An Investigation on Teachers' Perceptions of the Nature of Classroom Inquiry Questions

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Abstract

Science and mathematics teachers usually ask many questions in an inquiry lesson. But when teachers are asked about their perception of a question, often they seem to have problem to provide a clear cut answer. Hence, the main aim of this study is to investigate teachers' perceptions of the nature of questions. It also espouses the notion of the questions that are stimulating as well as able to help students to think and learn. This study used survey that was administered at particular point of time to collect data from different cohorts of teachers' perception of a question based on a list of the pre-described statements. The investigator set the preselected response choices as either 'yes' or 'no' to each of the statement. The respondents were classroom teachers who attended in-service science and mathematics education courses in SEAMEO RECSAM at various times over a period of three years. Most of these teachers were from SEAMEO countries. The rest of respondents were from the Colombo Plan member countries and Africa. The analysis of the findings revealed that, surprisingly, a substantial number of teachers thought that a question must be a statement ending with a question mark. Such erroneous perception was found to be fairly prevalent despite the fact that teachers habitually use questioning as a prompting process to elicit responses from students, to strengthen their higher order thinking skills and stimulate deeper understanding in learning. In conclusion, an extended investigation is suggested on a wider cross-sectional study to uncover further information about science and mathematics educators' perception and comprehension about questions.

Keywords: Questioning; Perception; Thinking; Learning.

Introduction

Asking question is essential for communications and information exchange. In conversation, the answer or the information we receive from the respondent will depend on the types of questions that have been asked. In other words, one has to ask the right questions to receive the correct answers. In the classroom learning, it is a common knowledge that social interaction is one of the principles of cognitive learning theory (The Peak Performance Centre, 2019). During social interaction among the students or with the teacher, the continuum of the dialogue is sustained by questioning. In classroom instruction, teachers invariably ask many questions to guide their students to gather better information and learn more. Insightful questioning can facilitate students see connection between the abstract ideas that they are studying by relating them to real world examples. This would enhance deeper understanding and meaningful learning. However, questions should be structured to elicit correct responses. Marzano, Pickering and Pollock (2001) had found that questions which focus student attention on important elements of a lesson result in better comprehension than those that focus on unusual or interesting elements.

Background and Review of Related Literature

In classroom instruction, questioning is seen as a popular and important pedagogy. During an interactive lesson, teachers typically spend about 35 to 50 percent of their instructional time asking questions (Fries-Gaither, 2008). It has also been documented that in a normal secondary class, the frequency of teacher questions range from 30 to 120 questions per hour, with a mean of 69 questions. On the other hand, Dillon reported in 1988 that for a class size of about 26 students, the students asked less than 4 questions within a one-hour lesson. That works out a student asks only 0.15 question within the lesson. It was also reported that 96% of the questions in a classroom environment were teacher questions.

In an attempt to gauge the frequency of teacher questions in a Malaysian school, the author (Lee, 2013a) used a self-inventory form to record a one-hour science lesson facilitated by an experienced teacher in a Grade 9 class. In this science inquiry lesson, the teacher asked a total of 166 questions. This total number of questions is an aggregate of three categories of questions (that are also used for the second study to be reported later), namely:

A. Routine (or class administrative) questions, e.g. Are you ready? Do you understand?

B. Lower level questions, e.g. What is…? How many…? Who and where…?

C. Higher level thinking questions, e.g. How does it happen? Why does it occur?

Accordingly, the scores in the three categories are 58, 100 and 8. In this lesson, the frequency of teacher question was precisely, 2.7 and approximately 3 questions per minute.

At the later part of the year, the author did a demonstration teaching on a mathematics lesson to a group of teachers attending an in-service course in SEAMEO RECSAM. The expected outcome of the lesson was to enable teachers to make inductive inference to generate a formula to find the areas of polygons by drawing polygons on geo-board grids, on the condition that exactly one dot must be in each polygon (Yeap, 2014). In the class of 32 participants, half the number of them were asked to play the role of Grade 8 students, and the remaining were to observe the teaching and each of them was given a specific task of focussing on certain aspect of the teaching. Two of the observers were tasked with noting the frequency of teacher question or the number of questions asked by the teacher in the one-hour lesson. Table 1 shows the results of the frequency of teacher question recorded by the two observers P and Q (Lee, 2013b).

Table 1
Number of Teacher Question in the One-Hour Mathematics Demonstration Lesson

Observer who record	Categories and numbers of questions asked by the teacher			
	Routine (A)	Lower level (B)	Higher level (C)	Total
P	77	63	27	167
Q	79	58	23	160
			Average	163.5
	Frequency of questioning per minute			2.7

The result shows that about 164 questions (i.e. the average of 167 and 160) were asked during the mathematics lesson and the frequency of questioning per minute is 2.7 or approximately 3. This finding is very close to the science lesson reported earlier, though there was insufficient data to make generalisation. Both lessons were however, adopting the enquiry approach in the delivery.

Rationale, Problem Statement and Significance of Study

Using questioning to promote thinking in learning would require classroom teachers to have a clear notion of question. Frequency of teacher question plays a prime role in an interactive lesson. A teacher is likely to ask many and various types of questions in classroom instruction. But, do teachers have clear conception of the nature of a question? How confident are they in what constitute a question? This paper attempted to focus on these probes. Effective questioning as an important aspect of classroom practice is identified as problem statement that triggers this study to gauge teachers' perception of the nature of questions (i.e. to ascertain what constitutes a question, whether in the verbal or written forms) used in classroom instruction, interactions, as well as test that can assist students to think and learn.

