**LESSON PLAN SCED 416**

1. **CURRICULUM**

My topic is ratio and proportion and it is placed in the 9th grade curriculum and it is an objective of the topic *9.2.4: Applications of equations and inequalities*. 38 hours are spared for this topic in the curriculum so I will choose some big ideas (not all of them) and use tasks related to these big ideas and real life connections of the topic. In the curriculum, some advices that the properties of ratio and proportion should be remembered to students and proportion and ratio should be used in real life problems are stated for teachers. In the course book determined by Ministry of Education of Turkey, definition of ratio and proportion concepts and their properties, direct proportion and inverse proportion, cross multiplication are mentioned and some questions related real life connections of ratio and proportion are solved in that book.

1. **MATHEMATICAL BIG IDEAS**
* The ratio concept is unitless.
* Ratio is the comparison of two different things and it says how much one thing changes compared to the other.
* Ratio is used also for comparison of two amounts that are not similar. (for instance km/ hour)
* The order of compared things in the ratio is important. (This part is closely related to the similarity of triangles and it is a preparation for similarity of triangles)
* Proportion is the equality of at least two ratios and is equal to a constant of proportionality, k. *(We can say that k constant is actually the slope.)*
* If $\frac{a}{b}$ = $\frac{c}{d}$ then a.d = b.c and it is called cross multiplication.
* If one of the amounts increases/ decreases, the other amount increases/ decreases with the same rate, we call these amounts as directly proportional.
* If there is a direct proportion between amounts x and y then, k= $\frac{y}{x}$ where k is the constant of proportionality.
* If one of the amounts increases and the other one decreases with the same rate or vice versa, we call these amounts as inversely proportional.
* If there is an inverse proportion between quantities x and y, then x.y= k where k is the constant of the proportionality.
* If a proportion has more than two proportion inside then we call it as composite proportion.
* If the ratios are multiplied, the square of constant of proportionality is found.
* If $\frac{a}{b}$ = $\frac{c}{d}$ = k then $\frac{a.c}{b.d}$ = k2
* If the sum of the nominators of the ratios is divided by the sum of denominators of the ratios, then the constant of proportionality doesn’t change.
* If $\frac{a}{b}$ = $\frac{c}{d}$ = k then $\frac{a+c}{b+d}$ = k
* Actually, the ratio and proportion topic is a base for functions because we try to build the *covariation* concept in ratio and proportion topic.
1. **LESSON PLAN**

**Objective ( MEB):**

*9.2.4.1: “Oran ve orantı kavramlarını gerçek/ gerçekçi hayat durumlarını modellemede ve problem çözmede kullanır.”*

**Materials:** Pencil, paper, Miniatürk task paper, Problems worksheet, Golden Ratio worksheet, project sheet, computer, internet, calculator

**Introduction:**

For this topic some prior knowledge is necessary for students. Students should know the integers, fractions, percentage and decimals because they will use these concepts in the ratio and proportion topic. The course will start with a real life example , *Miniatürk,* and students will talk about that.

As an introduction, we can start to the topic by saying that*:“Hi everybody. Today, lets start to our course with* ***“Miniatürk”*** *Does everybody know* ***Miniatürk****? What is the speciality of this place? Why do we use “mini” adjective for this place?”* Also, there will be a photograph of ***Miniatürk***for students who don’t know this place. The expected answers from students are that *“ In this place, there are some small versions of historical places in Turkey”* After students answer the previous questions, then we say: *“How are these structures built like their original? They look perfect, right? How did they determine their sizes?Did they use some scale to determine the size of smaller versions of these buildings?”*At this point, students can say that: *“ They used some ratio with respect to original versions of these structures.”*If students don’t come to this point, then I will help them by saying that *“Do you know that the Miniatürk has built by the techniques that original structures (big ones) have been minimized with some ratio.”* After students get this idea, then I will continue with a small task.

