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Planning strategy through reduce cognitive load of secondary school students: Brief metacognitive development analysis

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Abstract: Stages of the learning process sometimes reveal conceptual errors found in the information obtained by students that has been conveyed by teachers. Metacognition is able to provide monitoring strategies for students' thinking stages; therefore, they are able to describe thinking strategies, the results of their thinking, and the stages of the learning process. Metacognition plays a significant role, particularly in solving mathematical problems. This research is targeted at identifying planning strategies to reduce the cognitive load of metacognitive strategies in the mathematics learning model, which are considered dominant and linear among secondary high school students. The number of stages of metacognitive development includes identification of what you know, talking about thinking, keeping a thinking journal, planning and self-regulation, reporting back on thought processes, and self-evaluation. This research and development use the ADDIE steps, which cover analysis, design, development, implementation, and evaluation. The subjects of the research include 8th grade junior high school students in the City of Kediri. Findings indicate that metacognition is an individual's process of thinking related to thinking in order to build strategies for solving problems. Metacognition is identified through activities that cover planning how to approach learning tasks, monitoring abilities, and evaluating plans in order to carry out tasks. Research findings revealed the syntax of the worked example-metacognition learning model in mathematics learning, which includes the introductory stage, exploration, controlled practice, and evaluation. The worked example-metacognition learning model in mathematics learning is considered feasible by experts and practitioners. The worked example-metacognition learning model in mathematics learning is considered practical by observers and students, and it is effective in reducing cognitive load and improving students' improvisation metacognitive skills.

Keywords: *Cognitive load, Planning strategy, Worked example, Metacognition.*

1. Introduction

The worked example-metacognition mathematic learning model is crucial to develop as it could help students understand and absorb learning materials more effectively and it worked examples provide concrete and structured illustrations of how to solve problem, while metacognition encourages students to think of their own thinking processes during learning. The worked example metacognitive learning model is also expected to enhance students' critical and analytical thinking skills. Metacognition, which involves awareness and control over one's own thinking processes, allows students to recognize errors, evaluate methods they use, and plan more effective learning strategies. Moreover, worked example metacognitive learning model could increase students' motivation and confidence [1]. Students who use metacognitive strategies tend to have higher motivation and feel more confident in their learning abilities. Therefore, development of worked example metacognitive learning model not only helps

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students understand subject matter, in another hand, also encourages to become more independent learners.

Metacognitive strategies covered mapping thought patterns in acquiring learning targets starting at early stage which is not yet supported by previous observation data and mathematic metacognitive learning strategies are significant factor because they are able to direct learning process to become more structured and systematic. The relevance of renewable learning patterns and systems established by Ministry of Education and Culture in collaboration with Directorate General of Educators and Education Personnel (Ditjen GTK), *release* learning with *Higher Order Thinking Skills* or HOTS. The target of this policy is to improve quality of learning [2]. Bloom's taxonomy categorization and critical thinking indicators, HOTS component is significantly related to critical thinking skills [3]. Optimizing HOTS-based learning and contemporary economic and technological advances, students of 8th grade secondary high school need to acquire critical thinking skills, therefore, they are able to be more selective in gathering information and solving complex problems in daily life [4]. However, Mathemtic teaching is currently experiencing dynamic focus on teaching process in classroom which was initially centralized on teachers or lecturers in control of teaching, now learning focuses on students and learning process [5].

Students have varying levels of critical thinking ability and require different lengths of time to initiate critical thinking activities when solving Mathematic questions. The implication which emerges is that teachers should play vital role in developing critical thinking skills because there are fundamental differences in students' thinking characteristics. Critical thinking might be integrated and focused on mathematic curriculum, therefore, students are able to develop their abilities and apply them as means of progressing their academic achievement and critical thinking skills [6]. Each student has unique method of encouraging critical thinking and *self confidence*. These students are one of dominant factors in learning activities and s*elf confidence* students emerge when they are able to find answers to problems adequately and are able follow understanding ideas they obtain based on learning Mathematic [7].

Students who are unable to develop their cognitive abilities due to lack of *self confidence* and number of students prefer not to solve mathematic questions, condition of inadequacy *self confidence* and inability to understand mathematic skills are elementary aspects of emergence of number of these implications. *Self confidence* Individuals really need it in daily activities or in mathematic questions. *Self confidence* individuals are able to lead to creation of thoughts [8]. Based on research through meta-analysis [9] *self confidence* has significant effect on students' Mathematic learning achievement, therefore, students' Mathematic learning achievement is significantly influenced by degree *self confidence.*

Optimization of Mathematic learning strategies implemented at City of Kediri secondary high school as single locus within Mathematic *advance* would be research subjects and students with Mathematic *advance* able to utilize their learning strategies optimally, therefore, they are able to indicate satisfactory learning outcomes and practical abilities.

