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# Teacher's perception towards teaching and learning practice based on HOTs in mathematics

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**ABSTRACT**

Teaching and learning practice based on higher thinking order skills (HOTs) in mathematics is a critical approach to developing thinking skills among teachers and students in the classroom. It will help increase students' performance and encourage acceptance and attitude. This study aims to know the teacher simulation on getting student responses and their reactions; to know the using of non-routine questions, the impact of applying and implication to the student's mind development; and to understand the acceptances and attitudes of the student. This study was conducted using a qualitative approach, which involved a survey with an open-end questionnaire. A total of 72 mathematics teachers were made up of different categories of schools. The findings indicate that teachers tend to question and encourage ideas to simulated students on getting their response. Students tend to reflect on the teacher's simulation verbally as a reaction. Using non-routine questions, the finding showed that teachers who were applied in their teaching practice agreed that it affects the student's mind development. Teachers are also aware that thinking motivation and experiencing will be the implication of using non-routine questions in mathematics lessons. It also helps to develop students' performance levels. Other teachers are aware that adaptability, attracting, and self-expression appear most as acceptance and attitude of students during instruction. In conclusion, for effective teaching and learning practice based on HOTs in mathematics lessons, bringing the real-life problem to the discussion in class, encouraging student's cognitive develop and engage to their behavior.

**Keywords:** mathematics, HOTs, teaching & learning practice

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## INTRODUCTION

One of the most significant current discussions in the Malaysian education system nowadays is National Education Blueprint (2013-2025), which emphasizes the aspiration to produce students with the ability to generate new knowledge by mastering the range of thinking skills, especially in mathematics and sciences (KPM, 2012; Salih, 2014; Yunus, 2015). Skillful thinking is where the thinker assesses what is required to accomplish a thinking task and deliberately applies with proficiency the task-appropriate tools of thinking skills and mental behaviors in a strategic combination to produce thoughtful products of high quality (Marzano & Pickering, 2006; Swartz et al., 2010). Thinking skills, in general, is a process to develop minds that include the basic types of thinking such as compare and contrast, parts-whole, classifying, and the complex thinking task of problem-solving, decision making, and conceptualizing (Swartz & McGuinness, 2014).

Highlights to the range of thinking skills, higher thinking order skills, or HOTs, are essential in developing a curriculum. HOTs with thinking elements and values help achieve meaningful teaching and learning in the classroom (Anderson & Krathwohl, 2001; Brookhart, 2010; Marzano, 2000; Swartz & McGuinness, 2014). Teachers play a significant role in implementing HOTs elements in their teaching. Teachers, as 21st century educators, should infuse instruction in skillful thinking into content instruction. No thinking skills apply in the classroom, meaning no higher-order thinking skills will be developed.

Even though skillful thinking can be developed through classroom instruction, however, not just any education will do the job. The development of skillful thinking is not a discovery activity, not a 'think-harder' activity, neither is it aimed simply at encouraging, stimulating, or enhancing students' thinking (Salih, 2014; Swartz & McGuinness, 2014). It requires effort and skill by both the learners and teachers, and this can be done through repeated, conscious, effortful, continual mediated application, instruction, and reflection (Salih, 2014).

In accessing the global standard of education, preparing teachers and students with higher-order thinking skills in teaching and learning practice is a critical approach (Brookhart, 2010; Collins, 2014; Marzano, 2000; Murray, 2011; Swartz & McGuinness, 2014; Yunus, 2015). It is especially in mathematics and science, which very closed to global technologies and economies products. Salih (2014), in journal articles, mentioned that numerous researchers have shown that students are

severely lacking in thinking skills. A significant contributor to the problem is how students are taught in schools. Many attempts are being made to fix this problem, but none seems to have impacted that can be sustained at scale. In-service workshops and courses usually have a short-lived impact. Some blame our practicing teachers, while others blame teacher training institutions for poorly training teachers.

In general, according to research, implementing thinking skills in a teaching and learning practice will help teachers develop higher-order thinking skills among students or learners in the classroom (Brookhart, 2010; Marzano, 2000; Swartz & McGuinness, 2014).

