IN SEARCH OF GOOD PRACTICE AND INNOVATION IN MATHEMATICS TEACHING AND LEARNING: A MALAYSIAN PERSPECTIVE

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Introduction

This paper begins with a description of good practice of mathematics teaching as perceived by the Malaysian perspective. The sources of discussion include those from the school curriculum, local related research studies and the practicing mathematics teachers. The second part of this paper will focus on a small research project that promotes practices of good mathematics teaching through the Lesson Study model. Issues and challenges that we faced in introducing Lesson Study as an innovative model of teacher professional development will be discussed. A video clip of one of the lesson planned and taught during one of the Lesson Study cycle will also be displayed for further discussion.

What is a description of good practice from the Malaysian lenses?

There is yet to have consensus of a single definition of "good practice". Mohd Majid Konting (1997) proposed that information about good practice may come from various sources: theory, research, curriculum planners as well as expert teachers. Professor Nerida Ellerton (2003) in her summary of best practices and innovations in the teaching and learning of mathematics among the 6 represented APEC economies (namely Australia, Japan, Korea, Malaysia, Singapore and United States) listed four guiding principles for defining best practices:

a) Best practice is not the same the world over
b) Best practice needs to be developed in the school level
c) Models of best practice need to be shared
d) Best practice needs to be valued at all levels- school, community, district, state, national and international.

She further proposed that best practice involves:

a) listening to the voices of children
b) designing a child-centered curriculum
c) children enjoying learning
d) doing to understand – active learning

e) relating learning to the world of the child

f) teachers as learners

g) providing professional development

(p. 209)

Hence, in order to search for a good definition of good practice, we need to take into consideration voices from various parties such as students, teachers, school, community, district, state, national and international. This is because mathematics teaching is a cultural activity. Good practices in classroom teaching are shaped by all parties involved in the culture. The notion of good practice is in fact, loaded with value judgment. What is "good" to one culture might not hold true for another. With this notion in mind, I have looked into the following three sources to get a glimpse of 'good practice' of mathematics teaching as perceived by Malaysians:

1) From the Malaysian Primary and Secondary School mathematics curriculum

A brief content analysis of the latest Integrated Curriculum for Secondary School Mathematics syllabus (2004) highlighted the following emphasis in the process of teaching and learning mathematics:

a) the need to link mathematics "learning to everyday life and experiences in and out of school" (p.2);

b) the development of problem solving skills (p.3);

c) the development of logical, systematic and creative thinking together with valid reasoning (p.4); and

d) the inculcation of intrinsic values of mathematics and values of the Malaysian society which include being systematic, accurate, diligent, confident, not wasteful, moderate and cooperative, all of which contribute towards becoming a responsible citizen. (p.4)

Though not explicitly spelled out, the above emphasis may be considered as prescribed good practices which were planned or intended by the Malaysian mathematics curriculum.

Besides problem solving skills and logical reasoning, in the curriculum specification of the Integrated Curriculum for Secondary School Additional Mathematics (2004), the following were focused as the main elements in the teaching and learning of Additional Mathematics:

e) communication through mathematics, that "will develop students' ability in interpreting certain matters into mathematics models and vice versa" (p.6).

f) mathematical connections between different mathematical related topics, as well as with other learning areas (p.6).

g) the use of technology including both hardware such as computers & calculator and software related to education, websites and learning packages that are available and can enhance "students' understanding of certain concepts, providing visual representation and making complex calculation easier" (p.6).

However, to what extent are these intended 'good practice' implemented in the actual classroom? Are they pragmatic or are they too idealistic?

2) From the local research literature

The second source that I looked into was the local research literature pertaining to mathematics education. After a search of the local conference proceedings, journals, articles and unpublished paper presentations, I found only a couple of research studies related to good practice of mathematics teaching and learning.

The first one was a report of a workshop on the 'Thinking in Science and Mathematics (TISM) Project' published by SEAMEO-RECSAM (1990). The seven teacher researchers from a local school were asked to list down their perceptions of good teaching and good learning. Table 1 displays a summary of both lists.