There are two elementary problems which would be target of this research, types of metacognitive learning strategies which are often used by students within this level of Mathematic and types of metacognitive learning strategies which are rarely used by students at this level of Mathematic. It is expected that findings of this research would contribute significantly and be able to become reference source for students in optimizing learning strategies. Relevantly, it is expected that findings of this research would be able to provide latest formulations in Mathematic teaching *linear* student learning strategies, therefore, learning process becomes more optimal.

Numbers of studies have investigated learning characteristics and strategies as effort to achieve more independent learning process [10]. This learning strategy plays significant role as means of realizing student autonomy in Mathematic learning process [11]. Numbers of studies prove this aspect through indications which implementation of metacognitive strategies in Mathematic 8th grade secondary school learning is able to support and improve ability mastery [11-14]. The linearity of other relevant research covered there's no such research had been found related students' metacognitive learning strategies supported by level of Mathematic skill of 8th grade secondary school.

Critical thinking is thinking strategy which collaborates inquiry, observation, experience and other search activities in order to obtain rational conclusions by systematically connecting number of knowledge [15, 16]. Critical thinking skills are best alternative solution for students' logical problem solving abilities. Regardless of these conditions, students might be taught critical thinking skills in solving macro problems. Critical thinking capacity is determined by cognitive functions that enable students to decide best decisions, particularly when solving Mathematic questions [17].

Early observations at secondary school City of Kediri related through mathematics instruction at topic of solid geometry revealed several issues related to students' cognitive load and metacognitive skills. The observations indicated that teaching methods used were still focused on direct instruction without considering students' metacognitive skills. Teachers tended not to consider students' prior knowledge and rarely employed problem-solving methods in teaching. Cooperative learning was also not optimally implemented. Consequently, students' learning activities were less effective, and their academic performance was suboptimal. Document analysis shows average student score was only 78.5, which falls into category of below average according to fundamental education standards.

Additionally, cognitive load placed on students is excessively high and large volume of material and assignments given are not structured and planned properly, put it in difficult situation for students to comprehend content. Teachers have not provided intensive guidance, causing students to feel bored and disinterested in mathematics. Interviews held through students and teachers indicated, students understand material better when presented using problem-solving methods related to daily life and simple examples. Therefore, change in teaching methods which takes into account metacognitive skills and cognitive load is necessary to improve student learning outcomes. Students who are taught using worked example strategies to manage their cognitive load are better prepared to handle well-structured learning material based on CLT principles compared to students who are exposed to consistent educational system [18-21]. Therefore, using learning model which considers worked examples and metacognition would positively impact students' learning outcomes. At once, it is necessary to develop worked example-metacognition model in mathematics learning.

Oxford [22] Learning strategies are specific actions carried out by students to create learning activities which are more effective, easy, fast, fun and could be transferred to new momentum and one of categories learning strategies is indirect strategies. Based on [23] indirect strategies covered metacognitive, affective and social strategies and metacognitive strategies enable students to be able to control learning individually and focus on organizing their learning, planning activities and evaluating learning progress independently.

Metacognition is students' awareness of their thinking processes, checking back on their thinking processes, and regulating their thinking processes. In another hand, metacognitive awareness plays significant role in significantly elevating students' academic performance [24, 25]. Students compleated high levels of metacognitive awareness tend to achieve impressive academic results [26] exhibit strong motivation to reach academic achievement [27, 28] and obtain good learning outcomes [29]. Furthermore, their ability to respond challenges, covered problem-solving, is also better [30-32].

The results of research at State Junior High School 4 Bendahara Aceh Tamiang to analyze students' metacognitive abilities in solving mathematical problems [33]. The results show that students' metacognitive abilities play an important role in solving mathematical problems effectively. This research also indicates that metacognitive strategies are considered the most frequently implemented strategies.

Research by Fahmi, et al. [33] at State Junior High School 4 Bendahara Aceh Tamiang analyzed students' metacognitive abilities in solving mathematical problems. The results showed that students' metacognitive abilities play an important role in solving mathematical problems effectively.

