

**PROMOTING GOOD PRACTICES IN MATHEMATICS TEACHING
THROUGH LESSON STUDY COLLABORATION
: A MALAYSIAN EXPERIENCE**

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This paper begins by describing the elements of good practice in mathematics teaching as defined by the Malaysian mathematics teachers. An exemplar lesson plan collaboratively created by one of the Lesson Study group will be used to highlight the characteristics of good practice in mathematics teaching promoted through engaging teachers in Lesson Study process. Suggestions for adopting or adapting this lesson plan to another classroom context will also be discussed. A 10-minute video clip of an abstract of the lesson and some suggestions on how to use it for teacher professional development will be attached as Appendix to the paper.

Introduction

This paper aims to discuss and share our experiences of an attempt to promote good practices in mathematics teaching through Lesson Study collaboration project. First of all, we will describe the elements of good practice in mathematics teaching as defined by the Malaysian mathematics teachers. Then we will give a brief report of our Lesson Study project that aims to promote these good practices and discuss some challenges and issues that we have faced during the project. Next, to highlight the characteristics of good practice, an exemplar lesson plan collaboratively created by one of the Lesson Study group will be used. Finally, we give suggestions on how to adopt or adapt this lesson plan to another classroom context.

What is Good Practice in Mathematics Teaching?

As discussed in Lim (2006), generally, Malaysian practicing mathematics teachers agreed that a good lesson plan or good teaching practice should encompass the following characteristics:

- a) student centered activities that encourage conceptual understanding
- b) related to students' daily life experiences

- c) that the students understand what is being taught and can apply what they have learned to solve problems
- d) Good planning of student activities
- e) Active participation of students in fun and meaningful activities
- f) Use of teaching aids that enhance students' conceptual understanding

However, as experienced by many practicing teachers, these ideal characteristics are difficult to achieve in their day-to-day practice due to a number of challenges and constraints.

Challenges to Good Teaching Practices

a) Examination oriented culture

The Examination oriented culture is still very much prevalent in the Malaysian society. Examination results play an important role as a yard stick of accountability to the school performance. Hence, students' performance in examinations is used by school principals as a yard stick to evaluate teachers' teaching competency. Consequently, most teachers set their teaching priority on finishing the syllabus so as to ensure their students achieve excellent performance in these examinations. Very often, teachers need to spend a considerable amount of time conducting additional classes to prepare their students for these public examinations. This leaves teachers with very little time for professional development and innovative teaching.

b) Time constraint

Good practice of mathematics teaching requires student centered activities that promote conceptual understanding and active students participation. However, these activities are usually time-consuming. Due to the examination oriented culture as discussed above, teachers need to cover a fixed amount of syllabus within a limited teaching time. Hence, many teachers tend to adopt the traditional teacher centered approach that requires lesser preparation time.

c) Teacher's beliefs

Although most Malaysian teachers support the characteristics of good practice in mathematics teaching as mentioned above, many of them also believe that by giving clear explanation with suitable examples (teacher-centered approach) is more practical and good enough to achieve most of the teaching objectives. They feel that it is too much a hassle to allow students to construct their knowledge through student-based activities. They are not confident if their students could have acquired enough knowledge and skills by exploring the lesson themselves. Hence, the teachers tend to use the teacher centered approach where they can control the teaching and learning pace of their students.

Hence, due to the above challenges and constraints, teachers were shunning from innovative teaching approaches and continued to adopt the traditional teaching methods

(Fatimah and Lim, 2004). As a result, there was limited time and opportunity for teachers to collaborate in school for the sake of their professional development. In other words, the teaching culture and school context failed to promote teachers to adopt innovative and good teaching strategies. Under such circumstances, it is a real challenge for many teachers to incorporate good teaching practice.