This study provided useful information related to the perception of science and mathematics teachers from diverse background on 'question' used in their classroom instruction as well as assessment. The data were obtained from the course participants, comprising predominantly classroom science and mathematics teachers. A few of them were either teacher educators or education officers of Science and Mathematics disciplines, who attended various in-services courses in SEAMEO RECSAM. The data were obtained at various at various points in times over a period of three years, from 2013 to 2015. More than half of the number of the participants were from the SEAMEO member countries, namely Malaysia, Singapore, Indonesia, Brunei, Philippines, Thailand, Myanmar, Cambodia, Laos, Vietnam and Timor Leste. The rest of them were from Colombo Plan member countries, such as Sri Lanka, Pakistan, Nepal, Bhutan, Maldives, and South-East Asian nations, and some African countries including Zambia (predominantly in this study), Nigeria, Kenya, Uganda, Malawi, Lesotho, Burundi, Ethiopia Tanzania and Sudan. Hence the data were derived from a sample of population of wide geographical area covering Asia and Africa, albeit they are all from the third world countries. As such the finding would reflect responses from diverse background of educational settings in the SEAMEO region and beyond.

Objectives of Study and Research Questions

In an attempt to assess the science and mathematics teachers' level of perception on the nature of classroom questions, this study focused on the following research objectives:

1. To explore and document the perception of classroom questions of the science and mathematics teachers who were attending various in-service courses in SEAMEO RECSAM relating to their areas of specialisation in teaching.
2. To compare the level of perception on the classroom questions between science and mathematics teachers who were attending various in-service courses in SEAMEO RECSAM.

In relation to the realisation of these objectives, this research study also attempted to gauge the difference between the perception of classroom questions of the teachers from geographical divide, specifically between SEAMEO and non-SEAMEO (predominantly Colombo Plan and African) countries.

Specifically, this study would attempt to answer the following research questions:

1. To what extent are school science and mathematics teachers able to recognise the classroom questions expressed in the form of sentences that are ending with and without question marks?
2. How do the diverse forms of questions being recognised by science and mathematics teachers differently?

Conceptual and Methodological Framework of Study

This study was grounded on the theoretical and conceptual framework related to ‘question’. It attempted to uncover science and mathematics teachers’ perception on question, specifically what constitutes a classroom question, whether in verbal or written forms.

- In the verbal form and in direct dialogue, there is generally no issue in recognising a question because the sentence, phrase or word is certainly to be accompanied by a question mark at the end. For examples, ‘Can you define an atom?’, ‘Will you draw a diagram of an isosceles triangle?’, and ‘How do you solve this problem?’

- In the written form, however, the questions are often without a question mark. This is where the problem of uncertainty arise. The above examples, expressed in written form, would probably appear as: ‘Define an atom’, ‘Draw a diagram of an isosceles triangle’, and ‘Solve the problem’. So are they not eliciting for the same answers respectively?

This descriptive research would draw its conclusion based on concrete empiricism derived from questionnaires consisted of dichotomous questions. Using a theory testing approach, the process begins with a theory or generalisation, rather, in this study, a clear definition of question, to guide which choice of the responses to make from the dichotomous questions and accordingly to derive the appropriate empirical data through deductive reasoning (de Vaus, 2011). The data were the responses provided by the various batches of science and mathematics teachers who attended in-services courses in SEAMEO RECSAM at different points in time within a period of three years. The conceptual framework of the study is illustrated as in Figure 1.

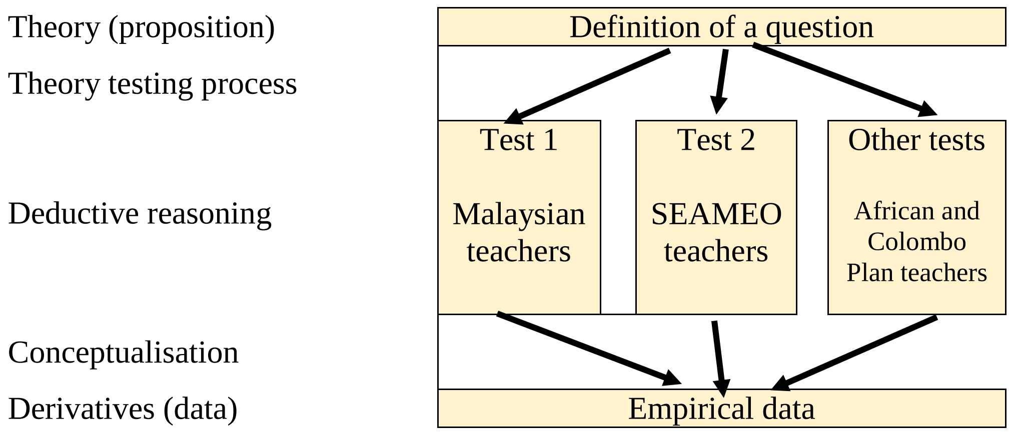

Figure 1. Conceptual framework of studying the identification of question by deductive reasoning (Adapted from de Vaus, 2001, p.6).

According to Kathleen Cotton, narrated in 1988, questioning as a classroom instructional method was second only to lecturing in popular approach in teaching. In resonance, the author has reported earlier in this paper that science and mathematics teachers asked question at the frequency of about three questions per minute. In fact research indicates that classroom teachers spend anywhere from thirty-five to fifty percent of their instructional time conducting questioning sessions. It seems that instruction which includes posing questions during lessons is more effective in producing achievement gains than instruction carried out without questioning students. However, on the average, in the classroom interactions, approximately 60% of the questions asked are lower cognitive questions, 20% are high cognitive questions, and 20% are questions related to procedural knowledge (Cotton, 1988).

Lower cognitive questions are those that require recall of fact and knowledge, usually stated in direct and closed format. Higher cognitive questions, on the other hand, ask students to create their own answers through logical reasoning to interpret, evaluate and synthesise responses appropriate to the enquiry. These questions are open-ended (Wilayah & Hafiz, 2011). Studies show that a combination of lower and higher cognitive questions is more effective in producing achievement gains than the exclusive use of one or the other (Cotton, 1988). Hence, the nature of the question would depend on its place in the lower or higher cognitive level. Therefore, using key questioning words to construct questions helps to show students how questions move from simple 'yes/no' of (less powerful) questions to 'why' and 'what if' (more powerful) questions that stimulate more reflective thinking and more creative responses (Jackson, 2013). Put it in other words, it is very important to use appropriate words to construct questions in teaching, ranging from lower cognitive to higher cognitive levels, in order to promote thinking in learning as illustrated in Figure 2.

