smith & Mancy (2018), Du Toit & Du Toit (2013)
	5. Choosing the suitable and the right strategies	Schraw & Moshman (1995), Cera,

		Mancini & Antonietti (2013), Tony Karnain et al (2014), Smith & Mancy (2018), Du Toit & Du Toit (2013)
	6. See some examples that have been implemented during previous studies/problems	Tony Karnain et al (2014), Smith & Mancy (2018)
	7. Plan tasks and time required for assignments/activities/problems	Schraw & Moshman (1995), Menz & Cindy Xin (2016), Tony Karnain et al (2014), Smith & Mancy (2018), Adnan & Arsad (2018), Ackerman & Leiser (2014)
Monitoring	1. Managing time to understand information	Cera, Mancini & Antonietti (2013), Ihdi Amin & Sukestiyarno (2015)
	2. Manage the time to find new information	Schraw & Moshman (1995), Cera, Mancini & Antonietti (2013), Ihdi Amin & Sukestiyarno (2015)
	3. Take time to implement strategies	Cera, Mancini & Antonietti (2013), Smith & Mancy (2018), Du Toit & Du Toit (2013), Ackerman & Leiser (2014)
	4. Implement selected strategies / operations	Smith & Mancy (2018) Ihdi Amin & Sukestiyarno (2015), Adnan & Arsad (2018), Hasbullah (2015)
	5. Focusing on what's more important, it's important to do it first	Ihdi Amin & Sukestiyarno (2015), Adnan & Arsad (2018), Hasbullah (2015)
	6. Make some revisions and allocate some time to check	Schraw & Moshman (1995), Tony Karnain et al (2014), Ihdi Amin & Sukestiyarno (2015), Adnan & Arsad (2018)
	7. Implement an alternative way if the previous way is ineffective	Schraw & Moshman (1995), Ihdi Amin & Sukestiyarno (2015)
	8. To remembers important matters / information	Adnan & Arsad (2018), Du Toit & Du Toit (2013)
	9. Monitor what's important to keep in mind	Adnan & Arsad (2018), Du Toit & Du Toit (2013)
Evaluating	1. Reflection on objective achievement	Schraw & Moshman (1995), Ihdi Amin & Sukestiyarno (2015), Du Toit & Du Toit (2013), Tony Karnain et al (2014)
	2. Evaluate the level of accuracy of the tasks	Schraw & Moshman (1995), Adnan & Arsad (2018), Hasbullah (2015)
	3. Evaluating the level of achievement / how well to answer the question is better than before	Schraw & Moshman (1995), Adnan & Arsad (2018), Du Toit & Du Toit (2013), Hasbullah (2015)
	4. Ensure new knowledge is in line to the previous knowledge	Ackerman & Leiser (2014), Suriyon, Inprasitha & Sangaroon (2013), Tony Karnain et al (2014)

Based on the three elements, the researcher then listed the activities carried out in the study on mathematical learning activities that directly implied metacognitive skills. The following Table 3.3 shows the learning activities in line with the metacognitive learning strategy based on the metacognitive behaviour and metacognitive skills (planning, monitoring and evaluating) listed on Table 3.2 above.

Table-3.3 Meta-Analysis: The Implementation of Metacognitive Skills in Learning Activities