Lesson Study Project in Malaysia

In June 2004, we started a Lesson Study project in two secondary schools in Malaysia (see Lim, White & Chiew, 2005 and Chiew & Lim, 2005 for more details). The main aim of the project was to gauge if Lesson Study process could served as an alternative model for mathematics teacher professional development programme. Each school has 8 mathematics teachers participated. At the end of one year, one school has undergone three Lesson Study cycles but another school just two cycles. Nevertheless, both project schools received positively the Lesson Study model of teacher professional development, although one of the schools shows keener interest in implementing the project than the other. All the 16 participating mathematics teachers espouse positively that Lesson Study has (a) promotes a collaborative culture that enhances the professional collegial bonds within their mathematics staff; (b) gained and enhanced their mathematics content knowledge and pedagogical content knowledge through group discussion and peer observation; and (c) allow and encourage teachers to prepare better student based activities that constitute good practices of mathematics teaching and learning. In fact, even though our project has completed last June 2005, one of the project schools still persists with their Lesson Study group.

In view of the potential of Lesson Study collaboration for promoting good practice, we have set up Lesson Study groups in another two schools, one primary and one secondary school in January 2006.

The Chinese primary school is a small school with a total of 12 teaching staff and 6 classes. As 8 of them involve in the teaching of mathematics and English, they form a Lesson Study group. Their aim of setting up the Lesson Study group was to promote good practice in mathematics teaching as well as to enhance the teachers' confidence in teaching mathematics using English.

The secondary school is a fully residential school consists of selected students with above average ability. It has 10 mathematics teachers, so two Lesson Study groups were set up, with one for the upper secondary and one for the lower secondary mathematics. Their main aim of setting up the Lesson Study group was to promote good practice in mathematics teaching. They have set their first goal as promoting mathematical thinking and creativity among students.

Both schools started with a half day workshop which aims to introduce the concept and process of Lesson Study. The workshop was given by the researchers/authors, illustrated with a video tape entitled *Lesson Study: An Introduction* produced by Makoto Yoshida and Clea Fernandez of the Global Education Resources (2002). At the end of the

workshop, the teachers from the Lesson Study group and began their first discussion by setting the goal and arranging schedule for the following meetings. Both schools faced similar problem when trying to arrange a teaching period that could be observed by all teachers and who would like to teach the lesson. All teachers were overloaded and had a busy working schedule, nonetheless, they managed to find a suitable time after much negotiation. Likewise, most teachers were shy and felt stressful to teach openly and to be observed by their colleagues. Perhaps, this is yet to be a culture of our Malaysian teachers. However, at the end, someone had to volunteer or was persuaded to be ‘the teacher’.

After 3-5 discussions, all the three Lesson Study groups managed to have their first teaching observation. The teaching lesson was video-taped and reflection on the lesson was carried out immediately after the teaching. The lesson plan was then revised according to all participating teachers’ comments and suggestions. Ideally, the revised lesson plan could be re-teach to another class. However, for the Chinese primary school, as it has only one class per grade level, it is not possible to re-teach the revised lesson to another class. For the secondary school, due to time and examination constraint, the teachers chose not to re-teach the lesson this year, but bring forward to re-use the lesson plan next year.

So far, the first two project schools produced 5 lesson plans while the last two schools produced 3 lesson plans. All were video-taped and analyzed. For the purpose of this paper, we will only discuss one lesson plan that best displayed good practice of teaching mathematics although we acknowledge that given time and effort, it could be revised and improved further. The VTR accompanied this paper is also based on this lesson plan

An Exemplar Lesson

The chosen lesson plan was designed to introduce the concept of “set”. Appendix 1 shows the complete lesson plan and the worksheet given. The target group was 20 Form 4 (Grade 10) students with above average ability. The lesson took 40 minutes to complete. The key mathematical concepts to be taught include: set, elements of a set, Venn diagram number of elements, empty set and equal set. This is the first lesson on the topic of “set” for this group of students. However, they already have prior knowledge of “classifying things into collections” and “able to group objects based on certain common characteristics”. The expected learning outcomes were at the end of this lesson, (i) the students were able to explain the concept of set to their peers; (ii) they can use the correct set notations such as braces { }, phrases and Venn diagram to represent a given set; (iii) they can identify the elements (\in) or non-elements (\notin) of a given set and its number (n); (iv) they can give examples of empty set (\emptyset) and equal sets.