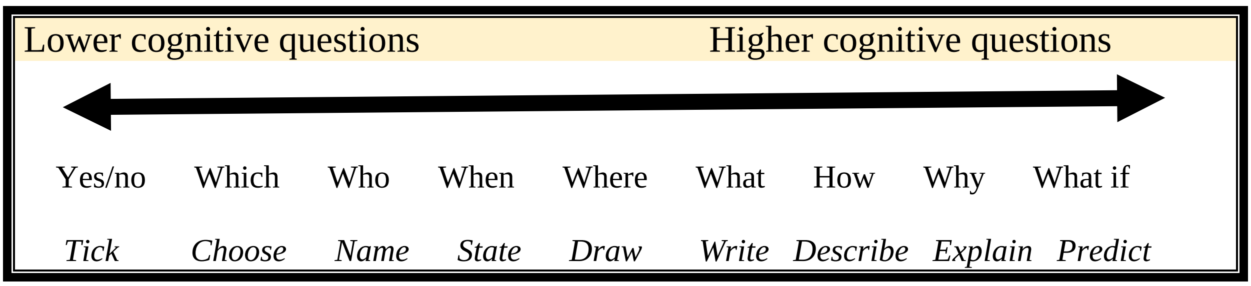

Figure 2. Using appropriate words to construct a range of questions from lower cognitive to higher cognitive levels (adapted from Jackson, 2013).

Methodology

Reviewing the Operational Definition of Question

The procedure in this research study depends on the definition of ‘question’ in its operational form. A question has long been deemed, say for example stated by Cotton in 1988, as any sentence which has an interrogative form or function. This definition seems to implicate investigative and inquiry intonation, and therefore necessary to end the sentence with a question mark. Longman Dictionary (2016) meanwhile defines question as ‘a sentence or phrase that asks for information’, and this is echoed by Oxford Dictionary (2017) which extends the coverage of a question as ‘a sentence, phrase or word that asks for information’. Hence a complete sentence is not a pre-requisite to constitute a question. In fact, Cashin (1995) precisely stated that a question referred to any enquiry that intended to elicit an answer regardless of its grammatical form, and that an answer was defined as any response that could fulfil the expectation of a question.

Hence, in this paper, the term ‘question’ is defined as ‘any sentence, phrase or word intends to elicit an answer regardless of its grammatical form’. This means that the question is not necessarily ending with a question mark. It could be a sentence, phrase or word that elicit an answer. However, this study only used sentence to gauge teachers’ perception of a question.

In the classroom settings, teacher questions are usually perceived as instructional cues or stimuli that convey to students the content elements to be learned and directions for what they are to do as well as how they are to do it. A check with some test and examination papers, at elementary or secondary levels (at the end of grade 6 and grade 11 assessment in Malaysia) shows that there are no lack of questions not written in enquiry format or ending with a question mark (Lembaga Peperiksaan, Kementerian Pendidikan Malaysia, 2014a, 2014b). Some examples are quoted as follows:

- State one inference from this experiment.
- Name one material which can stop gamma radiation.
- Predict the reading on the spring balance.
- Identify the problem.
- Choose the best method to solve this problem.
- Compare the weight of an object in the air and in water.
- Label P and Q in the diagram.
- Draw the arrangement of particles in the solid state in a substance.
- Give one reason that causes the change.
- Write one observation from the experiment.

Similarly, a check with any secondary mathematics textbook or reference book would certainly have the following questions without any question mark:

- Simplify the equation.
- Calculate the distance.
- Determine the value of x.
- Draw the graph of y=3.
- Solve the problem.
- Express the relation between x and y in an equation.
- Evaluate the value of P.
- Measure the height.
- Change these percentages into fractions.

Each and every one of the above examples intend to elicit an appropriate answer. Therefore they are all questions.

Research Design and Procedure

This research study used simple descriptive statistics to describe the outcomes of the data so as to analyse and interpret the meaning of these descriptions. The data were obtained from cross-sectional survey on the various cohorts of science and mathematics teachers who attended different in-service courses in SEAMEO RECSAM in three consecutive years from 2013 to 2015. The survey questionnaires are appended in Table 2 and Table 3.

Table 2
The Science Survey Items

	Is it a question?	Please tick (√)	
Item	Sentence	Yes	No
S1	What is digestion?		
S2	State the functions of stomach in digestion.		
S3	Our teeth play an important role in digestion.		
S4	Identify the parts of our alimentary canal that absorb digested food.		
S5	How does protein digest in out stomach?		
S6	Glucose is a simple sugar		
S7	List the end products of starch digestion		
S8	Is liver a digestive organ?		
S9	Describe the flow of food in our alimentary canal		
S10	Label the organ P		
S11	Can a person live without an oesophagus?		
S12	Not all digestive juices contain enzymes		

Table 3
The Mathematics Survey Items

	Is it a question?	Please tick (√)	
Item	Sentence	Yes	No
M1	The sum of two numbers is 120. The difference between the two numbers is 55. What are the two numbers?		
M2	Susan and Fatimah weigh 102 kg. Susan weighs 11 kg heavier than Fatimah. Find the weight of each person.		
M3	Draw a triangle with three straight lines.		
M4	A pentagon has five sides.		
M5	How many match sticks do you need to make a square?		
M6	Write a sentence to explain the meaning of an isosceles triangle.		
M7	Simplify the expression 4(x+3)+2(x-1)		
M8	State a rule for finding the area of a rectangle.		
M9	The radius of a circle is exactly half the length of its diameter.		
M10	Label the size of the angle P		
M11	Solve the problem 3/4 + 1/5 - 2/3		
M12	20% of 14 apples is not 3 apples.		