Author	Activities	Implementation Of Metacognitive Skills/Metacognitive Behaviour			The Impacts To Mathematical Learning
		Planning	Monitoring	Evaluating	
David S. Benders (2016) The Effect of Flexible Small Groups on Math Achievement in First Grade An On-line Journal forTeacher Research.Vol. 18, Issue 1	1.Cooperative work (game) 2.Independent work (practice workbook pages-math journal challenge) 3.Cooperative work (computer review skills)	1, 2, 3, 5, 7 1, 2, 4, 5, 6 1, 2, 5, 6, 7	1, 3, 5, 6, 9 1, 3, 4, 5, 8, 9 2, 3, 4, 5, 7, 8, 9	1, 2, 4 1, 2, 4 1, 2, 4	1. Increase conceptual understanding 2. Improve critical thinking skill
Halil Coskun Celik (2018) The Effects of Activity Based Learning on Sixth Grade Students' Achievement and Attitudes towards Mathematics Activities EURASIA Journal of Mathematics, Science and Technology Education, 2018, 14(5), 1963-1977	1.Problem solving activity 2.Project work 3.Practical investigation	1, 2, 3, 5, 6 2, 3, 5, 7 1, 2, 4, 5, 7	1, 2, 3, 4, 6, 9 1, 2, 3, 5, 8, 9 1, 3, 4, 5, 6, 7, 9	1, 2, 3, 4 1, 2, 3, 4 1, 2, 4	1.Increase mathematics achievement
Peter Rillero (2016) Deep Conceptual Learning in Science and Mathematics: Perspectives of Teachers and Administrators Electronic Journal of Science Education Vol. 20, No. 2 (2016)	1.PBL 2.Discovery Learning 3.Project learning	1, 2, 3, 5, 6 1, 2, 4, 5, 7 1, 2, 3, 4, 5, 7	1, 2, 3, 4, 6, 9 1, 3, 4, 5, 6, 7, 9 1, 2, 3, 5, 8, 9	1, 2, 3, 4 1, 2, 3, 4 1, 2, 3, 4	1. Become more effective thinker and decision maker 2. Used to apply their knowledge 3. More Engaged 4. More Motivated
Azuka Benard Festus (2013) Activity -Based Learning Strategies in the Mathematics Classrooms Journal of Education and Practice.Vol.4, No.13, 2013	1.Observations activities 2.Practical work 3.Using teaching aids 4.Cooperative activity or small group activity	1, 4, 5, 7 1, 2, 3, 5, 6, 7 1, 4, 5 1, 2, 3, 4, 5, 6, 7	1, 3, 4, 5, 6, 7, 8, 9 1, 2, 3, 4, 5, 6, 8, 9 1, 5, 8, 9 1, 2, 3, 4, 5, 6, 7, 8, 9	1, 3, 4 1, 2, 3, 4 1, 2, 3, 4 1, 2, 3, 4	1. Being active learner 2. Discovering things for themselves 3.Increasing mathematical achievement 4. Long-term retention of information

	5.Group discussion	1, 2, 3, 5, 7	1, 2, 3, 4, 5, 6, 7, 9	1, 2, 3, 4	5. Motivated towards further learning 6. Can apply information in new settings 7. Increase thinking skills
Aji Wibowo (2017) The Effect of Teaching Realistic and Scientific Mathematics Approach on Students Learning Achievement, Mathematical Reasoning Ability, and Interest Jurnal Riset Pendidikan Matematika 4 (1), 2017, 1-10.	1. Realistic and Scientific Mathematics	2, 3, 4, 5, 7	1, 2, 4, 5, 6, 7, 8, 9	1, 2, 3, 4	1. Increase reasoning ability 2. Motivated and interested to learned mathematics

4. FINDING AND DISCUSSION

4.1 What Are The Effective Learning Activities That Implied Metacognitive Learning Strategies?

According to Table 3.3 above, the Table 4.1 has presented. Table 4.1 shown what are the effective activities that implied of metacognitive learning strategy and their impact to the students.

Table-4.1 Effective Activities and the Impacts to Students

Effective Activities	Impacts to The Student	References
Problem Based Learning e.g problems solving activity, problems situation, experiment/investigation activity	Being active, interacting with others, higher transfer knowledge / concept to the new experiences	Rillero, 2016; Celik, 2018; Wibowo, 2017
Cooperative Learning e.g class discussion, group work, group project	Influence on classroom climate and students behaviour	Benders, 2016; Celik, 2018; Festus, 2013
Competition / Challenge Based Learning e.g individual/group competitions, school competitions or higher level competitions, problems challenge, project challenge	Increase in creativity, excitement, stimulation, learning skills	Benders, 2016; Celik, 2018; Festus,2013
Game Based Learning e.g played game, technology game	Excitement, interactivity, emotion, gain in self-care behaviour and self-efficacy	Benders, 2016
Transformed Learning e.g Web application, online based, representations, reciprocal teaching, folios, innovation competition	Excitement, being active, greater reduction of misconception	Rillero,2016; Benders,2016; Festus,2013

There are several principle must be considered by teacher in creating metacognitive learning strategies. It includes the expectations that: teachers know what students need to learn and based on what they know; teachers focused on developing metacognitive regulation skills and conceptual understanding, experiences; prior knowledge provide the basis for learning mathematics with understanding; students provide written justification

for problem solving strategies; and problem based activities focus on concepts and skills. The role of discovery and practice and the use of concrete materials are two additional topics that must be considered in developing and improving mathematics achievement.

Some researchers (e.g Festus, 2013; Rillero, 2016) suggested that such a program must be balanced between the practice of skills and methods previously learned and new concept discovery. This discovery of new concepts, they suggest, facilitates a understanding of mathematical connections. According to Rillero, (2016), Benders(2016), Festus(2013) and Wibowo(2017), suggest that when applied appropriately, the long-term use of metacognitive skills to increase mathematics achievement and improve student attitudes toward mathematics. The utilization of metacognitive skills helps students understand mathematical concepts and processes, increases thinking flexibility and provides tools for problem-solving (NCTM, 2000). Teachers using metacognitive behaviour must intervene frequently to ensure a focus on the underlying mathematical ideas, must account for the "contextual distance" between the skill being used and the concept being taught, and take care not to overestimate the instructional impact of their use.