▪ Set induction

The teacher started the lesson by asking his students where will they be going during their weekend outing. This is a fully residential school where all students are compulsory to stay in the school hostel. They were allowed to go outing only once a fortnight. The teacher knew that most likely they will visit the nearby hypermarket. The teacher then

attempt to link today's topic by asking a few related questions such as "in a hypermarket, where do you find a pair of trousers? A tube of toothpaste?" etc.

To arouse the curiosity of the students, the teacher introduced a guessing game. The teacher asked a student, AA to pick up a red packet. Each packet contains a piece of paper written an amount of money and the name of an object to be bought. The teacher asked the class to guess what student AA was supposed to buy. The class could not answer, so the teacher gave a clue by asking student AA to go to a corner where he can find that object. At different corners of the classroom, there were labels such as 'Toiletries', 'Food', 'Clothes' and 'Books'. For example, student AA went to the "Food" corner. The teacher encouraged the students to guess the possible object that AA was looking for. Some students guessed the answer as "junk food"; "sweets" or "chocolate". Teacher then asked AA the amount of money given to buy. This provides another clue that narrows down the possible answers. After a few guesses, the students were able to guess the correct answer as "Maggi Mee". The teacher repeated the game by asking a couple of students to choose the red packets again.

Comments:

This set induction fulfills/displays several characteristics of good practice:

- (a) It links the topic to the students' daily life experience such as shopping at a hypermarket.
- (b) The guessing game is fun and meaningful because it helps students to realize the importance of the concept of set and classification in daily life.
- (c) By encouraging the students to guess, it promotes the creativity of students to generate a set of objects that share common characteristics which is the basic concept of set. By giving various clues or conditions, it encourages students' logical reasoning that helps to deduce the correct answer.

▪ **Setting the context**

After playing the guessing game, the teacher highlighted the importance of classification and organization in daily life. He then brought the students' attention to today's topic. He explained the definition of set, and pointed out the main concepts to be learnt today as well as the four activities to be played later. All these information were displayed on three manila cards placed on the blackboard.

This step is important because it aims to set the students' minds to focus on the learning objectives and the expected learning outcomes of today's lesson. This allows students to be ready and well prepared for the learning.

▪ **Learning by doing**

Instead of the usual teaching style of explaining the key concepts by giving examples, the teacher in this lesson has chosen to use the structures of cooperative learning. He planned out the following three activities to develop the lesson:

Activity (1) Fan and Pick

The teacher displayed 20 cards in the form of a fan and asked one member of each group to come to the front to pick 5 cards. Each card was written the name of an element, for example: 'January', 'March', '3', '2' etc. In each group, the students were asked to sort the 5 cards into different sets according to some common properties. Later, they were asked to compare and sort their cards with all the other three groups. They were then asked to paste all elements which share the common properties on the soft board at the back of the class. Earlier on, the teacher has drawn five oval shapes and labeled them as A to E. It was observed that all students participated actively and they managed to paste all the cards onto the relevant Venn diagram in less than a minute.

Based on the results of the activity, the teacher developed some key concepts of set such as 'representing a set in three ways – using phrases, Venn diagrams and braces { }'; empty set, element and non element of set and the number of elements. The students were seen to participate actively in the discussion and developing of the concepts together with their teacher.

Comments

The above activity was well planned and it highlighted several characteristics of good practice:

- (a) The activity was student-centered where all students participated actively in sorting the given elements. The structure of the activity requested the students to help each other to get the task accomplished. This also encourages simultaneous interactions among students.
- (b) Through effective questioning technique, the teacher was able to lead the students to participate actively in the discussion and to develop the conceptual understanding naturally.

Activity (2) Round table

The teacher gave each group a worksheet and a pen. Each group member took turn to answer the questions on the worksheet. The worksheet contains two parts. The first part asks the students to list the elements of each set A to E using the set notation. The second part gave a set P and asked students to determine whether a given element belong to set P. This exercise aims to assess students' understanding of concept.