Dichotomous question format was used in both questionnaires so as to establish consistency and ease for comparison between them. Applying dichotomous question format would most probably compel the respondents to be clear of an issue (item) and hence make an unequivocal response as governed by the nominal scale (Cohen, Manion & Morrison, 2011). Furthermore, it is possible to code the responses quickly, there being only two categories of responses, in this case 'yes' and 'no'. A 'yes' or 'no' response was deemed suffice and appropriate for this survey situation that sought to elicit a clear-cut response without any complexity. Hence, all the 12 questions in each of the two survey questionnaires, targeted for the science and mathematics participants separately, were expressed in the dichotomous form. This application of using several dichotomous questions on a single topic (i.e. to examine the perception of question) to gain data could reduce the problems of respondents 'guessing answers'.

Scope of Study and Sampling

This investigation adopted the cross-sectional survey design (Creswell, 2005) of collecting data from the different cohorts of science and mathematics teachers who were attending various in-service courses in SEAMEO RECSAM at specific point in time during 2013-2015 period as described earlier in the 'Significance of Study' section. The participants were of different people but the questionnaires remained the same, albeit of two sets, one for science teachers and the other for mathematics teachers. However, the investigator only administered to those cohorts whom he was tasked to facilitate the topic relating to 'effective questioning' at the start of a session at a particular time. Hence, each survey session was based on a convenience sample governed by two conditions: they must be course participants and in direct contact with the investigator. As such this investigation was adopting repeated cross-sectional study (Ruspini, 2002), which was carried out at opportune times, each time using a completely new sample of respondents. The data obtained over time would enable the researcher to analyse the similarities, differences and changes over time with respect to the different cohorts of participants, as well as the summation of all these variables. The overall research design and procedure is illustrated in Figure 3.

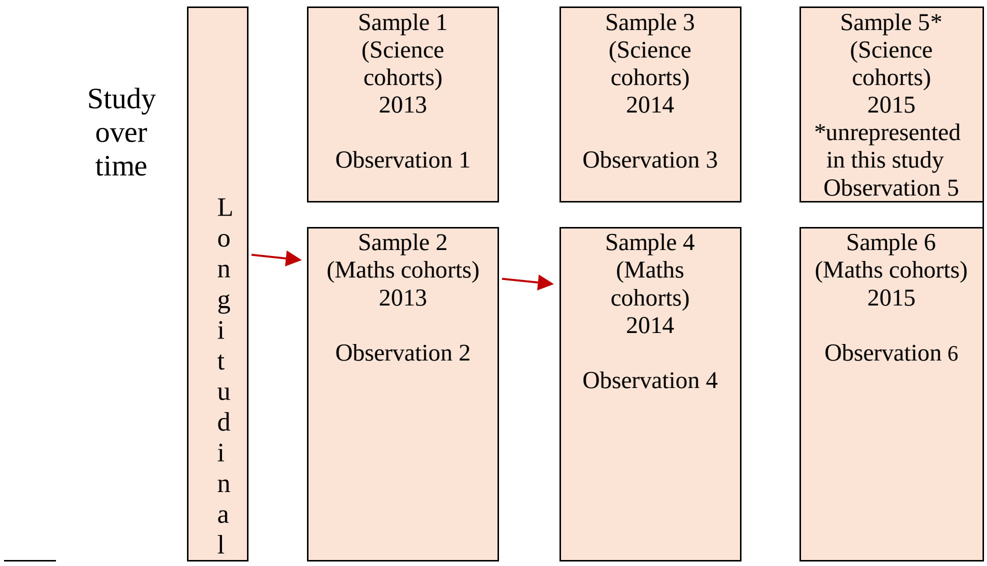

Figure 3. Summary of the overall research design and procedure of this study.
(Adapted from Cohen et al., 2011, p.268; Creswell, 2005, p.355).

This research study was based on the outcomes of the cross-sectional surveys on various cohorts of science and mathematics teachers who attended different in-service courses in

SEAMEO RECSAM at different point in time in three consecutive years from 2013 to 2015. The cross-sectional survey design is a design in which the researcher collects data at one point in time (Creswell, 2005).

The surveys used in this study were designed to explore the perceptions of 'question' by those teachers based on a list of the pre-described sentences. Tables 4 and 5 show the different cohorts of Science and Mathematics teachers who participated in this study.

Table 4
Cohorts of Science Teachers Participated in This Study

Date of survey	[Code] Course title	Geographical area	Number of participants
2013.09.02	[SA] Group A: Training Programme on Higher Order Thinking Skills (HOTS) for Science Coaches (2-20 September 2013)	Malaysia	39
2013.09.03	[SB] Group B: Training Programme on Higher Order Thinking Skills (HOTS) for Science Coaches (2-20 September 2013)	Malaysia	30
2013.10.15	[SC] TCTP-Colombo Plan: Training of Trainers- Professional Programme for Secondary Science Education (7 October – 1 November 2013)	Colombo Plan countries	21
2014.02.17	[SD] Customised Course for Science Educators from Zambia: Enhancing Subjective Learning in the Secondary Science Classroom (14 January – 01 February 2014)	Zambia	16
2014.03.25	[SE] Customised Course for Thai Science Teachers/Educators: Enhancing 21st Century Pedagogical Content Knowledge and Skills for Elementary/Secondary Science Education (17 March – 11 April 2014)	Thailand	31
2014.08.21	[SF] Professions Development Programme for Science Teacher Educators of Cambodia, Lao PDR, Myanmar and Vietnam (11-29 August 2014)	Indo-China	12
2014.10.23	[SG] Customised Course for Indonesian Secondary Educators: 21st Century Skills in Secondary Science (13 October- 7 November 2014)	Indonesia	15
		Total	164