The next research linearity by Gerami and Baighlou [34] research findings based on locus of PGRI Palembang University were supported by 25 respondents focusing on social strategies which were considered strategies most frequently used by students, *linear* learning Mathematic 8th grade secondary school teaching scheme. The next relevant comparative research was by Gerami and Baighlou [34] supported by 588 respondents in context of teaching English in Iran, research findings indicated that students within high level of English proficiency implemented six previous strategies and metacognitive strategies were the most frequent strategies. implemented. *Gap research* indicates that locus is located in Iran and English is second language and foreign languages are part of language teaching in Indonesia.

2. Materials and Methods

The methodological basis of this research is descriptive based on quantitative perspective which is targeted at being able to examine phenomena and describe findings in research reports. The entire series of research activities focuses on uncovering learning strategies used by high-achieving students at secondary school city of Kediri, focusing on research subject, entitled high-achieving students. The development model used as basis for development is result of adopting ADDIE model [35] covered stages of analysis, design, development, implementation and evaluation and detailed stages presented in table.

Table1.
Research Approach at Each Stage.

Analyze	Design	Develop	Implement	Evaluate
1. Validating performance gaps 2. Determining instruction objectives 3. Confirming informants 4. Identifying required resources 5. e. Developing project management plan	1. Conducting task inventory 2. Developing performance objectives 3. Generating testing strategies	a. Produce prototype b. Select or develop supporting media c. Develop a guide for students d. Develop a guide for teachers e. Conduct formative revisions f. Conduct trials	1. Preparing teachers 2. Preparing students 3. Conducting formative evaluations and final stage revisions	1. Selecting evaluation tools 2. Conducting formative evaluations to improve products 3. Conducting summative evaluations to see the quality of learning in general
Analysis Summary	Design Brief	Preliminary Product Development	Strategy Implementation	Evaluation Plan

2.1. Instrument and Measures

The macro research description above is basis for carrying out this research to provide alternative solutions. This research is development of implementation of previous similar research and effectiveness parameters of data availability and empirical theory support are measured based on displays *grand theory* and its derivation as well as availability of primary and secondary data that researchers have managed to collect from number of sources with verified objectivity. This conceptual basis is parameter for achieving research targets in synergy with aspects of relevance to real conditions at 8^{th} grade secondary school city of Kediri.

The instrument used to measure cognitive load is non-test form and non-test form is by using 9-point Likert scale and it has been proven to have quite high reliability, and is more sensitive to measuring cognitive load. however, assessment instrument for students' metacognitive abilities in solving mathematical problems and there are four problems which need to be presented in reading questions and assessing one's own confidence in finding correct answer, before solving problem, producing sketches which could help students solve mathematical problems, solving problems and filling answers, and assessing one's own confidence in having found correct answer.

2.2. Respondent

Products which have passed feasibility test by experts, then used in field trials to assess practicality and effectiveness of product implementation. Limited trials were conducted in one school, and extensive trials were conducted in three different schools. Respondents involved in development f worked example-metacognition learning model included five validators, four mathematics teachers, 238 students, and four observers.

Limited product trials involved 34 students of schools covered excellence categories and sampling was done by purposive sampling. Furthermore, larger scale product trial was conducted in different schools. The sampling technique used as stratified cluster random sampling and based on technique, class of 204 students was obtained.

Based on each category, one school was then taken using cluster random sampling technique. Furthermore, using same sampling technique, two classes were taken from each school. The first class was designated as experimental class, and second class was designated as control. Based on sampling flow, number of samples at experimental class was 103 students and while control class was 101 students.

2.3. Data Analysis

Research Instruments covered validity analysis of model is based on study held by experts on numbers components of model and supporting equipment developed such aspect of validated model components covered theoretical basis, syntax, social system, reaction principle, support system, and instructional and mentoring impact. The level of validity of model and its supporting tools is analyzed using Aiken validity index. Practicality of model is seen Based on analysis of results observations at implementation learning and student responses after following series of learning. The criteria for practicality of product used in study related to ideal ranking system. Furthermore, effectiveness of metacognition worked example learning model is analyzed at extensive test stage. Data analysis technique used at this stage is parametric statistical test at form of paired sample test.

2.4. Theory Background

Metacognition is terminology introduced by Flavell in 1976 that metacognition is an individual's awareness related their cognitive processes and independence in order to achieve certain targets. The concept of metacognition is an individual's alleged thinking about his thoughts which covered metacognitive knowledge, entitled individual's awareness of something he knows, metacognitive skills, entitled individual's awareness of something he does and metacognitive experience, entitled individual's awareness of cognitive abilities he has. Mentioned that junior high school students studying integer material need to be aware of knowledge they have related concepts and properties of integer counting operations that they have studied, identify and understand procedures for integer counting operations that they carry out and be aware of abilities they have in solving problems related to integers.