**Mathematical tasks:**

**MİNİATÜRK TASK**

The task is about to find the minimizing ratio of Miniatürk. This ratio is calculated as 1/25 but I won’t tell it students and they will find this ratio by themselves so that they will remember their prior knowledge about what a ratio is and how it can be found. The number of structures are small here but they can be increased. In this task,

* Students will find the first ratio for İzmir Clock Tower.
* Students are given that the other ratios are the same as the first one. (it will be 1/25)
* After they found the ratio, they will find the smaller sizes of these structures.
* Then I will ask them what are the units in their ratios that they found? ( I want students to come to the big idea: ratio is unitless.)
* Also I will ask them “Can you calculate the size of a big structure by knowing its ratio? (At this point students will come to the big idea that equality of two ratios is proportion.)
* After students answer these questions, I will remind the definition of ratio with students ( big idea about definion of ratio) and it is unitless because we compared two things having meters unit.( same unit for both amounts) Also, students will remember the proportion because they will use it while finding the smaller sizes of structures because they found that the ratio is 1/25 )

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| NAME OF THE STRUCTURE | REAL SIZE | SMALLER SIZE (MİNİATÜRK SIZE) | MINIMIZING RATIO |
| İzmir Clock Tower  | Height: 25 meters  | Height: 1 meters |  |
| Galata tower | Height: 69.9 metersExterior diameter: 16.45 meters | …………… |  |
| Bosphorus Bridge | Height: 165 metersLength: 1560 meters | …………… |  |
| Örme Dikilitaş | Height: 32 meters | ……………. |  |
| Atatürk Airport  | Area: 11 650 000 m2 | ……………. |  |

After students complete this task and remember the ratio and proportion concepts, I will write the properties of ratio and proportion on the board. Of course, students will say the properties because I want them to express this task and their previous knowledge via mathematical language. These properties are:

* The ratio concept is unitless.
* Ratio is the comparison of two different things and it says how much one thing changes compared to the other.
* Proportion is the equality of at least two ratios and is equal to a constant of proportionality, k. *(We can say that k constant is actually the slope.)*
* If $\frac{a}{b}$ = $\frac{c}{d}$ then a.d = b.c and it is called cross multiplication. (I will ask them what is the constant of proportionality in our task, then they will get the big idea.)

Then, I will continue to the course with group work. I will form groups consisting of three students (the number of students in a group can change with respect to class population) and give them different real life situations about the topic. They will try to solve problems with their group and explain their reasoning after every group completed the activity. I will give just five problems related to real life as representatives. The problems can be increased with respect to group numbers. The problems are:

1. An English tourist wants to change his currency but he is not sure whether he will change his currency to Turkish lira or Euro. He has 260 dollars. 1 dollar is equal to 2,32 TL and 1 dollar is equal to 0.845 Euro. If you were this tourist, what would you do? Explain your reasons.
2. Suppose your mum has guests for your birthday party and she will cook a birthday cake. She has two different recipes for a cake. The milk, the sugar and the flour has some ratio and its units are determined with respect to glass. For first recipe, the ratio is 1:3:2. respectively and second recipe's ratio is 2:4:6. Her both two recipes are suitable for 8 people but there will be 30 guests for your birthday. Also, your mom knows that you love the cake with more sugar. Then, which recipe should your mum choose for more sweet cake and how much glass of sugar should she use?
3. A university student having limited money goes to a market and he wants to buy some sausage. There are two types of sausages and he couldn't decide. The price of first sausage is 28 TL for 1 kilo and second sauge's price is 16TL for 250 gram. If he wants to buy 400 gram sausage, which one will he choose in terms of his budget?
4. Mira wants to change her GSM brand because of the internet usage in her cell phone. If she choose the A brand, she will pay 5 TL for 512 MB. If she choose B brand she will pay 3 TL for 1 GB. She uses 2 GB internet every month, so which brand is economic for her?
5. Ali wants to go to Ankara from Istanbul. The distance between these cities is 400 km. He will fuel up his car but he has to decide whether he will buy diesel or petrol. One leter of diesel costs 3.20 tl and the car goes 15 km with one leter diesel. Also one leter of petrol costs 4.5 tl and car goes 12 km. Therefore which one will Ali choose?