Table 5
Cohorts of Mathematics Teachers Participated in This Study

Date of survey	[Code] Course title	Geographical area	Number of participants
2013.10.15	[MA] TCTP-Colombo Plan: Training of Trainers- Professional Programme for Secondary Mathematics Education (7 October – 1 November 2013)	Colombo Plan countries	21

2014.03.31	[MB] Customised Course for Thai Mathematics Teachers/Educators: Enhancing 21st Century Pedagogical Content Knowledge and Skills for Elementary/Secondary Mathematics Education (17 March – 11 April 2014)	Thailand	30
2015.05.25	[MC] TCTP-Colombo Plan: Training of Trainers- Professional Programme for Secondary Mathematics Education (18 May - 12 June 2015)	Colombo Plan countries	12
		Total	63

The lists of pre-described sentences for science and mathematics participants were different in that the sentences were science-content or mathematics-content biased respectively. However, the nature of the contents were not significantly different for both Science or Mathematics based questions in this study since the emphasis is to find out their perception of question. The science or mathematics contents-oriented sentences nevertheless would give a sense of 'familiarisation' to the respective cohorts of teachers. The previous Table 2 and Table 3 display the science and mathematics sentences respectively.

This study took advantage of convenience sampling of the participants who happened to be available while attending in-service capacity building courses in SEAMEO RECSAM at different points in time. It is obvious that non-probability samples were used in this study.

The researcher was coincidently tasked to facilitate the sessions related to the topic on 'effective questioning'. So the researcher simply chose the samples whom he had easy access. Since these samples did not represent any bigger groups apart from themselves, the outcomes of this study would not seek to make generalisation as the responses from the wider population (Cohen et al., 2011).

Analysis and Findings

The survey instruments were administered to seven cohorts of science teachers and three cohorts of mathematics teachers respectively as shown in the abovementioned Table 2 and Table 3 during the period 2013-2015. There were a total of 164 science participants and only 63 mathematics participants. The disparity in the number was due to the fact that the researcher is designated as a Science Education Specialist in his workplace, and hence he facilitated more frequently in science courses but seldom in mathematics courses unless situation warrant his service. The outcomes of the surveys are shown in Table 6 and Table 7.

Table 6

Outcomes of the Science Survey

Item	Score	Science Cohorts														Combined (n=164)		Expected Score	
		SA (n=39)		SB (n=30)		SC (n=21)		SD (n=16)		SE (n=31)		SF (n=12)		SG (n=15)					
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
S1	Count	39	0	30	0	21	0	15	1	31	0	12	0	15	0	163	1	164	0
	%	100	0	100	0	100	0	94	6	100	0	100	0	100	0	99	1	100	0
S2	Count	29	10	19	11	15	6	9	7	10	21	1	11	5	10	88	76	164	0
	%	74	26	63	37	71	29	56	44	32	68	8	92	33	67	54	46	100	0
S3	Count	0	39	0	30	0	21	0	16	3	28	1	11	0	15	4	160	0	164
	%	0	100	0	100	0	100	0	100	10	90	8	92	0	100	2	98	0	100

S4	Count	28	11	18	12	17	4	9	7	18	13	4	8	7	8	101	63	164	0
	%	72	28	60	40	81	19	56	44	58	42	33	67	47	53	62	38	100	0
S5	Count	39	0	29	1	21	0	13	3	31	0	11	1	15	0	159	5	164	0
	%	100	0	97	3	100	0	81	19	100	0	92	8	100	0	97	3	100	0
S6	Count	0	39	1	29	0	21	1	15	0	31	0	12	0	15	2	162	0	164
	%	0	100	3	97	0	100	6	94	0	100	0	100	0	100	1	99	0	100
S7	Count	27	12	18	12	17	4	8	8	18	13	2	10	7	8	97	67	164	0
	%	69	31	60	40	81	19	50	50	58	42	17	83	47	53	59	41	100	0
S8	Count	39	0	29	1	21	0	15	1	31	0	12	0	15	0	162	2	164	0
	%	100	0	97	3	100	0	94	6	100	0	100	0	100	0	99	1	100	0
S9	Count	27	12	19	11	17	4	8	8	17	14	3	9	8	7	99	65	164	0
	%	69	31	63	37	81	19	50	50	55	45	25	75	53	47	60	40	100	0
S10	Count	29	10	19	11	17	4	7	9	25	6	2	10	8	7	107	57	164	0
	%	74	26	63	37	81	19	44	56	81	19	17	83	53	47	65	35	100	0
S11	Count	39	0	29	1	21	0	15	1	31	0	11	1	15	0	161	3	164	0
	%	100	0	97	3	100	0	94	6	100	0	92	8	100	0	98	2	100	0
S12	Count	0	39	1	29	0	21	2	14	0	31	0	12	0	15	3	161	0	164
	%	0	100	3	97	0	100	12	88	0	100	0	100	0	100	2	98	0	100

Table 7
Outcomes of the Mathematics Survey

Item	Score	Mathematics cohorts						Combined Score (n=63)		Expected Score	
		MA (n=21)		MB (n=30)		MC (n=12)					
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
M1	Count	21	0	30	0	12	0	63	0	63	0
	%	100	0	100	0	100	0	100	0	100	0
M2	Count	18	3	30	0	9	3	57	6	63	0
	%	86	14	100	0	75	25	90	10	100	0
M3	Count	16	5	2	28	6	6	24	39	63	0
	%	76	24	7	93	50	50	38	62	100	0
M4	Count	0	21	4	26	0	12	4	59	0	63
	%	0	100	13	87	0	100	6	94	0	100
M5	Count	21	0	30	0	10	2	61	2	63	0
	%	100	0	100	0	83	17	97	3	100	0
M6	Count	19	2	4	26	3	9	26	37	63	0
	%	90	10	13	87	25	75	41	59	100	0
M7	Count	18	3	7	23	9	3	34	29	63	0
	%	86	14	23	77	75	25	54	46	100	0
M8	Count	17	4	2	28	2	10	21	42	63	0
	%	81	19	7	93	17	83	33	67	100	0
M9	Count	18	3	2	28	6	6	26	37	0	63
	%	86	14	7	93	50	50	41	59	0	100