Table 1: Perception of teacher researchers on good teaching and learning

Perception of good teaching	Perception of good learning
1. Achievement of objectives in that goals of lessons were attained.	1. That the students are happy at the end of the lesson and that they want more of the lesson concerned.
2. Good delivery and presentation	2. That the students participate by asking more questions and are thinking hard.
3. Good planning of student activities	3. That the students understand what is being taught and can apply what they have learned to solve problems.
4. Keep students busy	4. Good learning results in ability to apply knowledge to new situation.
5. Involving participation of students	5. A good learner is not satisfied with what he knows at the moment. He constantly questions the 'truth'

	of what the teacher says. He also tries to relate what he learns to his previous knowledge.
6. Involving positive changes in students	
7. Resulting in long period of retaining the knowledge acquired.	
8. Resulting in students' ability to understand, analyze, and internalize new knowledge.	
9. Resulting in change of behaviors, attitudes towards learning.	
10. Resulting in good learning on the part of students.	

Source: SEOMEO-RECSAM (1990, page 6-7).

The second was a journal article by Mohd Majid Konting (1997) which uses a totally different method of data collection. He observed 58 lessons of 16 effective mathematics teachers from one district. His assumption was that these teachers were nominated as 'effective mathematics teachers' by those in authority (including the principal, assistant principal and head of department), thus their classroom practice might reflect 'good practice'. Findings of his study show that:

> *The effective mathematics teachers were inclined to use traditional whole-class teaching strategies and to dominate classroom interaction. There was little group work and little evidence of pupil-centredness. Their actions were associated with high levels of on-task activity and good pupil behaviour. But the differences are not, to some extent, parallel with the KBSM's recommended pedagogies of pupil-centredness.*
>
> (p. 17)

Hence, there seems a mismatch between good practice as intended by the Malaysian curriculum and that were practiced in the mathematics classroom. How do we operationalize the intended good practices in the mathematics classroom then? Is it not possible to do so? What are the possible hindrances or barriers?

3) From the practicing mathematics teachers

In the year 2004-2005, my PhD student and I have carried out a Lesson Study project in two secondary schools in one district in Malaysia (see Lim, White & Chiew, 2005 and Chiew & Lim, 2005 for more details). Both project schools received the Lesson Study model of teacher professional development positively, though one of the schools shows keener interest in implementing the project than the other.

From the interviews, group discussion and the resulted lesson plan, we observed that these teachers were using three guiding principles in planning and teaching their lessons:

a) student-based activities - attempt to involve students in group or individual activities that will help them to develop or construct mathematical concepts;

b) relating mathematical concepts with real life situations by giving related examples in and out of school experience that encourage students to make connections in mathematics and make learning mathematics meaningful to students;

c) the ultimate goal of teaching is to ensure that all students can achieve good results in public examinations - drill and practice involving pass year examination questions is encouraged.

Indirectly, these principles might be termed as the main characteristics of good practice of mathematics teaching as viewed by these practicing mathematics teachers.

An exemplar lesson plan

The two case studies of Lesson Study yielded five lesson plans. One of them was on the topic: “rotation”. Appendix 1 shows the complete lesson plan and the worksheet given.

Set induction (10 minutes):

To introduce the concept of rotation, the teacher asked students to describe examples of daily life situations that involve rotation. Two possible situations are the rotation of the ceiling fan or the rotation of the hand of a clock. This encouraged students to see mathematics connections with real life situations.

Teaching step 1: Developing the concept of rotation (15 minutes):

Teacher used a teaching aid (made of manila card and transparency) to elaborate the meaning of angle, direction and center of transformation as a result of rotation.

Teaching step 2: determining the image of an object under a rotation (35 minutes)

Teacher then guided the students(working in pairs with a learning aid) to determine the image of an object under various transformation of rotation such as 90 degrees clockwise and anticlockwise, as well as other angle such as 45 degrees clockwise or 240 degrees anticlockwise etc. The learning aid is made of a compass attached to a piece of tracing paper. Students solved problems in worksheet 1. Later the teacher asked students to present their answer in front and students checked their answers.

Teaching step 3: Describing a rotation(10 minutes)

The teacher distributed worksheet 2 that required students to describe a given rotation. Students work individually.