### Teaching and Learning Practice Based on HOTs in Mathematics

Encouraging students to think as a practice and skills of learning is the way to develop student minds and understanding to the lesson, especially in developing cognitive skills. For implementing HOTs, teacher should know and capable with the concept of thinking skills, which able to make teaching and learning process more exciting and enhance students learning (Brookhart 2010; Marzano, 2000; Murray, 2011). Besides, HOTs in teaching and learning practice in mathematics will help to increase students' performance (Brookhart, 2010; Swartz & McGuinness, 2014; Yunus, 2015).

In facts, HOTs related to life problems (Brookhart, 2014; Marzano, 2000; Swartz & McGuinness, 2014). So, to bring this to the lesson in class, teacher should use non-routine question, which can help them to communicate and getting responds from students (Collins, 2014; Marzano, 2000; Murray, 2011). It is also encouraged students to think and develop their thinking skills. Teacher should plan classroom questioning and discussion time to tap into particular HOTs. This is one of the how do teacher teach higher order thinking. The focus element here is 'plan'. Teachers, on the whole, are very good at 'thinking on their feet'; however, without meticulous planning they are likely to ask recall questions rather than questions that require higher order thinking (Brookhart, 2010; Collins, 2014; Marzano, 2000).

Basically, discussions can be derailed if they are not planned with a higher order thinking learning objective in mind. While this does not mean every question or discussion has to be pitched at higher order thinking, a good proportion should be (Collins, 2014). By carefully planning lessons and discussions, teachers can ensure the proportion is right. Teachers should also encourage students to reflect on their learning, so they understand their thinking strengths and weaknesses (Collins, 2014; Swartz & McGuinness, 2014).

## METHODOLOGY

A survey study has been carried out to explore the questions related to the teacher's perceptions towards teaching and learning practice based on HOTs in mathematics class. It has the following objectives:

1. To know the teacher simulation on getting student responds and their reactions by teaching and learning practice based on HOTs.
2. To know the using of non-routine questions, impact of applying and implication to the student's mind development.
3. To know the acceptances and attitudes of student during the teaching and learning practice based on HOTs in mathematics.

72 respondents were chosen to answer a questionnaire sheets. The respondents were made up of mathematics teachers from different categories of schools around selected areas.

The questionnaire had distributed during the Workshop of Enhancement of Knowledge, Pedagogy and Assessment Methods by Maths Teacher HOTs.

The questions posed in the questionnaire were to know the teacher's perception towards the teaching and learning practice based on HOTs in mathematics that they had implemented in the classroom. The respondents were given the opportunity to share their ideas and experience in improving the teaching and learning practice based on HOTs in Malaysia education system. In general, the respondents were keen in understanding a meaningful teaching and learning practice based on HOTs that collaborates the teacher's and student's relationship. They had also tried to improve the teaching and learning process in line with the global instructional learning process.

## RESULTS & DISCUSSION

### Teacher Simulation on Getting Student Responds and Their Reactions

Teacher simulation is important in teaching and learning practice based on HOTs especially on getting student responds as develop their thinking skills. For implementing HOTs, teacher should know and capable with the concept of thinking skills, which able to make teaching and learning process more exciting and enhance students learning (Brookhart 2010; Marzano, 2000; Murray, 2011). Good teaching and learning practice will be able to produce both good quality of behavior and performance.

**Table 1** shows the teacher's simulation and student's reaction that were considered by the respondents in teaching and learning practice based on HOTs in mathematics class.

According to teacher's simulation, most of the respondents considered that questioning and encouraging of ideas were good simulation on getting student responds and their thinking skills. They also considered other simulations such as appreciation, students-oriented, multimethod, collaboration and opportunity time. For example, R23 stated the consideration in using questioning and encouraging of ideas when simulating student responds:

> "Meransang dengan soalan. Menggalakkan murid menggunakan ayat mereka sendiri [Stimulating with question. Encourage students to use their own sentences]."