To make the activity more fun and competitive, the students were encouraged to complete the worksheet in the shortest time. The worksheet of the first completed group was labelled 1 and subsequently for the other three groups. Each group then exchanged their answers for checking (pairs check).

Comments

This is again another well planned activity that displays some characteristics of good practice:

- (a) it assesses if the students understand what is being taught and can apply what they have learned to solve problems.
- (b) It promotes active participation of students in a fun and meaningful activity.
- (c) Using the cooperative learning structure of 'round table', it encourages students to have equal participation. Every group member has an equal opportunity to complete the exercise.

However, it was observed that some group members who were more dominant tended to answer the questions individually. This observation was noted at the reflection of observing teachers and was suggested that teacher needs to be more alert when carrying out this activity in the future.

Activity (3) Mix and Match

This was an outdoor activity that aims to introduce the concept of 'equal set'. The teacher prepared 20 cards. Each card was written a set such as $A = \{1, 3, 5\}$, $C = \{5, 1, 3\}$, $E = \{\text{all positive odd number less than } 7\}$ or $J = \{s, u, k, a\}$, $L = \{s, k, a, u\}$. The teacher threw all the cards into the air and each student picked one card when the cards fell to the ground. The students compared and matched their cards with their friends. Students who have cards which are of equal sets were asked to stand in a group. The teacher inspected each group to ensure that they have grouped themselves correctly. The process was repeated to give more practice to the students.

Comments

This activity is unusual because it brings students out of the classroom setting. All students were very excited and happy. Everyone was seen actively engage in the activity. Perhaps they perceived it as a game rather than a lesson. Hence, this activity displays several of the characteristics of good practice such as:

- (a) it is a student centered activity that encourage conceptual understanding
- (b) it encourages the student to learn and to apply what they have learnt
- (c) It is a fun and meaningful activity that engage students actively in learning. The students were seen to yell and cheer while they learned happily.

- **Practice For Reinforcement Through The Activity "Think -Pair-Square"**

After the excitement of games and activities, the students were asked to do their work individually. They were given a worksheet that contains one question with 4 parts. The question asks the students to represent the given sets by Venn diagram as well as state the number of elements in each given set. When they have completed the questions individually, they were asked to pair with a group member to discuss and check their answers. If their answers were different, they were supposed to argue and to justify for the best answer. Finally all the group members were to make a final decision to accept the best and final answer for their group. The teacher then asked them to hand up their completed worksheets.

To further reinforce the students' skills, the teacher gave some home work exercise for the students by referring to the textbook.

Comments

This is a very common practice in Malaysian schools that mathematics teachers used to give class work and home work exercises that aim to reinforce the understanding of students at the end of the lesson. It is also a strong belief of "practice make perfect" that students need to drill and practice so as to master the skills that they have just learnt.

However, in this lesson, the teacher has cleverly using another cooperative learning structure: 'think-pair-square' that not only encourages students' individual accountability but also encourages Vygotsky's principle of 'thinking & talking' in the process of learning to be applied here.

▪ **Closure**

The teacher asked one student to volunteer to recap what they have learnt today. The student was able to list out the key concepts learnt. The teacher then summarized today's lesson and emphasized the importance of learning set and set theory in daily life. He also referred students to other daily life examples such as finding a book in the library or searching for the address of a hotel in the telephone directory. The teacher then foreshadowed the forthcoming lesson to the students about some key concepts to be learnt in the next lesson such as intersection and union of sets.

Comments

The whole lesson took exactly 42 minutes. This shows that the teacher has managed the time very well. The closure was well done as the students were able to summarize what they have learnt in today's lesson confidently. The objectives of the lesson were seen to have been achieved.



Activity: Fan and pick



Activity: Mix and Match

Suggestions for Adoption/Adaptation of the Lesson Plan

After the lesson, all the mathematics teachers in the Lesson Study group sat down to discuss and reflect on the lesson. All the teachers agreed that it was a good lesson that depicted various characteristics of good practice in mathematics teaching and all of them would like to try out the various activities in their mathematics classes too. All the observing teachers also enjoyed the lesson as the students did. They commented that the presentation of the teacher was very clear and easily comprehensible. The activities were fun and meaningful.