Teaching step 4: whole class discussion (8 minutes)

Students gave their answers and teacher checked orally.

Closing (2 minutes)

Teacher guided the students to summarize today's lesson. Teacher gave homework based on exercises given in the textbook.

Characteristics of Good Practices in mathematics teaching

The above lesson plan on rotation was planned and revised several times by the group of school teachers. After observing and reflecting on the lesson, the teachers were rather happy with the lesson. Ideally, they would like to have every lesson planned this way because it fulfills many of the characteristics of a good lesson or good practices. These characteristics include:

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 student understanding

However, in practice, these teachers espoused that it was rather impossible or too challenging for them to carry out this kind of lesson everyday. This is because they met with a number of issues and constraints that do not encourage or support this kind of practices in real teaching situation.

Issues and constraints faced by the mathematics teachers

a) time constraint

Both project schools reported time as the major constraint. This can be seen from two aspects: the students' and the teachers' time constraint. From the part of the students, doing group or individual work in the classroom could be time consuming. There are fixed amount of syllabus to be covered within a limited teaching time. Hence, many teachers opt for teacher centered approach where the teacher instructs while the students listen. Besides this, from the part of teacher, student based activities demand teachers to spend much time in planning and searching for resources/ideas. Very often, teachers do not have sufficient time to plan their lesson because they are tight down by heavy workload. Again, teacher centered approach is preferred as it requires lesser preparation time.

b) Teacher's beliefs

Many teachers tend to believe that giving clear explanation with suitable examples (teacher-centered approach) is practical and sufficient to achieve most teaching objectives. It is always too time consuming to allow students to construct their knowledge through student-based activities. Furthermore, they are not confident whether their students have acquired enough knowledge and skills if the students were allowed to explore by themselves. Hence, the teachers tend to feel more certain if they can control the teaching and learning pace of their students.

c) Examination oriented culture

Examination oriented culture is prevalent in Malaysian society. Examination results especially the public examination results is used as a yard stick or accountability of school performance. From the education minister to the students' parents, everyone is very anxious about their children's examination performance. Hence, it is common for school principals to use students' performance in examinations as a yard stick to evaluate teacher's teaching competency. Consequently, this has strengthened many teachers' belief that their teaching priority is to ensure that their students pass and achieve good results in the examinations. The main duty of the teachers is to make sure that they have taught the whole syllabus before the examination.

d) Common belief of 'practice make perfect'

As our study on culture of mathematics teaching and learning in some Malaysian schools (see Lim, Fatimah and Tan, 2003) has shown that many mathematics teachers and parents, especially those from the Chinese schools tend to hold strong belief of "practice make perfect" as a way of learning mathematics. Consequently, students are usually given large amount of home work and pass year examinations questions to practice their mathematics skills.

Although teachers are exposed to student centered learning, contextual and cooperative learning approaches, they seem difficult to change the culture of mathematics teaching and learning in schools. For any new approaches that they employed, they have to meet the demands of the school principals and parents. It is thus not easy to change the culture of teaching and learning in schools.

Lesson Study as an innovative teacher professional development programme

Despite the above challenges and constraints, all the Lesson Study research project participants expressed positive feedback. From the group and individual interviews conducted at the end of the research, the participants listed the strengths of the Lesson Study process as follows:

a) Through group discussions and observing other teachers teach, they gained and enhanced both their mathematics content knowledge as well as pedagogical knowledge.

b) Upon self reflection and advice from colleagues who observed their teaching, the participants were able to rectify their own teaching errors. Novice teachers, especially have the opportunity to improve themselves by observing and learning from the experienced colleagues the skills and techniques in teaching various concepts of mathematics.

c) Lesson Study promotes a collaborative culture that enhances the professional collegial bonds within their mathematics staff.

d) Lesson study is a valuable professional development program. It was observed that participants have regarded the Lesson Study sessions as the venue to solve their teaching problems, and to develop their professional knowledge of mathematics teaching and learning.