This opinion was supported by R46 respondent who stated, as follows:

> "Banyak memberi soalan dan galakkan murid berfikir dari perkara asas sehingga mendapat berfikir luar dari kotak [Give many questions and encourage student to think from the basics until got to think out of box]."

Questioning and encouraging of ideas more effective if students were given awards and rewards to show appreciation. For example, R31 respondent stated that, multiple questioning with rewards could attract students attention and well response:

**Table 1.** Teacher's simulation and student's reaction

| **Teacher's simulation** | **Respondent** | **Total** |
|---|---|---|
| Questioning & encouraging of ideas | R1/R12/R14/R19/R20/R21/R23/R24/R26/R30/R31/R36/R37/R38/R40/R41/R44/R45/R46/R49/R54/R55/R56/ R57/R60/R62/R65/R67/R68/R70/R71/R72 | 32 |
| Appreciation | R4/R26/R27/R31/R33/R38/R39/R43/R54/R58/R63/R66/R67/R72 | 14 |
| Students-oriented | R2/R6/R22/R25/R28/R29/R34/R42/R48/R49/R53/R69/R70 | 13 |
| Multimethod | R7/R13/R35/R40/R55/R56/R57/R59/R61/R62/R65/R69 | 12 |
| Collaboration | R3/R15/R17/R24/R25/R29/R34/R38/R50/R53 | 10 |
| Opportunity time | R10/R11/R42 | 3 |
| **Student's reaction** | **Respondent** | **Total** |
| Reflecting | R2/R5/R14/R15/R16/R18/R21/R24/R27/R31/R34/R36/R37/R41/R44/R45 | 16 |
| Throwing ideas | R1/R4/R29/R30/R33/R37 | 6 |
| Excitement | R15/R38/R39/R52/R59/R65 | 6 |
| Effortful | R12/R19/R51/R61/R68 | 5 |
| Thinking learning | R16/R18/R24/R35 | 4 |

> "Saya akan menanyakan soalan yang berbagai serta menggunakan ganjaran bagi menarik perhatian murid. Respon murid agak baik [I will ask a variety of questions and use the reward for attract students attentions. Student response quite well]."

Students-oriented and collaboration were also the way to simulate student responds by interaction. It can happen through discussion. R2 stated that, two ways discussion can let students come out with various response:

> "Wujudkan situasi perbincangan 2 hala. Beri soalan dan minta pandangan murid untuk selesaikan. Murid memberi respon yang pelbagai [Creating a situation of two ways discussion. Give questions and asked students opinion for solution. Students responded the various]."

Student responds also can obtained throught discussions in a group. This was supported by R25 respondent, who stated, as follows:

> "Perbincangan dengan rakan sekelas dalam kumpulan, menerima pandangan pelajar walaupun kurang tepat tetapi akan membetulkannya [Peer discussion in group, accepted students opinion even not really accurate but will be correction it]."

Simulating throught multimethod gives an alternative to students. This was stated by R7 respondent, which is, as follows:

> "Nyatakan kaedah penyelesaian yang lain [Express others solution method]."

When simulating students to think and responds with any of teacher's simulation, opportunity time need to be considered. R10 stated that student take a long time to find solution:

> "Murid mengambil masa yang panjang untuk mencari jalan penyelesaiannya [Students take a long time to find a solution]."

According to student's reaction, most of the respondent considered that reflecting was indicate student stimulus. Respondents consider it as active learning. This was supported by R15 who stated, as follows:

> "Bersoal jawab dengan murid–bagi pencerahan. Murid bertindak balas aktif dan respon yang memberangsangkan [Debating with students–for enlightenment. Students respond actively and favorable response]."

Respodents also considered other student's reaction such as throwing ideas, excitement, effortful and thinking learning. With simple statement, respondent R37 considered that student can throws of their ideas throught brainstorming:

> "Peta bulatan (brainstorming)–hampir semua murid beri pendapat/ideas [Circle map (brainstorming)–nearly all students give opinions/ideas]."