M10	Count	18	3	16	14	10	2	44	19	63	0
	%	86	14	53	47	83	17	70	30	100	0
M11	Count	18	3	26	4	10	2	54	9	63	0
	%	86	14	87	13	83	17	86	14	100	0
M12	Count	0	21	6	24	1	11	7	56	0	63
	%	0	100	20	80	8	92	11	89	0	100

Table 2 (as illustrated earlier) shows that among the science survey items, there are four sentences, namely S1, S5, S8 and S11, that are each ending with a question mark. So it was expected that all the participants would say that each of which was a question. However, the outcomes of the survey as shown in Table 6 surprisingly reveal that 1-3% of the participants failed to recognise these items as questions. Conversely, approximately 98% of the participants from the science cohorts were confident to identify each of the sentence ending with a question mark as ‘question’.

In Table 3 and Table 7 that illustrate data collected from the mathematics survey, items M1 and M5 are sentences each ending with a question mark, yet 3% of the participants were not able to recognise M5 as a question as shown in the outcomes of mathematics survey. However, all (100%) mathematics participants were right in saying M1 was a question. It could be interpreted that approximately 98% (i.e. 197/2 x 100%) of the participants from mathematics cohorts were confident to identify sentences that end with a question mark as ‘questions’. It also appeared that same percentage (i.e. 124/126 x 100% or 98%) of both science and mathematics participants were able to identify sentences that end with question marks as ‘questions’. However, contrary to common belief that any sentence ending with a question mark must be a question, the outcome of the survey on this aspect is still fell short of the expected result of 100%.

Among the rest of the sentences about questions in Table 6 and Table 7, there are three statements that provide information about knowledge of the science and mathematics. Therefore, it was expecting that participants would pick items S3, S6 and S12 in the science survey, and items M4, M9 and M12 in the mathematics survey as ‘not questions’. While 1-2% among the science participants were not able to differentiate information statement from question, about 41% of the mathematics participants encountered difficulty of categorising M9 as a statement that is providing information but not as a question that elicits information. About 8.5% [i.e. (6+11)/2 %) of the overall mathematics participants also failed to see that items M4 and M12 are information-giving statements.

The following Tables 8 and Table 9 are extracted from Table 6 and Table 7 respectively, and the related bar charts in Figure 4 (after Table 8) and Figure 6 (after Table 9) below to illustrate the overall and expected results of science and mathematics surveys.

Table 8
Comparing Overall and Expected Results on Science Survey

Item	Is it a question? Yes Overall	Yes Expected	No Overall	No Expected
S1	99%	100%	1%	0%
S2	54%	100%	46%	0%
S3	2%	0%	98%	100%
S4	62%	100%	38%	0%
S5	97%	100%	3%	0%
S6	1%	0%	99%	100%
S7	59%	100%	41%	0%
S8	99%	100%	1%	0%
S9	60%	100%	40%	0%
S10	65%	100%	35%	0%
S11	98%	100%	2%	0%
S12	2%	0%	98%	100%

Looking at Figure 4 and the above Table 8, it is visually obvious that nearly half the number [40% on calculation, i.e. (46%+38%+41%+40%+35%)/5] of science participants were unable to recognise that items S2, S4, S7, S9 and S10 were questions. These questions were expressed in the inquisitive form using leading words 'state, identify, list, describe and label' that elicit responses. These kind of words are commonly used in classroom interaction, instruction and test to assist students to think and learn by soliciting answers as responses, and hence these related sentences are questions. Among the samples studied (referring to Table 6 as illustrated earlier), SF (N=12) participants appeared to have poor score in identifying all these questions concerned.

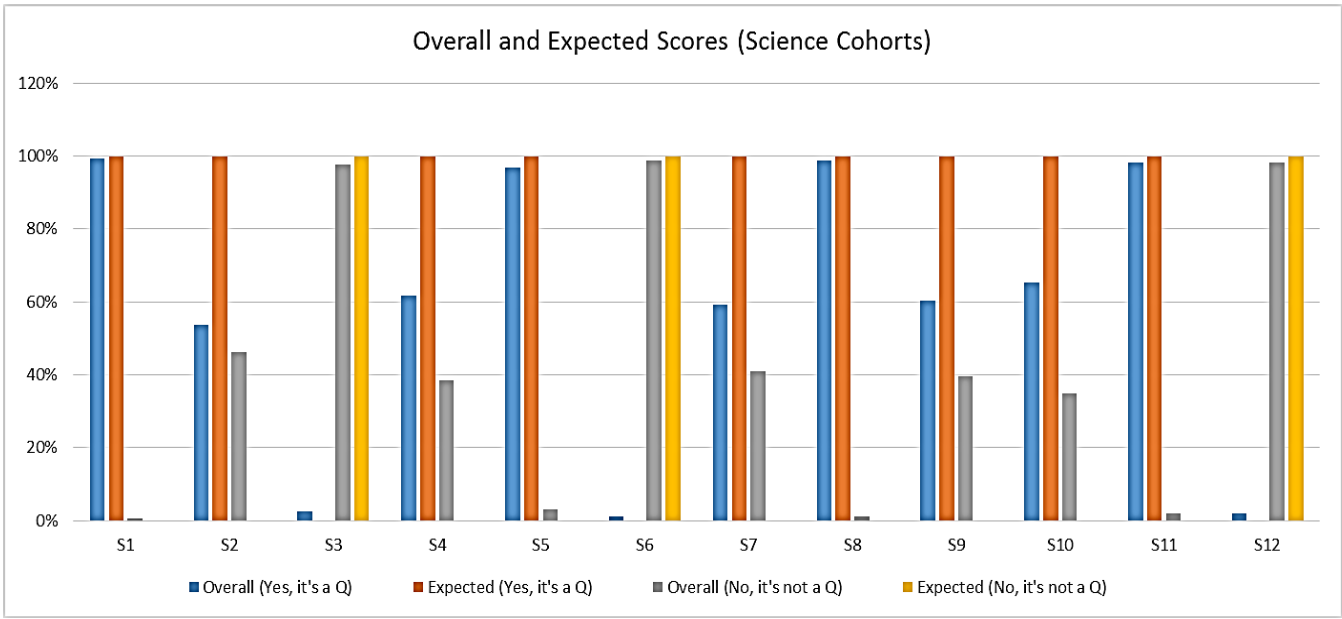

Figure 4. Comparing overall and expected scores for science survey.