These problems in this task are from real life and students have to make decisions using ratio and proportion concepts and they will explain their decision making after each group finish the task. At the discussion part of this task, these questions can be asked:

* While making your decision, which factors affected your decision making? (price- amount)
* At which points did you use ratio and proportion concepts?
* Is the order of ratio important in the 2nd question?
* What are the *changing amounts* in these problems and what are *the not changing* ones? (Here, I want students to come to the idea that ratio is actually how much one thing *changes* compared to the other.)
* How do you understand usage of direct proportion and inverse proportion? (If students don’t give the expected answer, then I will ask them: What are the key points in these problems; both of amounts increase/ decrease or one of them increase while the other decreases?)

After discussion of previous task, I will give students to a worksheet consisting of questions related to direct and inverse proportion. I give this worksheet students because in the previous task, they worked as a group and some students may not contribute to group work. Therefore, this task will be done by individually in order to assess every student’s understanding of topic.

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| WORKSHEET ABOUT DIRECT AND INVERSE PROPORTION |
| 1. Ayşe will buy socks. She goes to a shop and she sees that socks are sold within a pocket. A pocket having 2 socks is 4.90 TL and a pocket having 3 socks is 4.50 TL. The other pocket having 5 socks is 8.75 TL. thus, which one should she buy?
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| 1. There are four brothers and they want to share 120 TL with direct proportion with their ages 8,10,12,16. Then, explain that how much money each person took.
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| 1. In a shoes factory, 7200 shoes are produced in a day. The number of Ali’s and Ahmet’s shoes are inversely proportional to 4 and 8 respectively. The number of Mustafa’s and Murat’s shoes are directly proportional to 6 and 9. Please find that how many shoes each person produced.
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| 1. In a fruit juice, there are some orange, apple and lemon. We don’t know the how many grams included from each fruit but we know some ratios. The fruit juice 3 lt and the ratio of orange to apple is 3/9 and the ratio of apple to lemon is 6/15. Then, find the amount of each fruit in this fruit juice.
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| 1. In a pool there are three taps. The A tap fills the pool with direct proportion with tap B. Also, A tap fills the pool with inverse proportion with tap C. One day, the A tap fills 250 m3 water to pool and tap B fills 150 m3 water and tap C fills 300 m3 water to the pool. Another day, tap A fills 300 m3 water and B fills 120m3 water . Then find the amount of water that C tap fills.
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| 1. $\frac{a}{b}$ = $\frac{c}{d}$ = 8 and 2a+4c = 40 then what is b+2d=?
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| 1. You have a proportion that $\frac{3}{8}$ = $\frac{5}{x}$ Please write a real life problem about this proportion and find x value.
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After students solve this problems individually, problems will be discussed in the class. The meaning of having direct and inverse proportions will be discussed again in order to understand deeply. With these tasks, I believe that students will get the big ideas of the ratio and proportion unit. Most important thing in this unit is to provide students’ understanding of the main concepts and make connections between concepts and real life situations. After students get the concepts, the remaining part of the course is all about solving various problems in order to prepare students to next topic: equations. As a final part, I will talk about Golden Ratio to students. Its value and background will be explained to students. Using this web site and the simulation in this webpage, [http://www.mathsisfun.com/numbers/golden-ratio.html](http://www.mathsisfun.com/numbers/golden-ratio.html%20), students can understand the idea behind the Golden Ratio. After showing the simulation, I will give an activity about Golden Ratio to students and want them to work as a group of two students. Here is the activity:

( This activity is taken from this website but it is adapted. <https://www.tes.co.uk/teaching-resource/Do-you-have-the-and-39-Perfect-Face-and-39-6034199/> )

**GOLDEN RATIO ACTIVITY**

Our attraction to another person's body increases if that body is symmetrical and in **proportion**. Likewise, if a face is in proportion, we are more likely to notice it and find it beautiful. Scientists believe that we perceive proportional bodies to be healthier. You will measure some distances on your face and fill the table below. Then, you will find some ratios and check whether this ratio is close to Golden Ratio or not.