Cognitive load theory could be implemented in designing mathematics learning with target of reducing extrinsic cognitive load that students might experience. Through efforts to reduce non-essential cognitive load, students could better accept learning and construct knowledge gained into comprehensive understanding. Numbers of strategies in designing mathematics learning based on principles of cognitive load theory covered no-target effect, worked example effect, divided attention effect, redundancy effect, modality effect, effect of element interactivity, imagination effect, and effect of dim guidance.

Metacognitive knowledge contains declarative knowledge, procedural knowledge, and conditional knowledge. Declarative knowledge is knowledge about oneself as learner as well as knowledge related to strategies, skills and learning resources that one needs for learning purposes. Procedural knowledge is knowledge related to efforts to utilize everything that has been identified in declarative knowledge during learning activities. Conditional knowledge is knowledge about assumptions when implementing procedures, skills, or strategies and numbers of factors that do not provide reason for procedure to take place and in conditions in which it occurs. It was concluded that metacognitive knowledge is considered higher order thinking because it involves more executive functions that coordinate learning behavior.

2.5. Result of Research

Stages of learning process sometimes identify conceptual errors in information obtained by students that has been conveyed by teacher. Related through these conditions, metacognition is able to provide monitoring of students' thinking stages, therefore, they are able to describe thinking strategies and results of their thinking. The stages of metacognitive learning process play significant role, particularly in solving mathematical problems. The optimal benefits obtained in solving mathematical problems should be carried out through numbers of optimal systematic solving stages. One form of managing mathematical problem solving is understanding problem, preparing solution plan, implementing solution plan, and reviewing solutions that have been completed. Through numbers of stages of systematic problem solving and results are not only optimal solutions but also formation of optimal structured thinking patterns in individuals when facing problems that should be solved

Metacognition strategies help students at 8th grade secondary school city of Kediri fixed at concepts are abstracted from perceived regularities in objects or events and used to determine these regularities. Student creativity is involved in abstracting new concepts and effective learning is fundamental process and humans acquire majority of usable knowledge. The linearity of number of concepts, principles, theories, and philosophies as involved in selecting or interpreting observed objects or events is an integral part of instruction *metaknowledge*.

Metacognitive strategies control one's thoughts by designing, monitoring and assessing material being studied. Moreover, when implementing metacognition strategy, students are able to control their learning, covered designing material they want to study, monitoring their own learning progress, and assessing material studied. When students utilize their metacognitive abilities optimally, they would find it easy to solve mathematical problems.

Linear problemsolving means metacognition is also linear thinking strategy for students about their thinking and ability to determine right strategy for solving problems. The implementation of metacognitive abilities in problem solving is one of interesting factors which is focus of educational researchers. When problem solving is carried out by involving awareness of thought process and self-regulation abilities, this allows for strong understanding supported by logical reasoning. This understanding is something which is always emphasized during mathematics learning because of its strong linearity supported by mathematical thinking patterns. The most important factor in learning is process and not final result. Moreover, learning process has very important values and reflects students' abilities. This condition applies to stages of problem solving process because solving problems is linear process that requires extra thinking.

2.6. Mathematics Learning to Reduce Cognitive Load

Numbers of metacognitive aspects could be developed by implementing metacognitive development strategies, entitled solving problems in pairs and implementing it, one student talks about problem, describes his thinking process, his partner listens and asks questions to help clarify his thinking.

Target achievement in metacognitive strategies focuses on understanding that humans abstract knowledge and offer practice in process of abstracting valuable value claims related to number of regularities observed in objects and events. The level of students' mathematic mastery at 8th grade secondary school city of Kediri plays significant role in selection and use of variety of learning strategies and one of factors which supports students' mathematic mastery is duration of math learning time. The duration of mathematic learning time is able to support level of mathematic mastery. The test results using Independent Samples Test yielded t-value of 10.766 with significance value of 0.00. The significance value is less than 0.05, thus H_0 is rejected. Based on this analysis, experimental model produces better metacognitive skills than its control model. This result could also be seen from average metacognitive skills scores of students in control class group, which was 15.1, while score in experimental class was 18.1. Therefore, the experimental group which was given treatment with worked example-metacognition learning model, achieved higher average metacognitive skills score compared to control group.