Figure 5 amplifies this observation. SG (N=15) (refer Table 6) participants were also fared poorly in identifying questions S2, S4 and S7 in the survey.

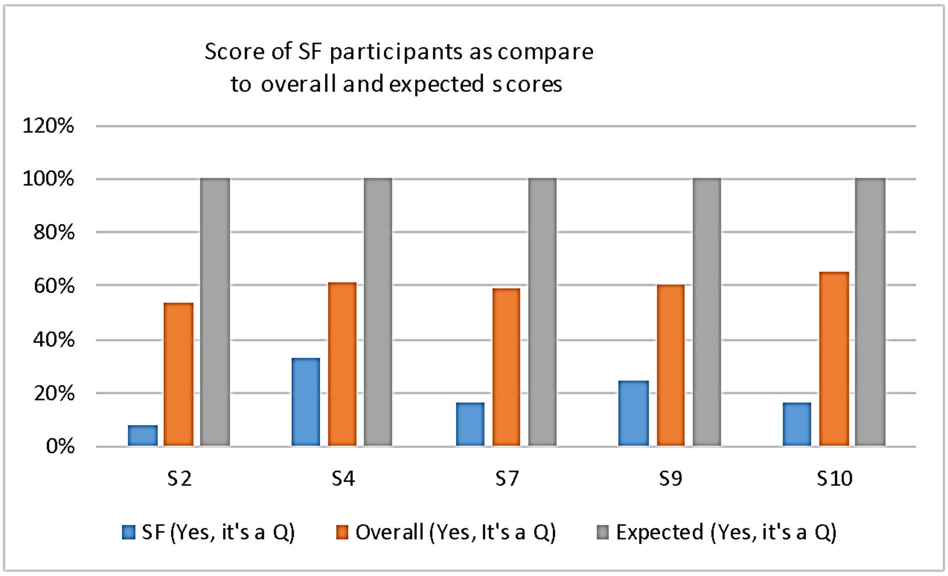

Figure 5. Comparing the scores on item S2, S4, S7, S9 and S10 by SF sample with overall and expected scores.

Examining the following Table 9 and Figure 6, it is apparent that many mathematics participants also had difficulty to identify items M3, M6, M7, M8, and M10 as questions. These sentences start with task-oriented words 'draw, write, simplify, state and label' to elicit answers. In fact less than 50% of the participants were able to identify M3, M6 and M8 as questions. It, therefore, appeared that 'to draw…to write …and to state…' were not usual expressions used in mathematics questions. However, 'simplify' (in M7) and 'label' (in M10) seen to be of fairly common usage in mathematics question. This was reflected by more than 50% of the participants identified them as questions. Items M2 and M11 are also questions without question marks, but more than 80% of the participants could ascertain that they were questions. Probably, the words 'find' (in M2) and 'solve' (in M11) were perceived to be commonly used in mathematics questions.

Table 9
Comparing Overall and Expected Results on Mathematics Survey

Is it a question?				
Item	Yes		No	
	Overall	Expected	Overall	Expected
M1	100%	100%	0%	0%
M2	90%	100%	10%	0%
M3	38%	100%	62%	0%
M4	6%	0%	94%	100%
M5	97%	100%	3%	0%
M6	41%	100%	59%	0%
M7	54%	100%	46%	0%
M8	33%	100%	67%	0%
M9	41%	0%	59%	100%
M10	70%	100%	30%	0%
M11	86%	100%	14%	0%
M12	11%	0%	89%	100%

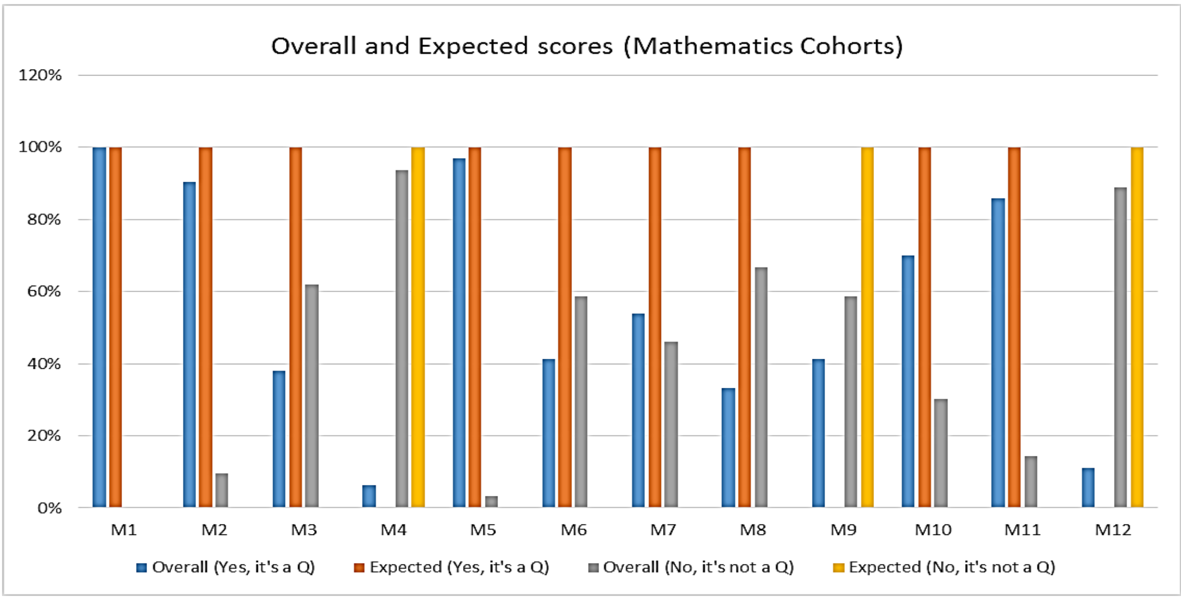

Figure 6. Comparing overall and expected scores for mathematics survey.