Nevertheless, based upon our reflection on the research projects, we recommend that the following approach should be taken to ensure the effectiveness of the Lesson Study process and to be practicable in Malaysian context:

i) The Lesson Study program be monitored and supervised by the Expert Teacher ("Guru Pakar") of Mathematics, and supported by the school administrator.

ii) The Lesson Study group be made up of smaller group (3-4 mathematics teachers) to allow greater flexibility of time; group according to grade level (such as lower secondary) to reduce the constraint of time, teachers' specialization and logistic.

iii) A network of mathematics teachers be created within the district to share, learn and collaborate within the context of Lesson Study.

Conclusion

In this paper, I attempted to give a description of good practice of mathematics teaching as perceived by the Malaysian perspective. I have looked at it from the school curriculum, local related research studies and the views of the practicing mathematics teachers. There is yet to have a consensus on a definition of good practice. What I can offer is just the characteristics of good practices. This is because it is not easy to maintain these good practices. Mathematics teachers are often faced with many constraints and challenges. The main constraint being the lack of time and the examination oriented culture.

However, our case study on using Lesson Study process to promote teacher professional development seems to yield encouraging outcomes. As a result of the Lesson Study process, teachers reported a change in the nature of the staff-room discourse with a greater focus upon the Study Lessons and alternative teaching strategies coupled with a lot more sharing of ideas. Teachers are able to prepare better student based activities as they share and collaborate in preparing a lesson plan. Furthermore, as a result of the change in staff room discourse, they felt more self confident and greater support from their colleagues. Thus, perhaps the Lesson Study process which provides a meaningful context for non-threatening lesson observation, and promote collaboration and sharing within the mathematics teachers might be a possible solution or measure to enhance good practice of mathematics teaching in schools.

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Appendix 1: Lesson Plan on " Rotation"

Topic : Transformations (I) (Form 2 – Chapter 11)

Learning Area : Rotation

Learning Objective : To understand the concept of rotation

Learning Outcomes : Students will be able to:

i) identify rotation as a form of transformation
ii) determine the image of an object under a rotation; given the centre, angle and direction of the rotation
iii) describe the rotation; given the object and image of the transformation of a rotation
iv) elaborate the properties of the rotation

Duration : 80 minutes

Resources : teaching kit of transformations, clock, fan, manila cards, tracing paper, compass, worksheets.

Teaching and Learning Activities

Set Induction (10 minutes)

Teacher asks students to describe/give examples of daily-life situation that involve rotation or 'putaran' in Malay language. The teacher facilitates and guides the students to conceptualize 'rotation' with examples in their daily life.

Teacher presents the following situations (if necessary):

Situation 1: Rotation of the ceiling fan

Situation 2: Rotation of the hands of a clock

Step 1: Concept of rotation (15 minutes)

Using a teaching aid (made of manila card), the teacher elaborates and emphasizes the angle, direction and centre of the transformation of rotation.

Teacher facilitates and guides the students (working in pairs with a learning aid) to determine the image of an object under various transformation of rotation such as: 90^o clockwise and anticlockwise, 180^o clockwise and anticlockwise,
270^o clockwise and anticlockwise, 360^o clockwise and anticlockwise.
To conceptualize the transformation of rotation, teacher facilitates students with examples such as 60^o clockwise, 45^o anticlockwise, 250^o clockwise etc.

Teacher uses the teaching kit provided and demonstrates it on the board with a few examples. Teacher guides the students to conceptualize the properties of the rotation.

Step 2: Determining the image of an object under a rotation (35 minutes)

Teacher distributes worksheet 1 that requires students to determine the image of an object under a rotation. Teacher demonstrates (using the teaching kit) to the students how to use the learning aids (tracing paper and compass) to solve the problems in worksheet 1. Students work in pair and the teacher checks students' answers.

Students present their answers on the manila cards (the teacher prepares the manila cards). Using the manila card, the students determine the image; given the transformation and object by the teacher. Students check their answers.

Step 3: Describing a rotation (10 minutes)

Teacher distributes worksheet 2 that requires students to describe/elaborate the rotation; given the object and image of the transformation of rotation. Students work individually in worksheet 2.

Step 4: Discussion (8 minutes)

Students give their answers in worksheet 2 and the teacher checks the answers orally.

