Sixth Grade **Lesson Plan for Mathematics**

Sep2,4,5,6

Date and Time: September 2 (Mon.) 2013, 3rd period
September 4 (Wed.), 3rd period
September 5 (Thurs.), 3rd period
September 6 (Fri.), 3rd period

Students: Koganei Elementary School Attached to Tokyo Gakugei University
6th year Homeroom 3, 39 students
Instructor: Takeo Takahashi (seal omitted)

1. Unit Name: "Speed"

2. Objectives of the Unit

[Interest, Eagerness, Attitude] – [I]
○ The students try to express speed numerically by using the idea of size of per-unit quantities. They also try to associate speed with actual scenes and use it in daily life and learning.

[Mathematical Way of Thinking] – [M]
○ The students can think about the ways to express and compare speed by using number line expressions based on the idea of size of per-unit quantities, and express it.

[Skill] – [S]
○ The students can find speed, distance, and time from quantitative relationships with respect to speed.

[Knowledge and Understanding] – [K]
○ The students understand that speed can be expressed by using size of per-unit quantities.

3. Present State of Students

Many students in the class are eager to learn. However, there are different types of students in class, such as those who can learn on their own, those who go to cram school and have advance knowledge, and those who have difficulty learning on their own, and their basic academic abilities, such as knowledge and understanding, thinking ability to solve problems, and living environments which support their learning are increasingly diversifying.

In order to give lessons in such a classroom group, it is necessary to take a measure to promote participation by all students according to respective abilities, not only by able students. In this lesson, instead of letting students with advance knowledge present how to find answers, I would like to encourage the students to think in group and build a way of thinking together, by providing many students with an opportunity to experience trial and error, and urge quiet students to speak out what they know and let others help out to complete the answer. That is because, by repeating such lessons, more and more students will associate own idea with their friends' ideas and nurture readiness to express own idea and inspiration in front of others even if it is incomplete, and I believe, that in turn will cultivate their abilities to think and express.

4. About the Unit

The students were exposed to the way of thinking of comparing two different kinds of quantities in the study of comparing "crowdedness" in "Size of Per-unit Quantities" in the 5th grade. This unit is the continuation of the study.
In this unit, the students learn to use the idea of "size of per-unit quantities" to compare speed.

Although the students are familiar with the word "speed," its concept is difficult for them to comprehend because "time," which is one of the two elements which determine "speed," is an intangible quantity. Therefore, I would like them to pay attention to what determines speed through firsthand experience, while associating it with actual experience, and help them realize that they can take advantage of the idea of size of per-unit quantities which they have already studied.

5. Syllabus of the Unit

1. Meaning of speed and the ways to determine it

(1) Understand the ways to compare speed when both distance and time differ. (This hour (1))

(2) Meanings of speed per hour, speed per minute, and speed per second and the ways to determine them

(3) The ways to determine distance by using speed and time

(4) The ways to determine time using speed and distance

6. Instruction of This Hour

The 1st Section: 1st hour

“The ways to compare speed when both distance traveled and time differ

September 2 (Mon.), 3rd period

i) Aim

○ To understand the ways to compare speed when both distance and time differ.

ii) Elaboration (Example)