However, there were 5 activities packed in one lesson. Even though the teacher managed to carry out all of them in the stipulated time, there was a bit of rushing and some observing teachers were worried that if all the students have managed to follow the activities positively. But the teacher in charge argued that it was deliberately planned this way so that the students will not get bored. These students are of above average ability. They can learn things very fast. They like to be challenged by a variety of activities. They get bored easily if the pace of the activity is too slow or not challenging enough for them.

Nevertheless, all the teachers agreed that the lesson plan can be modified to suit the needs and ability of students. For example,

- a) For normal or lower ability students, the number of activity could be reduced. It is not necessary to pack all five activities at one time. Perhaps two to three activities might be enough to attract students' attention for learning.
- b) For bigger class size such as more than 30 students in a class, the number of activity also should be reduced. This is because bigger class will have more groups; hence more time is needed for each group to present their answers.
- c) The cooperative learning structure such as 'Round table', 'fan and pick', 'mix and match' can be used to develop different kinds of content or concepts learnt.

Lesson Study for Teacher Professional Development

After one cycle of Lesson Study, we encouraged the teachers to reflect and write down their reflection in a questionnaire provided. Analysis of the data show that most teachers perceived the Lesson Study process positively. They espoused that:



Lesson Study group

“good, it stimulates teacher to change the way of teaching in the class”

(upper secondary lady teacher)

“more input, more thinking”

(upper secondary man teacher)

“good, all mathematics teachers discuss together”

(lower secondary lady teacher)

“useful. Should be practice, enable teachers to exchange knowledge and experience, help teachers to overcome problems about lesson, enable teachers to discuss about lesson, many heads are better than 1. ”

(lower secondary lady teacher)

The lesson study process has provided a meaningful experience for teachers to reflect on their own teaching while getting new ideas from their peers. We observed that when they discussed and collaborated in a professional manner, ideas of good teaching practices were examined through their self-reflection.

However, one teacher remarked that, “it is useful but time consuming” while another teacher found Lesson Study “must follow sequence and time frame”. These comments are expected because the teachers were asked to make time and come together to discuss, at least twice or three times; then to observe the teaching and to reflect. Due to some constraints in the school, teachers felt uneasy to juggle their time as they also have other teaching tasks and duties at the same time.

Concern over ‘time’ and heavy workload are prevalent and this would likely be the main issues, judging from the teachers’ responses about lesson study. However, we would like to argue this from a different perspective. Due to the recent trends and changes in the education, it is imperative that teachers change their mindset and be aware of their own professional development. Currently, we observed that teachers’ awareness of self-

development in teaching is lacking in the school teaching culture. As such, we anticipate a long journey to promote teachers as life-long learner as demanded by the Malaysian Ministry of Education. In our view, Lesson study has provided an alternative and potential model of teacher professional development that deserved serious attention from the Malaysian educational authorities.

Conclusion

This paper has shown that lesson study process is able to disseminate the characteristics of good teaching practices through engaging teachers in a Lesson Study collaboration. More importantly, the positive and encouraging feedback from the participating teachers has motivated us to spread the lesson study project to more schools. However, we acknowledged that it is still early to make any conclusive findings based on the few lesson study conducted. To date, Lesson Study as a form of teacher-led professional development is still relatively new to the Malaysian teaching context. Implementation of lesson study projects will require the determination and support from the school administrators especially at the initial stage. However, we are optimistic that more teachers will volunteer to participate in the lesson study process when they have realized the benefits that could be gained from lesson study process.