* Note: There are two answers for every question and teacher should sought both answers from the students. Using the transformation kit, teacher demonstrates and explains why there would be two answers for every transformation of rotation (if necessary).

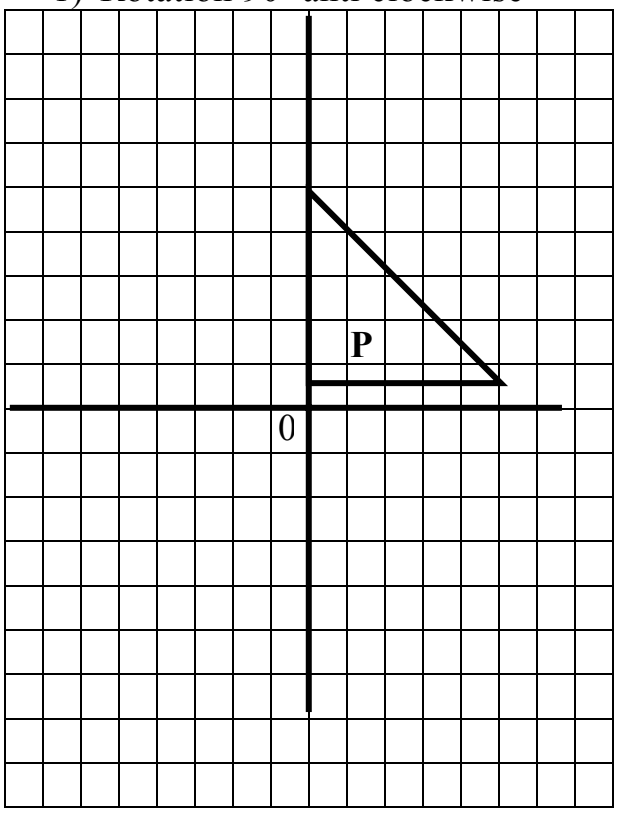
Closing (2 minutes)

Teacher guides the students to summarize today's lesson.
Teacher gives homework from the textbook: pg. 96, exercise 11.4, question 6.

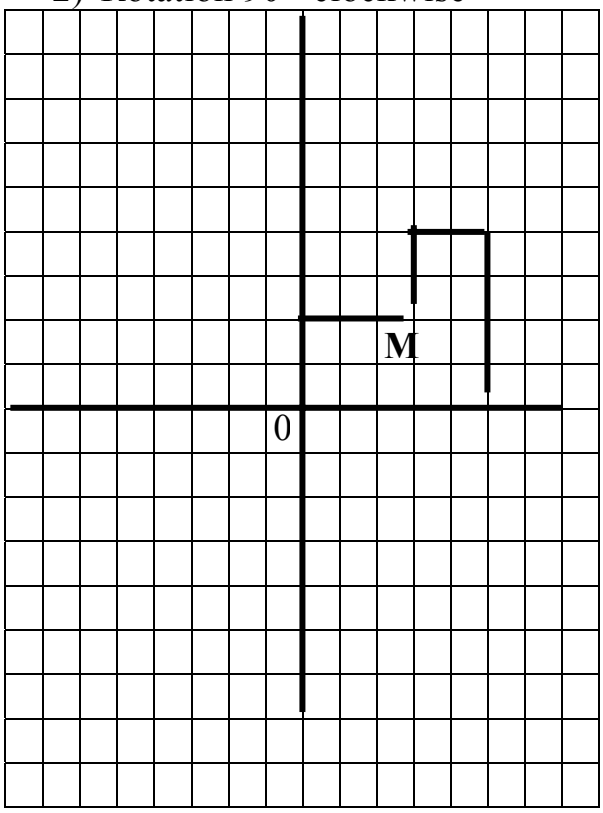
Worksheet 1

Instruction: Draw the image of the object under the rotation stated about the origin.