Learning tasks and questions to ask [●]	Activities [◎], Anticipated Responses [○] and Measures to take [→]	Things to keep in mind (*), Evaluation Standards
1. Discuss the meaning of “speed” based on page 82. ●What does it mean by “fast” and “slow”? ● Let’s compare quick walking and casual walking, when distances are the same or lengths of time are the same.	◎ Discuss when they think of “fast” in daily life. ○ It means something passes by you really quickly. ○ When you do something, you can do it in a short time. ○ You can travel far quickly. → Tell them not to use the word “fast” or “slow” when they express their opinions. → If there are few opinions, ask students “What do you recall when you hear fast things?” and let them think by telling specific examples. ◎ Students will determine distance and time and experience fast and slow speeds. ○ When we walk the same distance, the shorter time taken is faster. ○ When we walk the same length of time, the longer distance traveled is faster.	* Time will be actually measured with a stopwatch. * Make sure that speed is related to distance and time.
2. Understand the meaning of problem 1, and explore the ways to compare speed. ● Who was faster, Akira or Ken? Also, who was faster, Ken or Rie?	◎ Read and solve problems ★1 and ★2. **Let’s think about the ways to compare speed of 4 students.** ○ Between Akira and Ken, because they ran the same distance and Akira took shorter time to reach the goal, Akira was faster. → Have students recall their experiences in the prologue. ○ Between Ken and Rie, because they ran for the same amount of time and Rie traveled longer distance, Rie was faster.	I The students try to compare speed by using distance and time using the relationship between distance and time. (Observation and Making Remarks) * In the table, give data of only Akira, Ken and Rie. * <u>Make sure that the students understand that (1) when the distance traveled is the same, speed can be compared and one with shorter time is faster; and (2) when the distance traveled is the same, speed can be compared and one with longer distance is faster.</u>

3. Compare speed by using the ways of comparing "speed" the students come up with. (Solving the problem individually) ● Let's think about the ways to compare the speed of Akira and Rie.	◎ Find a way to compare the speed on their own individually. ○A: Compare distance traveled for the same amount of time (72 seconds). Akira: 40 * 9 = 360 (m) Rie: 50 * 8 = 400 (m) ○B: Compare time for the same distance traveled (200 m). Akira: 8 * 5 = 40 (seconds) Rie: 9 * 4 = 36 (seconds) ○C: Compare distance traveled in 1 second. Akira: 40 / 8 = 5 (m) Rie: 50 / 9 = 5.55… (m) ○D: Compare time taken to run 1 m. Akira: 8 / 40 = 0.2 (second) Rie: 9 / 50 = 0.18 (second) → For students who have difficulty solving the problem, have them recall why they could compare speed in the prologue and Task 1 and advise them "It may be useful if you can make the size of either distance or time the same".	* A and B use the idea of the common multiple. * C and D are the attempts to take advantage of the idea of per unit quantity. * For those students who came up with the answer using one way of solving the problem, encourage them to think about other ways. M They think that to compare speed, they need to consider either distance or time as 1. (Observation, Making Remarks, Notebook)
4. Present individual ideas and examine them. ● Let's present the ways to compare speed. Find good points of others' ideas.	◎ Present the ways to compare speed to each other and recognize good points of others' ideas. ○The way to compare speed by calculating the distance for the same amount of time uses the idea of "We can compare speed if either time or distance is the same." ○The ways to compare speed by using distance traveled in 1 second and time taken to run 1 m respectively use the idea of per unit quantity. ○When the way to compare speed by using distance traveled in 1 second or time taken to run 1 m is used, many different speed records can be compared at once. ○The way to compare speed by using distance traveled in 1 second is easy to understand because the faster the speed, the larger the number becomes.	* Ask the students to articulate the reason for own idea. * When the students do not realize the advantages of the idea of per unit quantity, advice them to think "Which method you should use to compare the speed of all class members?" to make them realize the advantages of using per-second or per-meter comparison.
5. Summarize the ways to compare "speed."	◎ Summarize that speed can be compared by using distance traveled in 1 second or time taken to travel 1 m (the idea of per unit quantity). When comparing speed, it is convenient to use the idea of per unit quantity, such as distance traveled in 1 second or time taken to travel 1 m.	K The students understand the ways to compare speed by using the idea of per unit quantity. (Observation, Making Remarks, Notebook, Comment on the Lesson)
6. When there is time to spare, solve an application problem.	◎ Solve an application problems ▼1 and ▼2 by using the summarized ways.	S The students can compare speed by using the idea of per unit quantity.
7. Write a comment on the lesson.	◎ Write a comment on today's lesson and summarize what they have learned.	* Ask them to write mainly what they understood, what they thought important about others' opinions, what they were interested in, what they did not understand, etc., in today's lesson.