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Appendix I: Lesson Plan

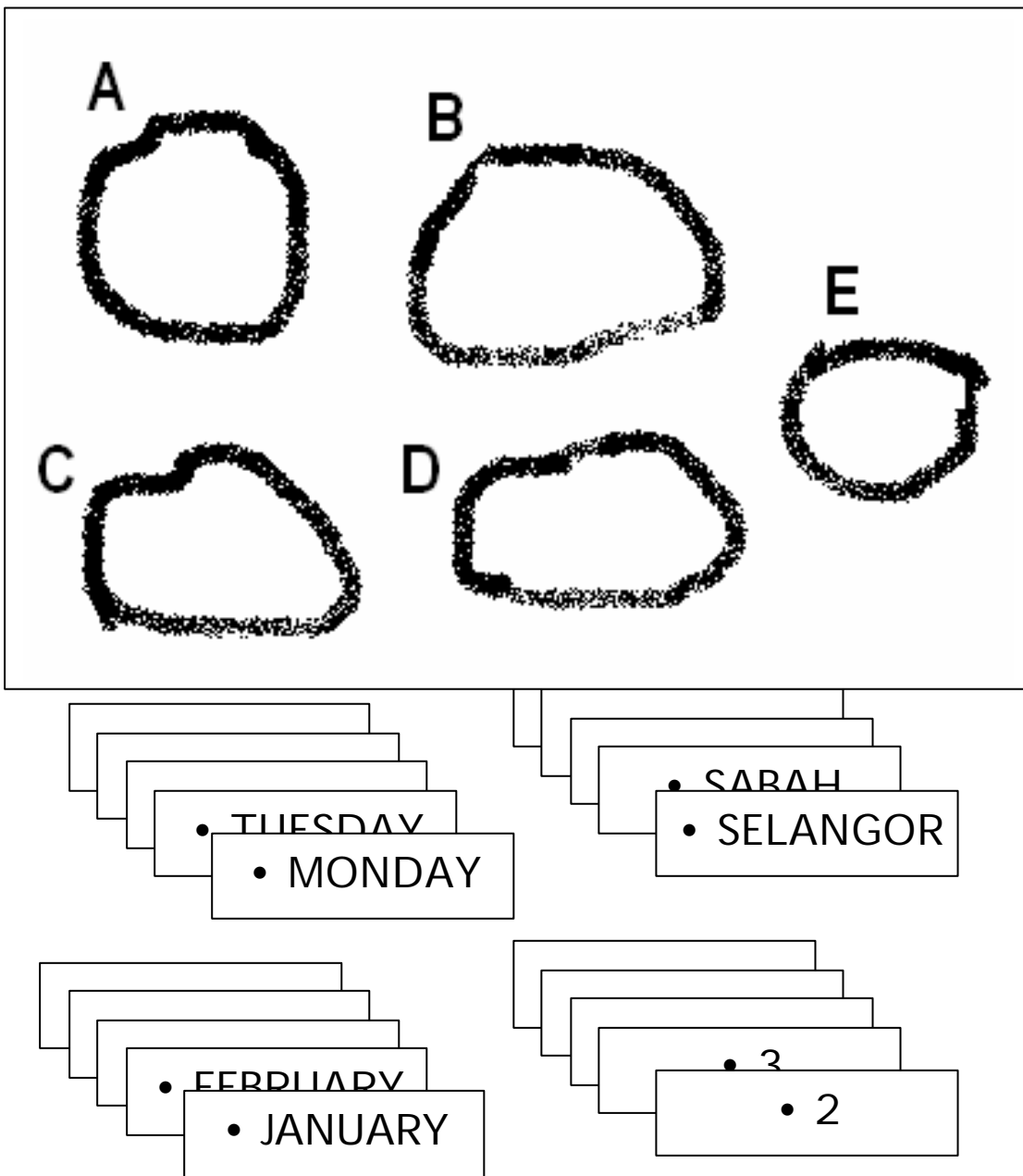
Date:	7 April 2006 (Friday)
Time:	9.50 – 10.25 am
Class:	Form 4S
Class Size:	20 students
Ability:	Above average
Topic:	SET (Form 4 or Grade 10 Mathematics)
Subtopic:	Understand the concept of set
Key Concept:	Set, elements of a set, set notations, Venn Diagrams, Number of elements, empty set, equal sets.
Prior Knowledge:	(a) The students have common sense of classifying things into collections. (b) The students can also group objects based on certain common characteristics.
Learning Outcomes:	(a) The students are able to explain the concept of set to their peers. (b) They are able to draw Venn Diagram and use the correct set notations. (c) They are able to identify equal sets.
Higher Order Thinking Skills:	Application, Analysis, Synthesis
Moral Values:	Being helpful and supportive.
Soft Skills:	Cooperation and teamwork.
Teaching & Learning Materials:	Worksheets, manila cards, double-sided tape, scissors, thumb tacks
Teaching & Learning Strategies:	Cooperative Learning (CL)- the *Structural Approach.
Classroom Setting:	4 groups with average 5 students per group

