Article 3: Math Heuristics in PSLE

Math Heuristics, to the weak students, can be a great source of fear and anxiety. It often brings back memories of failure and anxiety to students who express a dislike for this subject. What is heuristics math and why is it much talked about even after so many years of its implementation?

In Mathematics, a heuristic is a method that is used to solve a mathematics problem. This heuristic is a mental shortcut process that enables solving problems and making judgments quickly and efficiently. Heuristics are essentially problem-solving tools that can be used for solving non-routine and challenging problems. This approach might not be always be perfect in working out a problem but it does give a quick solution to help move towards a reasonable way to resolve a problem.

Verschaffel (1999) defines heuristics as "systematic search strategies for problem analysis and transformation." It is area where numerous researches had been looked into and documented. Many of such heuristic strategies are found in literature done by Polya, 1973; Larsen, 1983; Schonenfeld, 1985 as well as NCTM, 2000. Heuristics in primary school is a specialized mathematical problem-solving concept. Knowing how to do well in this area will facilitate better skills in solving regular as well as challenging mathematical problems. The Ministry of Education in Singapore has incorporated 11 Problem-Solving Heuristics into all primary-level mathematical

syllabus on top of its regular mathematical topics. This not only makes it difficult for students to pick up Heuristics skills, but can also make mathematics confusing for some students. It can also be challenging for parents to re-learn Heuristics, much less teach these skills their own children.

Students' and parent responses on doing heuristics questions

For the purpose of this writing piece, a short interview was done at random in order to get a feel of what is it like to deal with such kind of math questions. The responses are as follow:

"I dislike doing such kind of questions. It is tedious and draining!" Boy, P5 mainstream school.

"If my parents who are so educated cannot do it, what do you expect from me?" Girl P6 mainstream school.

"I like heuristic math because I can draw model which makes it easier for me to understand. It allows me to express myself easily on paper." Girl P6, homeschool student.

"After so many years of its implementation (in the education system), I still wonder its relevance in developing critical thinking in students." Parent of a P6 male student.

The above informal survey, though has yet to represent the majority of the students and parents' voices, is interesting to note. Though this heuristic math has been around in the math curriculum for more than 3 decades, it remains to be a love and hate thing among students and parents. A relook at the local math curriculum reminds educators that this mathematics framework has mathematical problem solving as its primary focus. The attainment of problem solving ability is dependent on five inter-related components – Concepts, Skills, Processes, Attitudes and Metacognition (Ministry of Education, 2012a; 2012b). Therein lies the challenges; exercising that sense of judgement, exerting mental energy especially when students are insufficiently motivated to solve them and using higher intelligence and divergent thinking are often required. This is very straining for primary level students.

The challenges that are embedded in Heuristics questions

Heuristics questions can be tough since they tap on our students' mental skills greatly. While such questions, students are constantly engaged in the process of acquiring knowledge, manipulating information, reasoning and problem-solving. The process of doing such questions certainly requires focused attention, deductive and inductive reasoning as well as a strong working memory. Learning has always been a stratified process. Any student will need to progress slowly from mastering the basics of number operations before becoming possible to learn how to do

heuristics calculations. Hence, core lower level cognitive abilities must be acquired first, before it becomes possible to deal with higher-order brained-based skills. A good tuition center with committed and math veteran teachers will help students greatly in this aspect.

What can be done to facilitate better coping skills with Heuristics

1. Giving questions in bite size portions make a lot of sense. Do remember that such non-routine structured questions are challenging. When students are turned off either by too tough or many heuristics questions, they may develop a dislike for these questions. Questions given in bite size primarily helps to increase a learner's psychological engagement.

2. Ask any Math expert on the best way to make Math appetizing; invariably, you will hear ideas like "Make it visual by using manipulatives," "Make it hands on," " Use colors to compartmentalize various portions of the sum so as to make understanding possible," "Show structured and explicit workings so that the mechanics of addition, subtraction, multiplication and division are clear." This cannot be emphasized enough.

3. Before approaching a student with any mathematics questions, always check on the students 'prior knowledge on the topic. This is to ensure that questions are given to the students at the right pitching. Cases where if the student's conceptual understanding on, for example, looking for a pattern or sums on working backwards are weak, then it pays to give the student graded level of difficulty in the given questions. Heuristics questions generally test on students' higher-order thinking skills; something that goes beyond basic observation of facts and memorization. Experienced teachers will definitely come in very useful in developing students' critical thinking skills so as to enable them to work through questions in an organized and rational manner and draw connections between ideas and facts.

4. Writing Math Journals are useful (though not commonly used strategy). Essentially, students are often asked to record their strategy and thought processes, apart from their solutions. Modern ways of doing Math is not just about getting the problem solved, it is equally important to get students learn how to articulate what they are learning. After all, math is about establishing a deeper understanding on complex issues and not just doing them in a procedural manner.

The above, are but just a few working strategies, to help students navigate the minefield of questions using the heuristics approach. While such questions can be challenging, the process of

working through math questions do help to students "think about thinking" i.e. identifying, analyzing and finding and refining ways to think better. Educators call this the development of critical thinking.

Heuristics play a key role in decision making and affect the way we make decisions. Understanding heuristics can help resolve problems as well as understand biases that affect effective decision making. Hence, it does offer a lot of benefits in terms of grooming our nation's next wave of children who will play a pivoting role in the development of the future in Singapore. Of course, with the help of competent and patient teachers, it certainly helps to give that extra edge in making learning much easier for them. Here lies the core mission of the teachers from AlphaOmegaMath: To develop critical thinking among her students through their mathematics learning journey so as to form a solid foundation of a good education!

AlphaOmegaMath Editorial Team