The 1st Section: 2nd hour

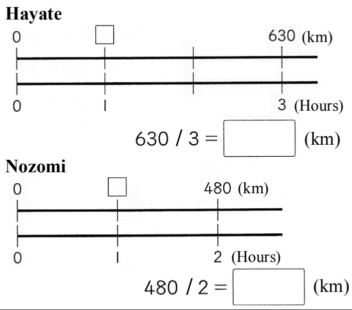
"The ways to compare speed when both distance traveled and time differ"

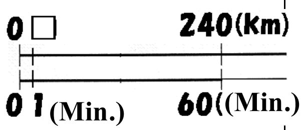
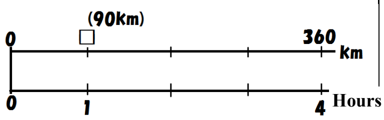
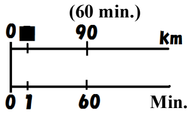
September 4 (Wed.), 3rd period

i) Aims

○ To understand the formula for calculating speed and to be able to use the formula for calculating speed.
○ To understand the meanings of "speed per hour," "speed per minute," and "speed per second."

ii) Elaboration (Example)

Learning tasks and questions to ask [●]	Activities [◎], Anticipated Responses [○] and Measures to take [→]	Things to keep in mind (*), Evaluation Standards
1. Understand the meaning of the title. ● Let's read problem 2.	◎ Read problem 2 and understand the purpose of the problem is to compare speed. **Which Shinkansen bullet train is faster: Hayate or Nozomi?**	* Sentences of problem 2 will be either written on a blackboard or an enlarged copy will be displayed. * Remind the students of the ways of comparing speed which they learned in the previous hour.
2. Find the distance traveled in 1 hour. (Solving the problem individually) ● How much distances do Hayate and Nozomi travel in 1 hour? (Ask this question supplementally.)	◎ Read ★1 and understand the purpose of the problem is to find out the distances traveled in 1 hour. ○ Hayate 630 / 3 = 210 (km) ○ Nozomi 480 / 2 = 240 (km) Answer: Nozomi is faster. → For the students who have difficulty solving the problem, give them clues to jog their memory of the previous hour to help them solve the problem on their own individually.	
3. Present individual answers to each other and examine them. ● Let's present your answers. And, please explain why you came up with such expressions.	◎Ask students to present their answers first and then explain how they found out the answers. ○ I drew number lines, made expressions, and found the answer. 	* Ask them to explain the reason why they came up with the equation by using a figure, such as a number line chart.
4. Understand the meaning of speed.	◎ Understand that speed is expressed by the distance traveled per unit time. ○ Because the longer distance it travels in 1 hour is faster, I figured out Nozomi is faster. To compare speed, find the distance traveled in unit time. Speed = Distance / Time	* Teach meanings of speed by having an answer of ★1 as an example.
5. Make a list of formulas to find "speed." ● Let's make expressions using words to find speed.	◎ Think and make expressions with words to find speed based on problem ★1 on their own. ○ Speed = distance / time ○ Speed = distance / time ○ Speed = distance traveled / time ○ Speed = distance traveled / time taken → When the students cannot come up with ideas, based on the	K The students understand the formula for calculating speed. (Notebook) * Pay attention to students' remarks and try to use their words as much as possible to summarize.