Procedure and Time	Content / Skill	Teaching- Learning Activities	Remark
1) Set Induction (5 min)	<p><u>Content:</u> Categorization/ classification</p> <p><u>Skills</u> Critical & analytical thinking skill</p>	<p>Teacher begins the lesson by asking some daily life questions: In a hypermarket. Where do you buy a pair of trousers? A tube of toothpaste? A dozen of oranges? A packet of Maggi mee? A kg of tomatoes?</p> <p>Guessing game</p> <p>Teacher asks a student to pick an envelop containing a piece of paper written an amount of money and an object. The students need to go to the corner where he can find that object. Other students are asked to guess the object which that student is looking for. <i>(This will help to generate a set of objects having the same property.)</i></p> <p>More real life examples: Where to find Science books in the library? <i>(Dewey Decimal System)</i></p> <p>How to find the phone number of a hotel in the telephone directory? <i>(Alphabetical order)</i></p>	<p>The classroom is label ‘Toiletries’, ‘Food’, ‘Clothes’, ‘Books’ at different corners.</p> <p>To help students to realize the importance of set theory in everyday life.</p> <p>Real life examples give them the significance of mathematics in everyday life.</p>
2) Setting Context (2 minutes)	Overview of today’s lesson	<p>The teacher emphasizes the learning outcomes precisely and explicitly :</p> <p>(a) The students are going to learn the concept of set. (b) They will be able to draw the Venn Diagrams (c) The students will be able to identify equal sets.</p>	Set the students’ mind to focus on the learning objectives and the expected learning outcomes.

<p>3) Learning By Doing (15 minutes)</p>	<p><u>Content:</u> Set, elements of a set, set notations, Venn Diagrams, Number of elements, empty set, equal sets</p> <p><u>Skills:</u> Analysis Synthesis Interpretation Presentation</p>	<p>Activity (1) CL Structure: Fan & Pick Each group is given 5 cards with an element on each card. They are required to discuss with other groups so as to form groups of elements with common properties. They are asked to paste all objects on the soft board according to similar properties. (<i>That will clearly show the Venn Diagram</i>) Refer to Appendix 1a</p> <p>Activity (2) CL Structure: Round Table Each group is given a worksheet and a pen. Each group member takes turn to answer the question, one by one. They compete between groups. They exchange the answers for checking (pairs check). Refer to <i>Appendix 1b</i>.</p> <p>Activity (3) CL Structure: Mix and Match The teacher throws pieces of cards with a set written on each of them. Each student has to pick one card and compare with their friends. Students having equal sets are asked to stand in a group. (This procedure may be repeated to give more practice to the students). Refer to <i>Appendix 1c</i>.</p>	<p>This CL structure encourages <i>simultaneous interactions</i>. Students need to help each other to get the task accomplished</p> <p>This CL structure encourages <i>Equal participation</i> Every student is taking part in the activity.</p> <p>CL structure: <i>Positive interdependence</i> This fulfils their excitement need. They will yell and cheer as they learn.</p>
<p>4) Practice for Reinforcement (10 minutes)</p>	<p>Reinforcement and Evaluation</p>	<p>Activity (4) CL Structure: Think-Pair-Square Students do their own work individually to encourage individual accountability. Then they pair up with a friend to discuss. Finally all members in the group make final decision to accept the final solution. The teacher asks them to pass up all their papers. Refer to <i>Appendix 1d</i>. Homework: 3.1 (a) – (d) for further reinforcement.</p>	<p>CL structure: <i>Individual Accountability</i> Vygotsky’s principle of ‘thinking & talking’ in the process of learning applies here.</p>
<p>5) Closure (3 minutes)</p>	<p>Maximum Recall</p>	<p>The teacher recaps today’s lesson by prompting the students to give the lesson’s learning objectives. The teacher foreshadows the coming lesson to encourage the students to do</p>	<p>The students recall and reinforce their learning. The students</p>