Scanning through Table 7 as illustrated earlier, sample MB (N=30) appears to have comparatively poorer scores in M3, M6, M7 and M8 than the other samples. MB scores in the four items are shown in Figure 7.

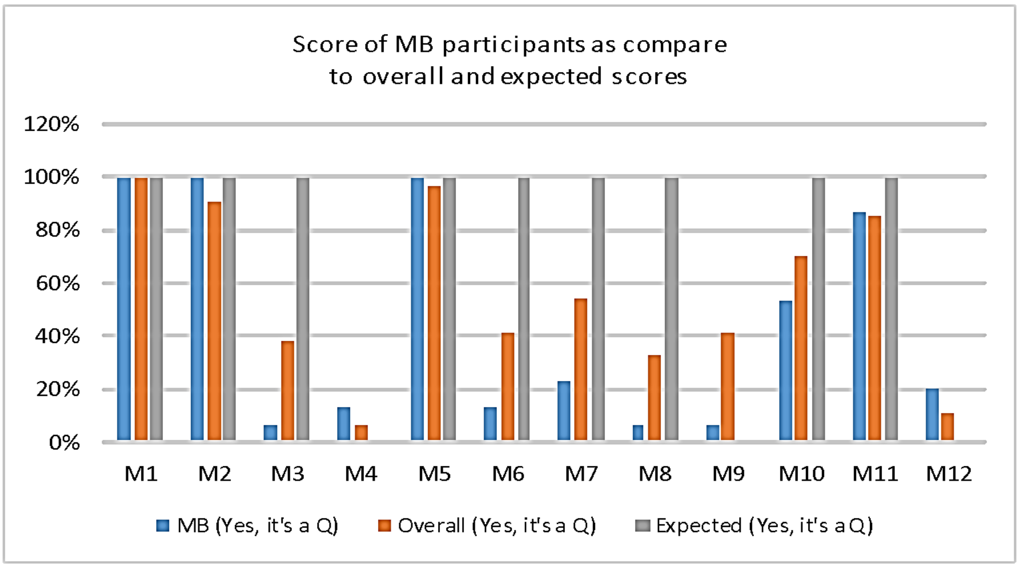

Figure 7. Comparing the scores on items M3, M6, M7 and M8 by MB sample with overall and expected scores.

Conclusion

Summary and Implications

This study reveals that even though inquiry sentences (S1, S5, S8, S11, M1 and M5) are each ending 'with a question mark', only 98% of both the science and mathematics participants from the various cohorts attending different in-service courses in SEAMEO RECSAM during the period 2013-2015 were able to identify them as ‘questions’. Interestingly, among the sentences (S3, S6, S12, M4, M9 and M12) that provide information and therefore not ending with a question mark each, all the participants were also not confident enough to categorise them as ‘not questions’. Coincidentally, among the science participants, again about 98% of them were able to identify informative statements from inquisitive questions. However, the mathematics participants seemed to have encountered greater difficulty to distinguish among the two. Only approximately 80% of the mathematics participants could identify the information-giving statements from questions expressed in inquisitive sentences.

For questions expressed in sentences (S2, S4, S7, S9, S10, M2, M3, M6, M7, M8, M10 and M11) ‘without question marks’, it was found that approximately 60% of both the science and mathematics participants could identify them as ‘questions’. However, significantly high percentage (approximately 40%) of the teachers failed to identify these task-driven sentences as questions to elicit answers, which they themselves often used in classroom questioning during instruction or conducting of a test.

Reflections and Recommendations

The adoption of cross-sectional survey of cohort analysis in this study was a deliberate attempt to yield rich data over time from the vast variety of participants’ background spreading through a wide geographical areas of Asia and Africa. Different cohorts of classroom science and mathematics teachers from SEAMEO, Colombo Plan and African countries brought with them the diverse cultures and teaching experiences while attending various in-service capacity building courses. However, a major concern in longitudinal study is the comparability of data over time (Cohen et al., 2011).

In this study, though the questionnaires remained constant, the respondents were very diverse. This might affect the consistency in the data collection over time. For example, it was not possible to anticipate and include all the variables that would emerge over time, from the initial stage of research to the end of cut-off time. Specifically in this cohort study, the various cohorts of participants from diverse geographical areas had different levels of mastery in English, which is the language used in the surveys. This was a concern to achieve higher consistency in the measurement and data collection. Furthermore, the environmental and social groups changed over time would have made the study highly unlikely to be completed in the way that it was originally planned.

The dichotomous questions in the surveys that were constructed seemed to be downgrading the study for the sake of simplicity. However, Youngman (1984) stated that it is natural human tendency to agree with a statement rather than to disagree with it. Hence, this suggests that a simple dichotomous question might build in respondent bias. Indeed people may be more reluctant to agree with a negative statement than to disagree with a positive question (Weems, Onwuegbuzie & Lustid, 2003).

In conclusion, the author would like to recommend that an extended investigation be conducted on a wider cross-sectional study using purposeful samples of homogeneous population to uncover further information in this subject. The number of items in the questionnaires may be increased to enrich the collection of data, and perhaps it may be necessary to have face-to-face interview or focus group discussion with some selected individuals to confirm their perception and comprehension about question.

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