4.2 What Is The Impact Of Activities To The Student's Learning In Mathematics?

The impacts of implementation of metacognitive learning strategies can be seen from two aspects:

4.2.1 Mastery of Mathematics Concept

Reviewed articles showed that implementation of activities such as Problem Based Learning, Project Work, Discussion, Game, etc, is mostly effective to students understanding (e.g; Benders, 2016; Celik, 2018; Festus, 2013). It means, student learning is greatly enhanced when the student's prior knowledge is made visible. At that point the students have opportunity to correcting any misconceptions; using the prior knowledge, and create schemas of understanding around a topic. Learning is optimized when students can see where new concepts build from prior knowledge. Students learn more when the concepts are personally meaningful to them. In order to deeply understand a topic, learners not only need to know relevant facts, theories, and applications, they must also make sense of the topic through organizing those ideas into a framework (schema) of understanding. The development of schema, require students learned topics in ways that are relevant and meaningful to them.

4.2.2 Thinking Skill

In fact of applying the metacognitive learning strategies, critical thinking skill and other thinking types such as reasoning skill, are popular reported by Rillero (2016), Wibowo (2017), Benders (2016), Festus (2013). Critical thinking allows students to process information in a logical manner and to prepare themselves for learning. They can identify logical errors, and it can help students to solve the problems. If student can think critically, creatively, and solve mathematic problems independently, then they will be able to succeed in making decisions Singh (2017), understand options and expand knowledge to daily life (Kumar,2018;Pathak,2018).

CONCLUSION

As a conclusion, these review inform that, there are several activities that can be used by teacher in learning process due to the principles. But teacher should choose the effective activity, depend on the content and students condition. The use of activity based learning in the form of metacognitive strategies facilitate higher level of learning and understanding of the concept of mathematics that lead student to improved academic performance. Through the activities and strategies, students become more motivated and attitudes towards mathematics become positive, so that improve their academic performance. Using metacognitive learning strategies in mathematics, means students encourage to solve the problem with their own way. Here students are required to have good prior knowledge, to make them easier find the relationship between the concept in mathematics and real context. It also can change student's perception about mathematics is difficult become mathematics is very useful and applicable to solve problem in their daily life.

Further studies can be carried out to further enhance the findings of this study. Among them can be done to see effectiveness in other subjects. Besides that it can also be examined about the motivation or attitude of the students after learning based on activity.

REFERENCES

[1] Ackerman, R., & Leiser, D. The effect of concrete supplements on metacognitive regulation during learning and open-book test taking. British Journal of Educational Psychology, 84(2), 329–348. 2014.

[2] Adnan & Arsad Bahri. Beyond effective teaching: Enhancing students' metacognitive skill through guided inquiry. IOP Publishing .Journal of Physics: Conf. Series 954 (2018) 012022 doi:10.1088/1742-6596/954/1/012022. 2018.

[3] Ariya Suriyon, Maitree Inprasitha & Kiat Sangaroon. Students' Metacognitive Strategies in the Mathematics Classroom Using Open Approach. Psychology. 2013. Vol.4, No.7, 585-591. 2013.

[4] Benders,D.S.The Effect of Flexible Small Groups on Math Achievement in First Grade. An On-line Journal forTeacher Research.Vol. 18, Issue 1.Issn 2470-6353.Spring. 2016.

[5] Bonwell,C. C.,Eison,J.A. Active Learning: Creating Excitement In The Classroom. ERIC Digest. ERIC Clearinghouse on Higher Education.Washington DC. 1991.