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Independent Samples Test showed t-value of -7.748 completed significance value of 0.00. The significance value is less than 0.05, thus H_0 is rejected. Experimental model results in lower cognitive load compared to control model. Revealed average cognitive load scores of students in control class group with score of 3.8, while score in experimental class was 3.5. Therefore, experimental group, which was treated with worked example-metacognition learning model, achieved lower average cognitive load score compared to control group.

Normality tests using Kolmogorov-Smirnov and Shapiro-Wilk on distribution of data for learning model scores of worked example-metacognition in experimental and control groups have sig > 0.05, indicating metacognition skills scores are normally distributed. Furthermore, homogeneity test would be conducted to examine variance within same population.

The homogeneity test described found Homogeneity of Variance statistic has significance value of 0.331. This significance value is greater than 0.05, indicating metacognitive skills scores in worked example-metacognition learning model are homogeneous. Subsequently, determining difference in metacognitive skills between experimental class and control class, t_{test} statistical analysis would be conducted. Component Metacognition does not have to be used comprehensively and in certain standard order, however, numbers of components could be used separately *linear* characteristics of problem to be solved. An example of optimizing metacognition in problem solving activities, entitled creative thinking, is an aspect which is highly considered as skill that should be improved by all students. these conditions *linear* Creative thinking abilities could and should be developed in all students. However, this ability would not appear immediately and creative thinking requires context of individual making preparations based on significant previous experience to face new circumstances. Developing students' metacognitive abilities in mathematics learning could be done through habituation of thinking and this condition is considered to be carried out continuously and sustainably and its effectiveness is researched. These conditions are not always easy to do and concept discovery stage cannot be carried out by students instantly, therefore, students' metacognitive activities also do not always occur easily.

2.7. Mathematics Learning Efforts to Improve Metacognition Skills

The quality of learning of students and graduates is often determined by success of teacher in managing classroom. Class management in English is termed classroom management, means management terminology is synonymous with management. The definition of management or management in general, entitled activities covered planning, organizing, directing, coordinating, supervising and assessing in order to achieve goals. Delivery of mathematics material in mathematics learning in an effort to achieve certain competencies could be done, among other things, through teacher's strategy of using friendly language and could help stimulate students' thinking related mathematics material being presented. Delivery of mathematical material realistically and realistically in students' lives. The teacher asks questions that stimulate students' metacognition. Metacognition could be realized by asking individual questions, therefore, as to identify cognitive processes and cognitive activities carried out.

The use of methods is teaching strategy and teacher approach that greatly determines student learning activities, as well as use of teaching aids and learning media. Mathematics teaching methods and approaches covered lecture, demonstration, question and answer, assignment, discussion and inquiry methods. The use of this method is based on material to be delivered, characteristics of students, and existence of environment where students learn.

Metacognition is very necessary for successful learning because metacognition allows students to be able to manage cognitive skills and be able to find weaknesses which would be corrected with next cognitive skill. Individuals who are able to perform certain skills are able to perform metacognition, entitled thinking about efforts to perform these skills. Students could be encouraged to carry out metacognition with strategies to increase awareness that metacognition is needed to improve academic achievement. Metacognitive abilities play strategic role in solving numbers of problems in mathematics learning. Students could be aware of their metacognitive abilities and would carry out better and more strategic thinking than students who are not aware. The thinking process in problem solving is an important factor that needs attention from educators, particularly helping students develop their abilities in solving problems.

Student metacognition involves students' knowledge and awareness related their individual cognitive activities or all linear cognitive activities. Numbers of stages improve metacognition, entitled identifying what you know and what you don't know. Starting an observation activity, students need to make conscious decisions related knowledge. Pair problem solving is another useful strategy and students talk about problem, describing their thinking process, while their partner listens and asks questions to help clarify thinking process.

Keeping thinking journal is another strategy for developing metacognition through use of journals or study notes. The journal is in form of diary and each student reflects on their thinking, compiling notes related to awareness of ambiguities and inconsistencies, and comments related efforts to face difficulties. Developing planning and self-regulation Students must start working on increasing their responsibility to plan and regulate learning. It is difficult for students to become self-regulating people when learning is planned and monitored by others. Reporting back on thinking process is final activity that focuses student discussion on stages of thinking process in order to develop awareness of strategies that could be applied to other learning situations. three-stage method could be used, entitled teacher directs students to review activities, collect data related to thinking processes; group classifies related ideas, identifies strategies used; evaluating success, discarding inappropriate strategies, identifying strategies that could be used later, and looking for promising alternative approaches. Self-evaluation focuses on experience of self-evaluation could be initiated through individual meetings and focused list of stages of thinking process.