		their own reading when they go home.	anticipate the upcoming learning topics
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Appendix 1a: Fan and Pick



Cards are shuffled so that the students will get the cards randomly. They are asked to sort them according to certain common properties and place them in the Venn Diagram above.

Appendix 1b: Round Table

Topic: Set

Group: _____

Structures: Roundtable

Instruction: Each member takes turn to answer the question, one at a time.

1) List the elements of the sets by using the set notation.

(a) $A =$

(b) $B =$

(c) $C =$

(d) $D =$

(e) $E =$

2) Given $P = \{ \text{all multiples of 5 from 20 to 40.} \}$
 $= \{ \quad \quad \quad \}$

Determine whether each of the following is an element of P
by using the symbols \in or \notin

(a) 3 P

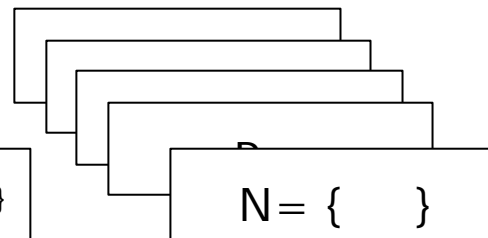
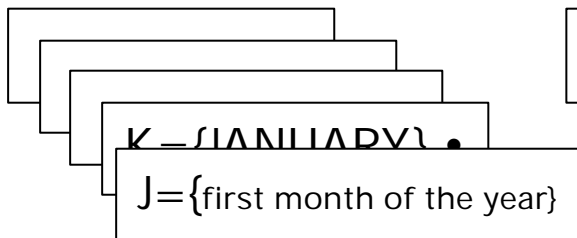
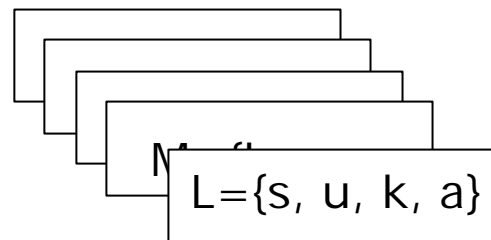
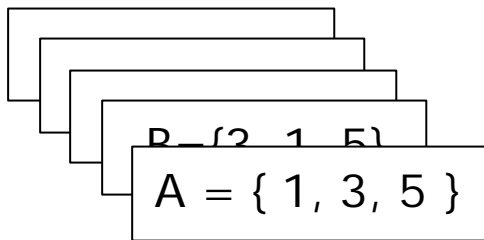
(b) 10 P

(c) 25 P

(d) 30 P

Appendix 1c: Mix and Match

The teacher shuffles all the cards. He throws it into the sky and the students pick one card when the cards fall to the ground. They match the sets on their cards and pair with others who have equal sets.



Appendix 1d: Think-Pair-Square

Topic: Set

Group: _____

Structures: Think-Pair-Square

Instruction: Complete the answers on your own. Compare with a friend. Check your answers in group of four.

1) Represent the following sets by Venn Diagrams and state the elements in each of the sets:

Set	Venn Diagrams
$A = \{ \text{banana, papaya, orange} \}$ $n(A) =$	
$B = \{ 1, 3, 5, 7 \}$ $n(B) =$	
$C = \{ \text{even numbers less than 15} \}$ $n(C) =$	
$D = \{ \text{factors of 9} \}$ $n(B) =$	