	writing on blackboard for Task 2, ask them to express what the numbers mean in words and view the words like variables to create a formula.	
6. Conclude that speed can be expressed in different ways depending on the unit time.	◎ Understand the meanings of speed per hour, speed per minute and speed per second, and conclude that speed can be expressed in different ways depending on the unit time. Speed per hour: Speed expressed by the distance traveled in an hour Speed per minute: Speed expressed by the distance traveled in 1 minute Speed per second: Speed expressed by the distance traveled in 1 second	M The students realize that speed can be expressed in different ways by using different unit times, namely, hour, minute and second. (Observation and Making Remarks) K The students understand the meanings of speed per hour, speed per minute, and speed per second. (Notebook)
7. Express the speed of Nozomi, 240 km, in terms of speed per minute. ● Let's express the speed of Nozomi in speed per minute.	◎ Confirm that the answer found in Task 2 is given in speed per hour, and think what happens if it is expressed in terms of speed per minute.  ○ Its speed per hour is the distance it travels in 1 hour, and 1 hour is 60 minutes. Since speed per minute is the distance traveled in 1 minute, it is given by 240 / 60 = 4 (km). → For those students who do not know where to start, from the relationship between 1 minute and 60 minutes on the number line chart, help them realize the relationship between □ and 240 and lead them to 240 / 60.	
8. Solve an application problem ▲3. ● By using formulas, let's find the speed sailfish swims in terms of speed per hour. Also let's find the speed in terms of speed per minute and speed per second.	◎ Use the formulas summarized in Task 5 to find the speed per hour. ○ 360 / 4 = 90 (km)  ◎ Next, based on the speed per hour which they have just found, review the relationships between speed per hour and speed per minute and between speed per minute and speed per second which they have summarized in Task 7, and determine speed per minute and speed per second.  ○ Because sailfish is said to swim 90 km in 1 hour, the speed is 90 km / 60 = 1.5 km. So, its speed per minute is 1.5 km. ○ 1.5 km per minute means the fish swims 1.5 km in 1 minute. Because 1 km = 1000 m, speed per minute is 1500 m. 1500 / 60 = 250 m Speed per second is 250 m.	S The students can find speed by using formulas and express speed in terms of speed per hour, speed per minute and speed per second. (Notebook)
9. Write a comment on the lesson.	◎ Write a comment on today's lesson and summarize what they have learned.	* Ask them to write mainly what they understood, what they thought important about others' opinions, what they were interested in, what they did not understand, etc., in today's lesson.

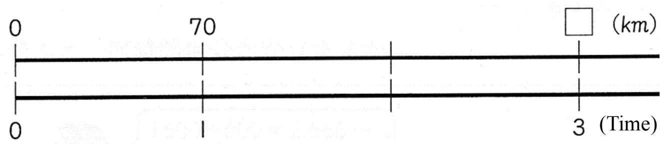
The 1st Section: 3rd hour
"The ways to compare speed when both distance traveled and time differ"

September 5 (Thurs.), 3rd period

i) Aim

○ To understand the formula for calculating distance and to be able to use the formula for calculating distance.

ii) Elaboration (Example)