3. Discussion

Indicators of duration of student learning time are indicated based on age of child and planning strategy through reduce cognitive load of metacognitive strategies in mathematic learning model which are considered dominant *linear* through secondary high school student, result in differences in characteristics of variations in types of learning strategies used by students at each age level. although there are number of similarities. Efforts to improve students' metacognition could be done through use of inquiry learning strategies [36]. Implementation of metacognitive strategies *problem solving* and *problem based learning* able to develop high-level thinking skills in students [37]. Teachers need to pay attention to learning models *linear*, therefore, students' metacognitive abilities are progressive [38].

The four strategies implemented were 80% at intensity level *often* on implementation of learning strategies in Mathematic learning process. The first strategy most often used is *I pay attention* and 88% of respondents described frequently using metacognitive strategies by paying attention.

The planning strategy through reduce cognitive load of metacognitive strategies in mathematic learning model which are considered dominant *linear* through secondary high school student which learning strategies *reciprocal teaching* collaborated *think pair share* proven to provide better achievements in improving students' metacognitive abilities. Moreover, it is proven that students' metacognitive abilities experience learning progress by implementing strategies *jigsaw* collaborated *problem based learning* based *lesson study*. This research is an effort to improve students' metacognition by optimizing school environment as learning resource and it is expected that final findings of this research would be able to obtain progress in students' metacognitive abilities as indicated by exceeding indicators of understanding, controlling and manipulating students' cognitive processes.

3.1. Metacognitive Strategy I Pay Attention

Cognitive load and metacognitive skills have close relationship in learning process. Cognitive load refers to amount of mental effort required by an individual to process information while learning. High cognitive load could hinder an individual's ability to absorb and process information effectively. This is where metacognitive skills play an important role. Metacognitive skills, which are abilities to

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understand and regulate one's own thinking processes, help individuals manage cognitive load better. Through metacognition, individuals could recognize when they are experiencing cognitive overload and then apply strategies to reduce this load, such as breaking information down into smaller parts or using elaboration techniques.

Furthermore, metacognitive skills not only help in managing cognitive load but also enhance overall learning effectiveness completed excellence metacognitive abilities, individuals could plan, monitor, and evaluate their learning processes more efficiently. For instance, they could determine right time to take break or change their learning strategies if it find them ineffective. This not only reduces cognitive load but also maximizes learning outcomes. Therefore, metacognitive skills are crucial tools for optimizing learning in more adaptive and controlled manner, allowing cognitive load to be better managed and making learning process more efficient and effective.

3.2. Mathematics Learning to Reduce Cognitive Load

Minimizing students' cognitive load, particularly unnecessary extrinsic cognitive load, is very important, therefore, material presented by teacher could be optimally processed by students into meaningful knowledge. Human Cognitive Architecture is an important concept in education, particularly in context of mathematics learning at junior high school level. HCA focuses on understanding human brain's efforts to process, store and obtain information that has great relevance in efforts to improve quality of mathematics learning [39].

Numbers of important HCA factors and concepts could be applied in mathematics learning at junior high school level. HCA is considered to play significant role in two types of learning process memory, entitled working memory and long-term memory. Working memory has limited capacity and is only able to process certain number of information elements at once. This condition has important implications for mathematics learning at junior high school level, because students are often faced with complex mathematical concepts. In order to increase learning effectiveness, it is important to present material with strategies that do not burden students' working memory. Moreover, teachers must ensure that explanations and learning materials are delivered briefly and clearly, therefore, students could process information optimally. The concepts of repetition and practice are dominant factors in moving information from working memory to long-term memory. Related through context of junior high school mathematics, students need to do regular practice to strengthen their understanding of concepts of algebra, geometry and statistics. This practice helps students internalize mathematical knowledge and skills, therefore, information could be more easily accessed and implemented in future [40].

Cognitive load theory is an important aspect of linear HCA strategies for optimizing mathematics learning and it suggests that learning be designed normatively, therefore, it does not burden students' working memory. Related through mathematics, this means breaking learning material into numbers of smaller parts, utilizing relevant examples, and implementing visualization methods to help students understand abstract concepts. Through efforts to reduce students' cognitive load, learning becomes more efficient and effective. HCA focuses on importance of schema development in long-term memory.

Schemas are mental structures which help individuals organize and interpret information. Related through mathematics, development of optimal schemas allows students to connect new concepts with previously held knowledge. These conditions facilitate students' comprehensive understanding and ability to solve mathematical problems [21, 40, 41].