[6] Celik, H. C. The Effects of Activity Based Learning on Sixth Grade Students' Achievement and Attitudes towards Mathematics Activities. EURASIA Journal of Mathematics, Science and Technology Education, 2018, 14(5), 1963-1977.2018.
[7] Cera R, Mancini, M.& Antonietti, A. Relationship Between Metacognition, Self-Efficacy and Self-Regulation in Learning.ECPS-Journal-7/2013. doi:10.7358/ecps-2013-007-cera.
[8] Du Toit,SD. & Du Toit,GF. Learner metacognition and mathematics achievement during problem-solving in a mathematics classroom .TD The Journal for Transdisciplinary Research in Southern Africa, 9(3), Special edition, December 2013, pp. 505-518.
[9] Festus,A.B. Activity -Based Learning Strategies in the Mathematics Classrooms. Journal of Education and Practice.Issn:2222-1735.Vol.4, No.13, 2013.
[10] Hasbullah. The Effect Of Ideal Metacognitive Strategy on Achievement In Mathematic. International Journal of Educational Research and Technology. 6[4] 2015; 42-45. DOI: 10.15515/ijert.0976-4089.6.4.4245
[11] Ihdi Amin & Sukestiyarno, Y.L. Analysis Metacognitive Skills On Learning Mathematics In High School. International Journal of Education and Research Vol. 3 No. 3 March 2015.
[12] Kumar,B. Inclusive Education-New Challenges And Strategies. International Journal of Technical Research & Science. Volume 3 Issue X, November 2018.
[13] National Council of Teachers of Mathematics. Principles and Standards for School Mathematics. Washington, D.C.2000.
[14] Noorzeliana Idris, Norazilawati Abdullah & Saniah Sembak. Kesedaran Metakognisi Dan Pemahaman Konsep Dalam Penyelesaian Masalah Matematik. Jurnal Pendidikan Sains & Matematik Malaysia Vol.5 NO.2 DEC 2015 / ISSN 2232-0393.
[15] Pathak,G. Collaborative Learning In Action: An Evaluative Study Of Its Effectiveness And Affectivness In Elementary Mathematics Classrooms Of Delhi. International Journal of Technical Research & Science.Volume 3 Issue I, February 2018.
[16] Petra Menz & Cindy Xin. Making Students' Metacognitive Knowledge Visible through Reflective Writing in a Mathematics-for-Teachers Course. Collected Essays on Learning and Teaching, Vol. IX. Simon Fraser University. 2016.
[17] Pokhrel,T.R. Activity Based Mathematics Instruction: Experiences in Addressing the 21st-Century Skills. Journal of Mathematics Education. Vol. 11, No. 1, pp. 46-61. March 2018.
[18] Raj,M.B. The Effectiveness of Activity Based Learning: An Analysis. Veda's Journal of English Language and Literature- JOELL, 2(4), 84-87. 2015.
[19] Ranjan,A. Effect Of Virtual Laboratory On Development Of Concepts And Skills In Physics. International Journal of Technical Research & Science. Volume 2 Issue 1, February 2017.
[20] Rillero,P. Deep Conceptual Learning in Science and Mathematics: Perspectives of Teachers and Administrators. Electronic Journal of Science Education Vol. 20, No. 2 .2016.
[21] Rillero,P.& Padgett, H. Supporting Deep Concept Learning.T.H.E Journal , 37-40. 2012.
[22] Schraw, G. & Moshman, D. Metacognitive Theories. Educational Psychology Papers and Publications. 40. Online :http://digitalcommons.unl.edu/edpsychpapers/40.1995.
[23] Singh,P., Gopalkrishnan,V.S. Effectiveness Of Integrated Teaching Programme On Problem Solving Skills. International Journal of Technical Research & Science. Volume 2 Issue 1, February 2017.
[24] Smith, J.M & Mancy,R. Exploring the relationship between metacognitive and collaborative talk during group mathematical problem-solving – what do we mean by collaborative metacognition?, Research in Mathematics Education, 20:1, 14-36. 2018. DOI:10.1080/14794802.2017.1410215.
[25] Smith, M.J. An exploration of metacognition and its effect on mathematical performance in differential equations. Journal of the Scholarship of Teaching and Learning, Vol. 13, No. 1, pp. 100 – 111. February 2013.
[26] Su, H.F., Ricci, F.A., & Mnatsakanian, M. Mathematical teaching strategies: Pathways to critical thinking and metacognition. Journal of Research in Education and Science (IJRES), 2 (1), 190-200. 2016.
[27] Thangarajan,M. A Study Of The Relationship Between Teacher Attitude And Teaching Aptitude Of Prospective Secondary School Teachers. International Journal of Technical Research & Science. Volume 3 Issue IV, May 2018.
[28] Tony Karnain, Md Nor Bakar, Seyed Yaser Mousavi Siamakani, Hossein Mohammadikia & Muhammad Candra. Exploring the Metacognitive Skills of Secondary School Students' Use During Problem Posing. Jurnal Teknologi (Social Sciences) 67:1 27–32. 2014.
[29] Van Der Stel,M., Veenman,M.V.J., Deelen,K. & Haenen,J. The increasing role of metacognitive skills in math: A cross-sectional study from a developmental perspective. ZDM Mathematics Education. Springer. 42:219-229. 2010. Doi: 10.1007/s11858-009-0224-2
[30] Wibowo,A. The Effect of Teaching Realistic and Scientific Mathematics Approach on Students Learning Achievement, Mathematical Reasoning Ability, and Interest. Jurnal Riset Pendidikan Matematika. 4 (1), 2017, 1-10.