Respondent R38 considered that competition as learning activity can make fun to students. This looks like excitement. R38 stated that students enjoy with the activity:

> "Tanya soalan. Kad kepujian. Pertandingan dalam kumpulan. Murid-murid didapati seronok semasa dalam pertandingan kumpulan [Ask questions. A credit card. Competition in the group. Students found fun during the group competition]."

Besides of the excitement, certain respondent consider that effortful also important to students when they struggles with ideas and responses. According to R19,

> "Semasa PdP matematik menggalakkan murid memberi jawapan dalam pelbagai kaedah yang mereka tahu. Asalkan jawapan tersebut betul dan tidak salah. Dengan cara ini murid akan berusaha memberi jawapan walaupun mungkin berlainan dari kawan yang lain [Mathematics during teaching and learning encourages students to respond in a variety of methodsthat they know. As long as the correct answer and not one. This way students will strive to give an answer may be different even from friends other]."

Thinking learning is look like higher order thinking skills element, which encourage students to think. Its considered as student reactions especially when it works with simulations. It is also aroused curiosity. This supported by R52 who stated that

> "Menimbulkan keadaan ingin tahu/menimbulkan minat untuk tahu. Pelajar akan mengajukan soalan-soalan bagi menjawab perasaan ingin tahu mereka [Gives rise to an inquisitive/create interest to know. Students will be asking questions to answer their curiosity]."

**Table 2.** Using of non-routine questions, impact of applying, & implication to the student's mind development

| **Using of non-routine questions** | **Respondent** | **Total** |
|---|---|---|
| Apply | R1/R4/R5/R6/R7/R11/R12/R13/R14/R17/R18/R19/R21/R22/R23/R24/R27/R28/R33/R35/R36/R37/ R38/R39/R41/R42/R43/R45/R49/R50/R51/R52/R54/R55/R56/R57/R59/R60/R62/R66/R68/R69/R70/ R71/R72 | 45 |
| Not apply | R40/R44/R45/R55/R56/R57/R61 | 7 |
| **Impact of applying** | **Respondent** | **Total** |
| Mind development effectiveness | R2/R3/R4/R7/R11/R14/R15/R16/R17/R18/R20/R22/R23/R25/R26/R27/R29/R30/R31/R33/R34/R35/ R36/R37/R38/R39/R43/R48/R49/R53/R56/R58/R59/R60/R61/R63/R66/R67/R68/R69/R70/ R71/ R72 | 43 |
| Mind development not effectiveness | R1/R10/R21/R41/R44/R52/R63 | 7 |
| **Implication to the student's mind development** | **Respondent** | **Total** |
| Thinking motivation & experiencing | R4/R5/R24/R28/R34/R35/R38/R43/R49/R54/R57/R59/R60 | 13 |
| Performance level | R12/R19/R34/R38/R58/R63/R65/R67/R68 | 9 |
| Cognitive mastering | R5/R12/R16/ R18/R19/R43/R46/R55 | 8 |
| Collaboration | R13/R14/R23/R39/R45/R70 | 6 |
| Interest tendency | R16/R18/R21/R44/R50 | 5 |
| Critical & creative thinking skills mastering | R16/R17/R18/R30 | 4 |
| Problem solving skills mastering | R66/R69/R71/R72 | 4 |

### Using of Non-Routine Questions, Impact of Application, and Implication to the Student's Mind Development

Generally, HOTs related to life problems (Brookhart, 2014; Marzano, 2000; Swartz & McGuinness, 2014). To bring this into the lesson in class, teacher should use non-routine question, which can help them to communicate and getting responds from students (Collins, 2014; Marzano, 2000; Murray, 2011). This shows that applying of non-routine question during instruction encourage the development of student's mind and produces a wide range of implications.

**Table 2** shows the dimension of using of non-routine questions, impact of applying to the student's mind development and its implication.

Based on this study, most teachers apply non-routine questions in their instruction and consider it effective develop student mind. This was supported by R23 respondent for example, who stated, as follows:

> "Soalan bukan rutin digunakan mengikut kesesuaian perbincangan di dalam bilik darjah. Pada pendapat saya ianya berkesan bagi menggalakkan perkembangan minda murid [Non-routine questions used according to appropriate discussion in the classroom. In my opinion it is effective to encourage the development of students' minds]."