Implementing cognitive load theory in mathematics teaching is very important as an effort to reduce non-essential cognitive load which could hinder students' understanding and learning. Cognitive load theory is an important concept in Human Cognitive Architecture which focuses on human brain which has limited capacity to process information. Moreover, mathematics learning context utilizing cognitive load theory plays significant role in ensuring students could assimilate mathematical concepts more efficiently.

One important aspect in implementing cognitive load theory is breaking down mathematics learning material into numbers of smaller parts which are more easily accessible to students. Mentioned that when teaching complex mathematical concepts, entitled algebraic equations, teachers could start with numbers of simpler stages and gradually introduce more complex concepts, helping students not feel too overwhelmed by majority of information that should be processed at once.

The use of concrete examples and real-world situations is also an effective strategy in reducing non-essential cognitive load. Related through mathematics teaching, teachers could illustrate mathematical concepts with relevant examples in life. Mentioned that when teaching concept of comparison in mathematics, teachers could provide examples which are easy for students to understand, covered comparing prices of goods in shops or comparing amounts of ingredients in cooking recipes. Through this strategy, students could more easily relate mathematical concepts to real situations, which helps reduce non-essential cognitive load that might arise when students try to connect theory with practical applications. Regardless of these conditions, use of learning technology could be very effective tool in reducing non-essential cognitive load in mathematics learning. Mentioned that use of interactive mathematics software or mathematics learning applications could help students conceptualize and practice numbers of mathematical concepts with strategies which are interesting and easier to understand. The technology is often equipped with step-by-step guides which help students understand material gradually without feeling too overwhelmed. Regardless of these conditions, it is also important for teachers to provide constructive feedback to students during learning process.

This feedback helps students understand where they might experience difficulties and how to overcome these obstacles, therefore, students could focus cognitive energy on progressive understanding and mastery of essential mathematical concepts.

In an effort to reduce non-essential cognitive load in teaching mathematics, teachers must also consider use of optimally prepared learning materials. The material should be presented in logical and clear sequence, therefore, students could follow development of concepts smoothly. The use of appropriate words and language which is easy to understand is also very important, therefore, students do not experience difficulties in understanding instructions and explanations. Related through conclusions, implementation of Cognitive Load Theory in mathematics teaching is considered important to reduce non-essential cognitive load which could hinder student learning. By breaking down material, using concrete examples, utilizing learning technology, providing feedback, and compiling optimal material, teachers could help students to more efficiently assimilate important mathematical concepts.

Completed by right approach, students would more easily understand and master mathematics, creating more meaningful and effective learning experience. It was concluded that cognitive load theory is cognitive load that arises when students solve math problems. This cognitive load could arise internally and externally but could be managed if students are trained. It was further explained that intrinsic cognitive load is linear, complexity of information or material being studied by students and cognitive structure of human brain allows limited amount of information to be processed, this condition is linear, students' acceptance of mathematical material is limited in receiving information, possibility of information being missed. Moreover, cognitive load theory could be implemented in designing mathematics learning with target of reducing extrinsic cognitive load that students might experience.

3.3. Mathematics Learning to Improve Metacognition Skills

Metacognitive experience involves use of metacognitive strategies and metacognitive strategies are sequential processes for controlling cognitive activities and ensuring that cognitive achievement are met. This process is based on an understanding of managing and supervising learning and is categorized into planning, entitled ability to plan learning activities; strategies for managing information, entitled ability to develop strategies for managing linear information in learning process carried out; comprehensive monitoring, entitled ability to monitor learning process and numbers of linear process factors; debugging strategies, entitled strategies used to correct wrong actions in learning; and evaluation, entitled evaluating effectiveness of learning strategy and changing strategy, giving in to situation, or ending activity.

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The definition of metacognition stated above varies greatly, however, focuses on an individual's awareness of thinking related their thought processes. The individual's awareness of thinking is individual awareness, therefore, metacognition is categorized into two components, entitled metacognitive knowledge and metacognitive skills. Linear metacognitive knowledge declarative knowledge, procedural knowledge, and conditional knowledge. Linear metacognitive skills, planning skills, monitoring skills, and evaluation skills.

Metacognition plays significant role in thinking, entitled regulating and controlling an individual's cognitive activities or processes in learning and thinking, therefore, learning and thinking they do becomes more effective and efficient. Metacognition in mathematics education is able to produce numbers of findings, entitled metacognition plays significant role in solving problems; and students are more skilled at solving problems if supported by metacognitive knowledge. Successful solving of mathematical problems requires students to be able to determine appropriate strategies for understanding problems, making representations, and solving problems. These abilities covered metacognitive knowledge, entitled important knowledge in high-level learning and problem solving.