A = Top-of-head to chin cm G = Width of head at ear level cm

B = Top-of-head to pupil cm H = Hairline to pupil cm

c = Pupil to nose tip cm I = Nose tip to chin cm

D = Pupil to edge of lip cm J = Lips to chin cm

E = Width of nose at base cm K = Length of lips cm

F = Outside distance between eyes cm L = Nose tip to lips cm

Now use these values to find the following ratios (write down the first 5 numbers of your calculator):

A/G =  E/L = 

B/D =  F/H = 

I/J =  K/E = 

I/C =  Total =

Bottom of Form

Bottom of Form

Top of Form

Bottom of Form

Top of Form

Are any of these close to the golden ratio of **1.618?** If so, these are the parts of your face that are the most attractive. It is important to remember that everyone is an individual and what is attractive to one person might not be to another. The idea behind this is to give you an idea of how to use ratio and proportion in real life scenarios.Bottom of Form

Bottom of Form

After students completed the Golden Ratio activity, the activity will be discussed in the class. “*Why is this ratio constant every time and do students know other constant ratios like Golden Ratio?*” These questions will be asked to students during discussion part.

At the end of the class (after course summary), students will have a short quiz including direct and inverse proportion because I want to assess their learning. Because the tasks done in the class mostly were group work and sometimes it is hard to see which students made contribution and which one didn’t. Thus, with the help of this quiz, I will see which students understand or which one have some missing points.

**Review: (Summary will be done before the quiz)**

After completing the Golden Ratio activity during the course, as a summary, definitions and properties of ratio and proportion are repeated by the teacher. Also, teacher wants students to say other real life situations that ratio and proportion are used. By doing so, teacher assess students’ learning of these concepts’ usage in real life.

1. **ASSESSMENT:**

The group work tasks above and questions that will be asked to students will be the formative assessment for the topic. Also, students will say the properties of ratio and proportion concepts after they did the Miniatürk activity. Thus, this will be also formative assessment. The quiz is done at the end of the course for summative assessment. Finally, students will be given a project homework related to the modeling of Haydarpaşa Train Station and this homework will be their summative assessment and I want students to bring their projects to class and present them in class.

**PROJECT HOMEWORK**Suppose that you are an architect and you want to model Haydarpaşa Train Station. Before you model this place, you need the knowledge about the area of this place and you have a map of Turkey showing the place of Haydarpaşa Train Station. How would you find the area of this place by using only this map? Please explain your decision. After you find the area, you want to model this place. How would you model it? (You can do research about real size of this place.) Don’t forget that your model should closely look like its original version.)

**QUESTIONS**

1. I didn’t change my lesson plan. Of course, there are many things that I should learn about lesson plans but for now, I think that the content of my lesson plan is enough.
2. Also, since you gave me feedback about sced 431 lesson plan and you wrote “very good” in the feedback part , I didn’t change it. Maybe, the lesson plan can be separetd into two parts because it is long for a class hour. Also, the number questions in group work activity sheet can be incerased in terms of class population.
3. In my opinion, my lesson plan is effective if tasks are applied in the right order like in the lesson plan. By being effective, I mean that students have a chance to apply their knowledge about ratio and proportion topic to real life situations as it is stated in the objective. Also, the final task (Haydarpaşa Train Station) is very beneficial for students because students can understand whether they learned the topic or not and they can use their knowledge effectively in order to create a model.

**REFERENCES**

* 9th grade course book determined by Ministry of Education of Turkey, 2014
* <https://www.tes.co.uk/teaching-resource/Do-you-have-the-and-39-Perfect-Face-and-39-6034199/>
* [http://www.mathsisfun.com/numbers/golden-ratio.html](http://www.mathsisfun.com/numbers/golden-ratio.html%20)
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