Other than that, R27 and R36 also stated the same thing, which is, as follows:

> "Soalan bukan rutin digunakan secara berkala. Berkesan kepada perkembangan minda murid [Non-routine questions were used periodically. Effective on the development of students' minds]" (R27).

> "Ada guna soalan bukan rutin. Ia memang berkesan memperkembangkan minda murid-murid [Available use of non-routine questions. It is indeed effectively to develop students mind]" (R36).

This study shows that according to the teachers consideration, thinking motivation and experiencing; performance level; collaboration; cognitive mastering; interest tendency; critical and creative thinking skills mastering; and problem solving skills mastering are all implication of applying non-routine question in the instruction. From certain teachers, they considered that thinking motivation and experiencing; and performance level are most general impact to students learning. This because applying of non-routine questions in teaching practice helped students to think. This supported by R34 respondent who stated, as follows:

> "Murid bijak–gemarkan cabaran dan sukakan sesuatu yang baru dan mencabar. Murid lemah–mendapat ilmu yang baru dan mereka terdedah kepada peluang yang tidak mereka alami sebelumnya [Intelligent students–love a challenge and like something new and challenging. Poor students–getting new knowledge and their exposed to opportunities that they are not experienced before]."

Discussion considered as collaboration. R14 respondent considered that discussion in class with non-routine question encourage development of student's mind. R14 stated that

> "Ya, ada menggunakannya semasa perbincangan dalam bilik darjah. Ianya sangat berkesan dalam menggalakkan perkembangan minda murid-murid [Yes, there is use it during discussions in the classroom. It is very effective in promoting the development of students mind]."

Non-routine questions help students generate their thinking skills, which about mastery of cognitive skills. Cognitive skills refer to critical and creative thinking skills. Students need to be mastering both of it because its can encourage students interest. For example, R18 stated that

> "Ya, ia berkesan. Dengan menggunakan soalan bukan rutin murid-murid berminat dengan pelajaran dan dapat berfikir secara kreatif, kritis dan logic [Yes, it's effective. By using non-routine questions pupils interested with lessons and can think creatively, critically and logically]."

Besides of above, using of non-routine questions in the lesson can also generate problem solving skills. This was supported by R71, who stated that

**Table 3.** Student's acceptance & attitude

| Student's acceptance & attitude | Respondent | Total |
|---|---|---|
| Adaptability | R1/R2/R3/R4/R5/R6/R7/R10/R11/R12/R13/R14/R15/R17/R19/R20/R21/R22/R23/R24/R25/R27/R28/ R29/R30/R31/R33/R34/R35/R36/R37/R38/R40/R41/R42/R43/R44/R46/R49/R50/R59/R60/R61/R63/ R65/R66/R69/R70/R71/R72 | 50 |
| Attracting | R4/R5/R16/R18/R19/R23/R28/R30/R40/R41/R46/R48/R51/R53/R54/R55/R56/R57/R60/R67/R72 | 21 |
| Self-expression | R4/R11/R13/R17/R19/R20/R23/R28/R29/R34/R36/R39/R40/R60/R62/R63/R68/R69/R70/R72 | 20 |
| Engaging | R3/R13/R21/R24/R31/R33/R35/R42/R43/R44/R49/R50/R58/R59/R61/R62/R66/R70/R71 | 19 |
| Level of intelligence influence | R1/R2/R10/R12/R14/R15/R19/R25/R29/R31/R39/R45/R52/R68 | 14 |
| Initiative | R7/R21/R26/R29/R31/R35/R37/R41/R68/R69/R71 | 11 |

> "Ya, ia berkesan dan dapat menggalakkan murid mencari cara penyelesaian [Yes, it is effective and can encourage students to find ways of solution]."