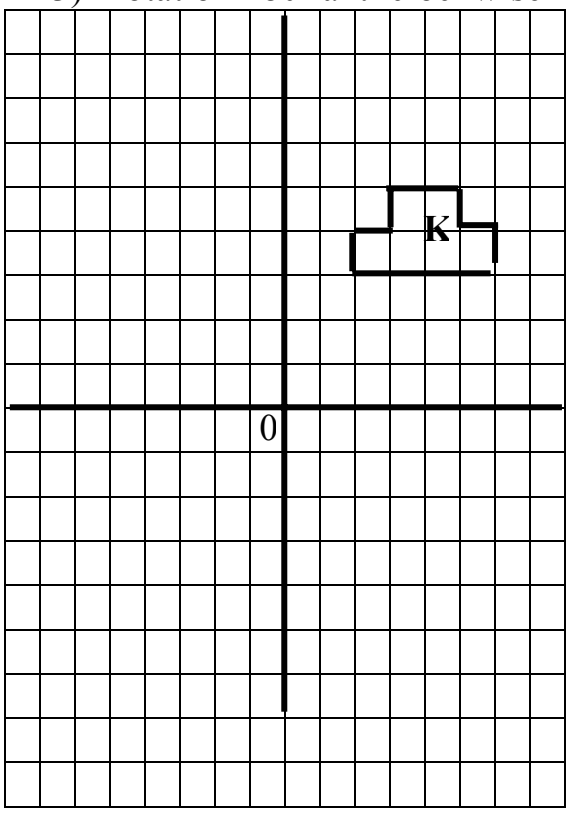
1) Rotation 90^o anti clockwise



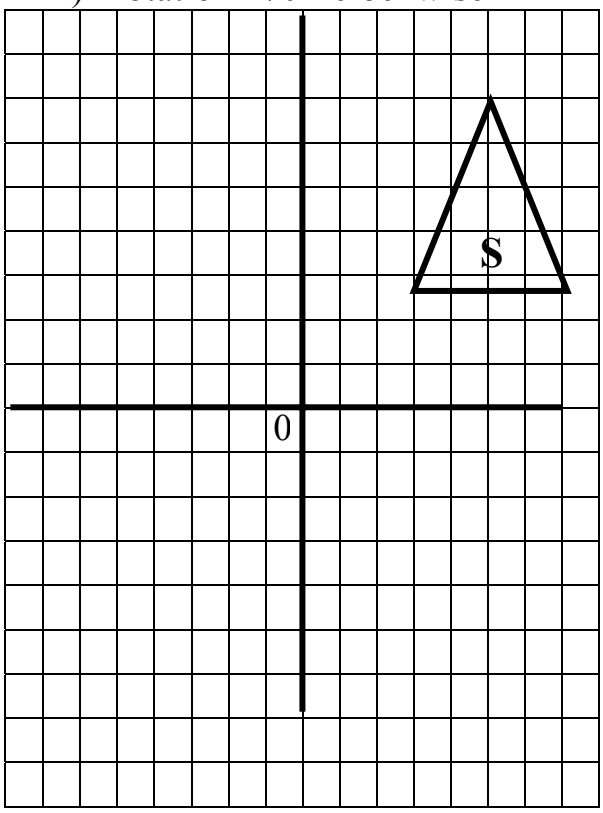
2) Rotation 90^o clockwise



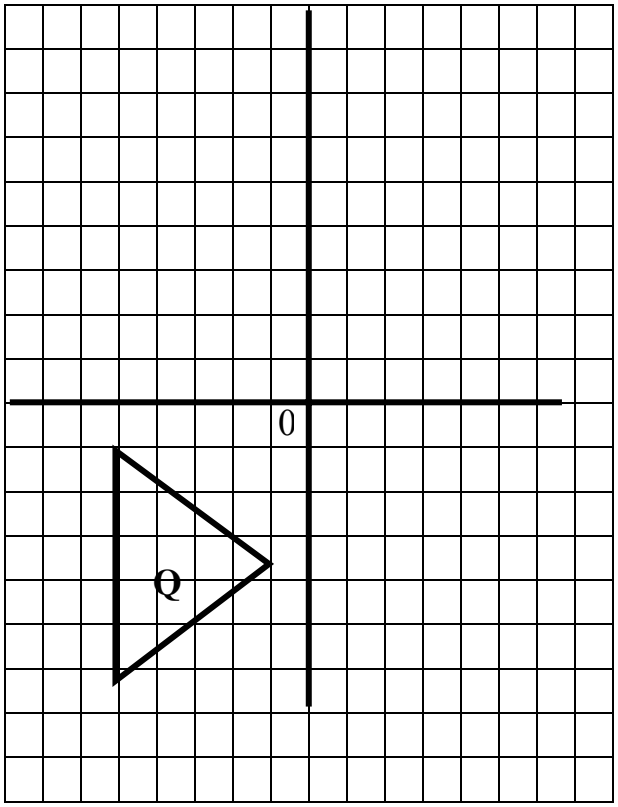
3) Rotation 180^o anti clockwise