Learning tasks and questions to ask [●]	Activities [◎], Anticipated Responses [○] and Measures to take [→]	Things to keep in mind (*), Evaluation Standards
1. Understand the meaning of the problem. ● Let's read problem $\boxed{3}$.	◎Read problem $\boxed{3}$ and understand that it is a problem to determine distance from speed and time. Let's think about ways to find distance from speed and time.	* Prepare an enlarged copy of problem 3 to display on a blackboard and instruct students not open their textbooks.
2. Come up with a way to determine distance from speed and time and find the distance. (Solving the problem individually) ● What calculations are necessary to find distance from speed and time? Also let's think about reasons.	◎ Based on already-learned subjects, try to come up with a way to find distance on their own individually and find the distance. ○ From the number line, I thought that distance could be determined by 70 * 3. $\boxed{\rightarrow}$ For those students who do not know where to start, advise them "Let's use number lines and think the problem" or "At the speed of 70km per hour, how long a swallow can travel in 1 hour? How about in 3 hours?" and encourage them to solve the problem by themselves. $\boxed{\rightarrow}$ Lead the students to notice benefits of using number lines and to utilize those for solving problems.  ○ Because speed per hour is the distance traveled in an hour, I thought that the distance traveled in three hours would be three times as long. Time　Distance 1 hour　70 km times 3 ↓　↓ times 3 3 hours　210 km ○ Based on the formula for calculating speed, because □ / 3 = 70, I thought I could find the distance by reversing the formula, by calculating 70 * 3. Speed = Distance / Time 70 = □ / 3 □ / 3 = 70 ↓ □ = 70 * 3 = 210	$\boxed{\text{I}}$ The students try to find the distance by associating it with multiplication. (Observation, Making Remarks, Notebook) $\boxed{\text{M}}$ The students think that the distance traveled in the given time is the distance traveled in unit time times the amount of time taken. (Observation, Making Remarks, Notebook) $\boxed{\text{M}}$ The students accurately capture the meaning of speed per hour. They have noticed that there is a proportional relationship between time and distance. (Observation, Making Remarks, Notebook) $\boxed{\text{S}}$ The students try to apply an expression that involves □, which they have already studied. (Observation, Making Remarks, Notebook) $\boxed{\text{I}}$ The students try to come up with a way to find distance by recalling an already-learned subject. * Guide them to become aware that time and distance are in proportional relationship, and as one of them is doubled,

		tripled, etc., the other will also be doubled, tripled, etc. However, do not use the term “proportional” just yet.
3. Present answers to each other and examine them. ●Please explain your ideas to everyone in an easy-to-understand way.	◎ Present a formula and the answer, and the reason for coming up with the formula. Conduct discussion to come up with a better idea through the concerted efforts by recognizing good points of others’ ideas, asking questions and adding relevant ideas.	* Ask them to explain to others, articulating the reason for coming up with particular formulas. Encourage them to use a number line chart or other aids. * When a student cannot explain alone, others should help him/her and summarize the idea in an easy-to-understand way.
4. Make a list of formulas to find distance. ●Let’s make expressions using words to find distance.	◎ Let the students think about a word formula to find distance based on the formulas presented in Task 3 on their own first. ○ Distance = speed per hour * speed ○ Distance = speed * time ○ Distance = speed * time traveled → If students do not come up with an answer individually, use the Task 3 board writing as a lead and ask them to represent the meanings of numerical values verbally. In this case, summarizing the problem as a class would be fine.	**K** The students understand the formula for calculating distance. (Notebook) * Try to use their words as much as possible to summarize. Not limited to this case, it is safe to give priority to commonly used ideas.
5. Solve an application problem. ● Let’s find the distance by using formulas.	Solve an application problem ▼4. 800 * 5 = 4000 <u>Answer: 4000 m</u>	**S** The students can find distance by using the formula for calculating distance. * When there is time to spare, do the supplementary exercises on page 111.
6. Write a comment on the lesson.	◎ Look back today’s lesson and write down what they have learned and the distance they want to find.	* Ask them to write mainly what they understood, what they thought important, what they were interested in, what they did not understand, etc., in today’s lesson.

The 1st Section: 4th hour

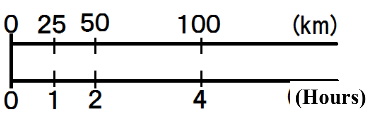
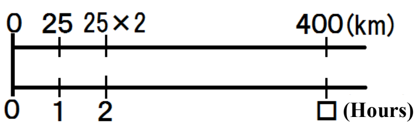
“The ways to compare speed when both distance traveled and time differ”

September 6 (Fri.), 3rd period

i) Aim

○ To understand the way to find time from speed and distance.

ii) Elaboration (Example)