### Acceptance and Attitudes of Student

Teachers should encourage students to reflect on their learning, so they understand their thinking strengths and weaknesses (Collins, 2014; Swartz & McGuinness, 2014). Consider that reflect is reflection. Reflection can look like student's behavior while they react to learning source or simulation. In this study, it is referred to student's acceptance and attitude during teaching and learning practice based on HOTs. Student's thinking strengths and weaknesses are dependent on their acceptance. This means that, student's attitudes influence by their acceptance.

**Table 3** shows the student's acceptance and attitude according to teachers consideration and experience.

Based on this study, most teachers considered that nurturing can emerge students acceptance and attitude. This refer to adaptability in the context of this study. For example, R5 respondent stated that

> "Penerimaan pelajar adalah positif cuma pelajar perlu dipupuk sikap positif dan aktif dalam mengambil bahagian dalam pdp [Acceptance of students is positive, they just need to be nurtured a positive attitude and active participate in teaching and learning]."

To be nurturing a positive acceptance and attitude as stated by R5 respondent, attracting to lesson and build up self-expression important to encourage. This same as respondent R23 consideration, who stated, as follows:

> "Teruja dengan pendekatan PdP yang digunakan. Tercabar dalam menyelesaikan [Excited with teaching and learning approaches used. Challenged to solve]."

Engaging in term of acceptance and attitute related to attention, interesting or involvement. It can be active or passive reactions. For example, according to R59 and R70 respondents, both teachers stated an active reactions. While R62 stated the opposite:

> "Murid memberi persaingan dalam mengeluarkan idea masing-masing [Student perform competitive in issuing their ideas]" (R59).

> "Murid-murid seronok. Bergiat cergas. Melibatkan diri secara sukarela. Berfikir secara kritis dan kreatif [Students are enjoyed. Actively involved. Get involved voluntarily. Think critically and creatively]" (R70).

> "Keliru. Risau. Takut tak dapat jawap [Confuse. Worry. Are afraid can not be answer]" (R62).

Level of intelligence influency and initiative are other elements of showing student's acceptance and attitude. Different level of intelligence giving a different initiative of student's. For example, R31 consider that weak students less motivated than students who are good. R31 respondent stated that

> "Bagi murid yang lebih lemah dalam matematik, mereka akan bersikap tidak berminat dan tidak mempunyai motivasi untuk menyelesaikan masalah manakala murid yang sederhana atau baik dalam matematik akan lebih mempunyai daya untuk mencari jalan penyelesaian [For students who are weaker in mathematics, they will be in no mood and have no motivation to solve problems while students who are moderate or better in mathematics will have more ability to find ways of solution]."

## CONCLUSION

The teaching and learning practice based on HOTs could be seen in three different context. This refer to an approach of cognitive, affective and behavior. Teaching and learning practice based on HOTs can be develop by teacher's simulation in which to encourage students engage with the lessons. Simulation able to help teacher on getting student responds and at the same time viewing their reactions, which important for teachers to know whether their students think and learn. Teacher's simulation and student's reaction can succeed through two-way interaction or collaboration in verbal or non-verbal ways. Teacher appreciations and opportunity times encourage student to enjoy and learn to think.

To ensure that teaching and learning practice based on HOTs are effective, then applying real life problems, which are also considered as non-routine problems is favorable approach. It is also able to develop students mind effectively. Mastering of cognitive skills, which is critical and creative thinking skills and mastering of problem solving skills are the meaningful implications to the student learning if teacher aware to applying of non-routine problems in lesson. Deeper implications more to motivation and experiences. In summary, applying non-routine problems can enlighten the student minds and arise student performance while also creating interest tendency in the learning mathematics based on HOTs.

Acceptance and attitude of students in learning math based on HOTs important to know. This is because it can be a factor to engage student with their learning process, especially in terms of exposes their interesting. It helps teachers to understand students and their perceptions, so that the teaching and learning process ended successfully and continuously.

Basicly, to develop student's mind effectively, teachers need to establish their teaching and learning practice, so that impact of the good approach with elements of HOTs engage to the students cognitive able to make student feels comfortable, easy and meaningful.

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**Declaration of interest:** Authors declare no competing interest.

**Data availability:** Data generated or analyzed during this study are available from the authors on request.

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