Numbers of relevant studies have identified findings that metacognitive knowledge helps problem solving become more efficient through three aspects, entitled identifying problems and forming mental representations of their elements, determining appropriate plans and strategies to achieve goals; and identifying obstacles to achieving progress. Metacognition in problem solving involves planning, monitoring and evaluation processes, particularly when carrying out and determining right strategy. The metacognition process makes individuals more flexible, because problem solving process does not always run smoothly and sometimes experiences deadlock. Moreover, metacognitive process is useful in facilitating problem solving activities and improving ability to achieve goals. As an example, at each stage of problem solving, students need to be aware of everything they think and do. Individuals who carry out problem solving control and monitor strategies they use, therefore, their abilities become better. Difficult problems have potential to activate metacognitive function of conscious problem solving and control their cognitive processes. The metacognitive process covered determining knowledge possessed, formulating solution plan, determining solution strategy, monitoring and evaluating. Moreover, metacognitive progress focuses on monitoring students' abilities and regulating individual cognitive processes used during problem solving.

4. Limitations and Directions for Future Research

The basis for determining planning strategy through reduce cognitive load of metacognitive strategies in mathematic learning model which are considered dominant *linear* through secondary high school student is supported by number of logical, empirical and methodological considerations *linear* strategy and type of research used by researchers is expected to give rise to research novelty and form *novelty* research from number of previous similar studies.

5. Conclusion

Student metacognition is students' knowledge and awareness related their cognitive processes and activities and has two components, entitled metacognitive knowledge and metacognitive skills. Linear metacognitive knowledge declarative knowledge, procedural knowledge and conditional knowledge. Metacognitive knowledge is link between individuals, tasks and strategies. Linear metacognitive skills of planning, monitoring and evaluating completion of certain tasks. Students' metacognition plays significant role in problem solving, particularly in organizing and controlling students' cognitive activities in solving problems, therefore, students' learning and thinking in solving mathematical problems becomes more effective and efficient. Developing students' metacognition could be done with strategy of helping students develop learning strategies by encouraging students to monitor their learning and thinking processes, guiding students in developing effective learning strategies, asking students to make predictions about information that would appear or be presented next based on material they have read or studied, guiding students to develop habit of asking questions, showing students how to transfer knowledge, attitudes, values, skills from one situation to another.

Guiding students in developing good habits with habit development strategies: managing individuals, positive thinking, hierarchical thinking, and asking questions. Students' metacognition in mathematics learning could be grown in each phase of problem solving: understanding problem, planning solution, carrying out linear solution plan, and interpreting.

At stages of learning process, sometimes there are conceptual errors in information obtained by students that has been conveyed by teacher. Related through these conditions, metacognition is able to provide monitoring of students' thinking stages, therefore, they are able to describe thinking strategies and results of their thinking. Stages of learning process, metacognition plays significant role, particularly in solving mathematical problems. To obtain optimal results and benefits in solving mathematical problems, it should be done through numbers of optimal systematic solving stages. One form of managing mathematical problem solving is understanding problem, making solution plan and implementing solution plan, as well as reviewing solutions that have been completed. Through numbers of stages of systematic problem solving and result is not only correct solution, however, also formation of well-structured thinking pattern in individual when facing problem that should be solved. Metacognition is process of individuals thinking about thinking in order to build strategies for solving problems.

Metacognition is identified through activities covered planning how to approach learning tasks, monitoring abilities and evaluating plans in order to carry out tasks. Metacognition is an individual's awareness of processes and results of his thinking and process of developing plans, monitoring implementation and evaluating actions. The entirely students have implemented metacognitive strategies in learning mathematics, with varying categories and generally categorized as rare. The most frequently used strategy is peer tutoring, and least frequently used strategy is evaluating way of thinking and acting.

The findings analysis of intensity of planning strategy through reduce cognitive load of metacognitive strategies in mathematic learning model which are considered dominant *linear* through secondary high school student on low scale. Even though it has not used metacognitive strategies optimally, elementary school students have used them in learning these four skills. Numbers of metacognitive strategies used by students are focusing attention on lesson and connecting what is learned with previously known material Research findings of planning strategy through reduce cognitive load of metacognitive strategies in mathematic learning model which are considered dominant *linear* through secondary high school student *linear* implementation of learning model on mathematic skills based on metacognitive strategies indicates that respondents gained new experiences using strategies and methods which involve mental activity in thinking.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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