Learning tasks and questions to ask [●]	Activities [◎], Anticipated Responses [○] and Measures to take [→]	Things to keep in mind (*), Evaluation Standards
1. Understand the meaning of the title. ● Let’s read problem 4.	◎ Read problem 4 and understand that it is a problem to determine time from speed and distance. Let’s think about ways to find time from speed and distance.	* Prepare an enlarged copy of problem 4 to display on a blackboard and instruct students not open their textbooks. * Remind the students of the ways to find distance they learned in the previous hour.
2. Come up with a way to determine time from speed and distance and find the time. (Solving the problem individually) ● To find time to be taken from speed and distance, what kind of calculation should we carry out? Also let’s think about reasons why such calculations are reasonable.	○ Let the time to find be X, wrote an equation by substituting X in the formula for calculating distance, and solved the equation for X. $25 \times X = 400$ $X = 400 \div 25$ $= 16$ (Hours) → For those students who do not know where to start, advise them “Can we solve the problem by using formulas we made in the previous lesson?” ○ Let the time to find be X, wrote an equation by substituting X in the formula for calculating speed, and solved the equation for X. $400 \div X = 25$ $X = 400 \div 25$ $= 16$ (Hours) → Suggest to use previously learned proportions or expressions using □. ○ From the number line, I thought that if the distance is doubled, the time taken will be doubled as well; because 400 km is four times 100 km, I thought that it takes four times four hours = 16 hours. → For students who still cannot solve the problem, advise “Let’s recall number lines we learned in the previous lesson. What kind of number lines can we use for this problem?”  (Distance traveled) (Time taken) 25 1 50 2 100 4 ○ From the number line, I thought that 25 times □ is 400; because 25 * □ = 400, wrote an expression 400 / 25 and found the answer. 	I The students try to come up with a way to find time by associating it with the formula for calculating distance or speed, which they have already studied. (Observation, Making Remarks, Notebook) M The students are trying to find time by using the formula for calculating distance or speed. (Observation, Making Remarks, Notebook)
3. Present answers to each other and examine them. ● Please explain	◎ Present a formula and the answer, and the reason for coming up with the formula. Conduct discussion to come up with a better idea through the concerted efforts by recognizing good points of others’ ideas,	* Ask them to explain to others, articulating the reason for coming up with particular formulas.

your ideas to everyone in an easy-to-understand way. ● Let's find out good points and similar points to your own idea in your friends ideas.	asking questions and adding relevant ideas. ○ If we use number lines, it is easy to understand a proportional relationship between time and distance; if speed is fixed and elapsed time becomes double, triple···, distance traveled also becomes double and triple···. ○ If we use number lines, when elapsed time becomes double, triple ···, □ times as much, distance traveled also becomes double, triple···, so when speed is fixed, it is easy to understand that time and distance are in a proportional relationship. By using the expression of multiplication with □, he/she found the elapsed time and the distance traveled smartly.	Encourage them to use a number line chart or other aids. * When a student cannot explain alone, others should help him/her and summarize the idea in an easy-to-understand way.
4. Summarize the ways to find time. ● Let's summarize ways to find time from speed and distance in words based on ways you found so that you can use them whenever you need.	◎ Let the students think on their own based on the ideas presented in Task 3. ○ Consider time as □ and substitute it in the formula to find distance. ○ Consider time as □ and substitute it in the formula to find speed. ○ Same as previously learned lessons, utilize the expression using words; Time = Distance ÷ Speed ○ Draw number lines and make expressions by using those relationships. **Time = distance / speed**	K The students understand the way to find time from speed and distance. (Notebook) →For those students who do not know where to start, encourage them to recall how they have summarized problems in expressions using words until now. * When summarizing a word formula as the formula, do so while giving value to other methods.
5. Solve an application problem.	◎ Solve applications problems ▼5 and ▼6. ○ Use ways summarized in Task 4 to find time.	**Expression** The students can find time from speed and distance. (Notebook)
6. Write a comment on the lesson.	◎ Look back today's lesson and write down what they have learned and the time they want to find.	* Ask them to write mainly what they understood, what they thought important, what they were interested in, what they did not understand, etc., in today's lesson.