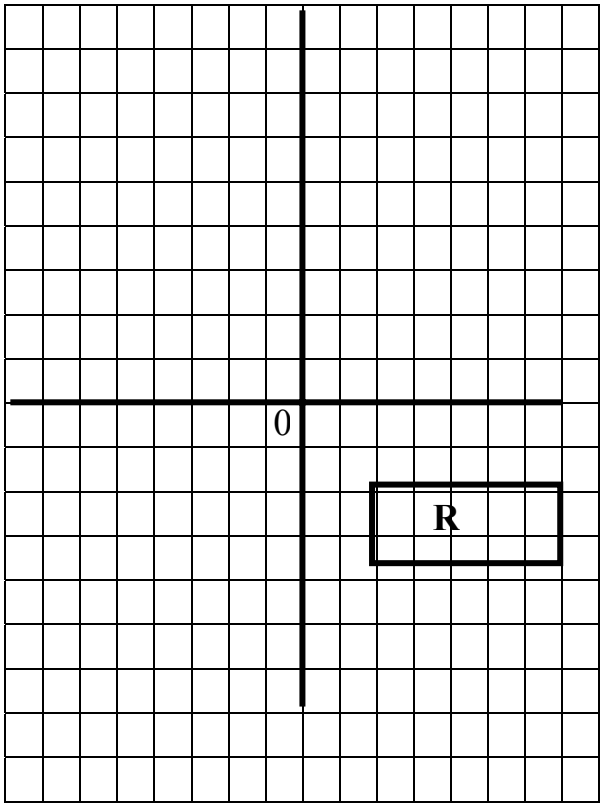
4) Rotation 270^o clockwise



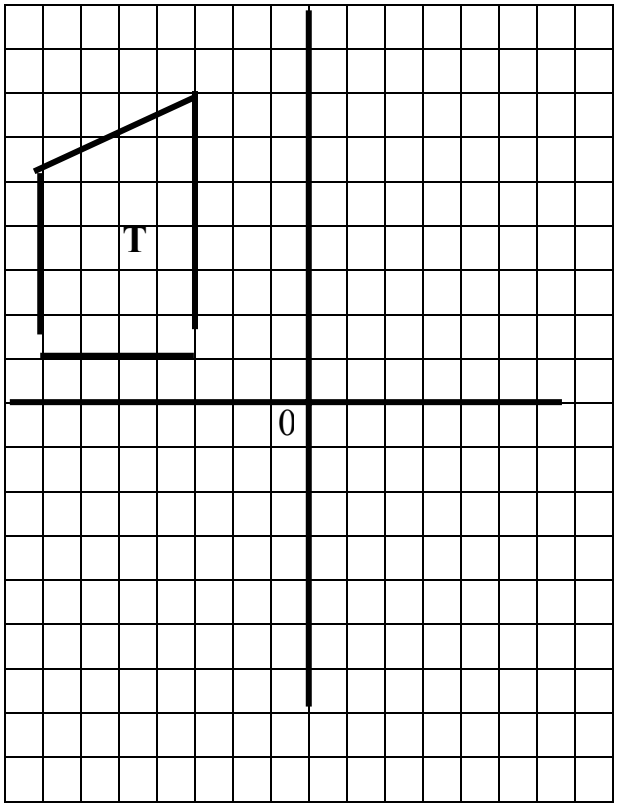
5) Rotation 90^o anti clockwise



6) Rotation 90^o clockwise



7) Rotation 180^o anti clockwise



8) Rotation 270^o clockwise