

4.3 Case study 3 (CS3 Greece)

Concept focus	Nutritional balance of proposed recipe
Activities implemented	Activities A-C
Inquiry skills	Developing hypotheses Planning investigations Forming coherent arguments Working collaboratively
Scientific reasoning and literacy	Scientific reasoning (observing, making comparisons) Scientific literacy (understanding concepts under investigation)
Assessment methods	Classroom dialogue Teacher observation Peer-assessment Self-assessment Worksheets Student devised material (pudding)
Student group	Grade: lower second level Age: 14-15 years Group composition: co-ed class, mixed ability Prior experience with inquiry: Yes

Through guided inquiry implementation, students developed “healthy” pudding recipes, which they then prepared at home. The students used online resources to aid in identifying the nutritional value of their ingredients. All inquiry skills and competencies identified in the SAILS project were assessed, which was achieved through teacher observation, classroom dialogue, peer- and self-assessment, as well as evaluation of worksheets and puddings.

(i) How was the learning sequence adapted?

The teacher made adaptations to the suggested activities in order to fit with the state curriculum and the background of the students at this level (lower second level). The teacher started the lesson by asking students to form groups of 3-4 members. The groups were friendship groups and mixed gender. The teacher announced to the class that they are going to make a cheesecake but due to the limitations of the school lab the students will have to make the cheesecake at their home working in groups. The students were enthusiastic and they had a lot of questions of how and what exactly they had to do. The teacher asked students that they had firstly agree on some requirements of the final product and then they will try to implement it. In order to clarify these requirements the teacher asked students the inquiry question “How can we make a really good cheesecake?” The students started to discuss the research question and the teacher observed them while at the same time he set more questions to guide them, such as:

- Is the industrial cheesecake a really good cheesecake?
- What aspects could you use to compare the industrial one with the homemade cheesecake?
- What makes the cheesecake good or bad – what positive features or quality problems can you define?
- Which cheesecake can be made more easily?
- What kind of main nutrient groups do you know?
- What are the advantages and disadvantages of those nutrient groups?
- From which food groups/categories would you choose the main nutrients for a “good” cheesecake?

The teacher reported that students described several views of the meaning of “good,” most of them concerning a healthy diet. The students described that the main quality criteria of the industrial

cheesecake were: cost, ease of manufacture, good taste, and appearance. Then, the teacher gave students the first worksheet (worksheet 1, Figure 1), in order to drive students to analyse the product from different perspectives and examine their prior knowledge. The worksheet includes a cheesecake recipe that students are asked to analyse from different perspectives. The perspectives were:

- Physical condition of the ingredients of the recipe
- Classification and purpose of the jelly
- Factors that could affect the final texture of the product
- Nutritional value of the ingredients and the whole product
- Value in energy of the ingredients and the whole product
- Issues concerning a balanced daily diet of an adult
- Health issues of the ingredients

The students answered all the worksheet questions. The teacher asked students to present their answers in class in order to discuss these issues between them and take feedback. Between the activities of the worksheet there was one where students had to fill the cells of a table that contain the nutritional value of the recipe ingredients as well as their value in energy (kcal). The teacher gave students the following two links from the internet: <http://www.foodnutritiontable.com> and <http://ndb.nal.usda.gov/ndb/foods>. The teacher explained to students how to use these tools and they used these resources for their calculations. The students liked this activity very much.

Then the teacher proceeded to Activity B: Planning investigations, where the groups had to formulate a hypothesis concerning their final recipe that will implement at home. For this purpose he gave them a second worksheet (worksheet 2, Figure 2), where the groups had to rewrite the initial recipe by replacing as much ingredients as they can in order to reduce fats. Also, they had to reconstruct the table that contains the nutritional value and the energy of the new recipe. The groups had also to justify their answers. The teacher used this artefact and a related rubric to assess the skill *developing hypotheses*.

After that, the teacher gave the third worksheet (worksheet 3, Figure 3), where the groups had to draw two bar graphs for the total content of nutrients 100 g cheesecake (one for the initial recipe and one for the modified). The groups also had to compare these graphs and make conclusions. Also, he asked students to make a peer assessment on the conclusion section of the worksheet using a rubric. The teacher discussed the criteria of the rubric with students and after that he asked them to perform the assessment. The students had previous experience in peer assessment and found the criteria and the whole process easy to be followed.

The groups implemented the suggested recipe at home. For this purpose they had to follow the instructions included in worksheet 4 (Figure 4). The teacher explained to students the steps of the worksheet and gave them feedback to their questions. The students were enthusiastic about the work they had to do.

Worksheet 1

Counting...



Cheesecake recipe:

- 200 g crushed digestive biscuits
- 125 g melted butter
- 500 g cream cheese
- 1 sheet of gelatin
- 400 g milk sweetened
- 1 cup. strawberry jam

1) Rank in the table below the ingredients of the recipe depending on their physical condition

solid	liquid	gas

a) In which group are foods like jelly classified? What is special about their texture?

.....

.....

.....

b) Gelatin is used as a thickener of water and contains collagen. Why do you believe we use gelatin in the cheesecake?

.....

.....

.....

c) What factors could affect the final texture of the cheesecake?

.....

.....

.....

2) With the help of the links below,

<http://www.foodnutritiontable.com>

<http://ndb.nal.usda.gov/ndb/foods>

- a) record in the table the nutritional value of these ingredients, as well as their value in energy (kcal), and
- b) sum nutrients and calories of individual materials and check the nutritional value of the whole product:

ingredient	carbohydrates	proteins	fat	calories (kcal)
biscuits				
butter				
cream cheese				
gelatin				
sweetened milk				
strawberry jam				
total:				

3) Conclusions

(To answer these questions, think that a balanced daily diet of an adult must contain 2000 calories, 270 g carbohydrates, 50 g protein and 70 g fat)

1. Do you know any disease caused by the excessive consumption of carbohydrates, protein or fat?

.....

.....

.....

2. How do you judge the amount of calories contained in 100 g of cheesecake?

.....

.....

.....

3. Rank in a list, which of the above nutrients (carbohydrates, protein, fat) contained in 100 gr of cheesecake are more harmful for human health.

- 1)
- 2)
- 3)

4. In the end, is our cheesecake healthy?

.....

.....

.....



Figure 1: Worksheet 1 for CS3

Worksheet 4

Cooking!!!!



Now try to cook the cheesecake based on the recipe that you proposed in Worksheet 2!

We will need:

- Stovetop
- A small saucepan
- Wooden spatula
- Cooking Thermometer
- Timer

Method:

- Mix the biscuits with butter and spread the mixture on the base of a spring-form tin. Press well with a spoon.
- In a bowl with cold water, put the gelatin sheet until it softens.
- In a saucepan, lightly heat half of the sweetened milk (40 °C).
- Once warmed up, stir and add the softened gelatin sheets until dissolved and allow to cool
- Mix cream cheese with sweetened milk from the pot and the remaining milk and beat until fluffy.
- Pour the mixture of cheese in the spring-form tin, over the biscuits, and put the cheesecake in the refrigerator for at least 4 hours.
- When thickened, spread the jam on the surface.

Step 1: Implementation

a) Carry out the recipe, carefully following the steps of the method.
Take the following measurements:

1. How much time takes gelatin to soften when thrown in the cold water?
.....
2. How fast should stirring be to ensure that the mixture has a uniform texture?
.....
3. At what temperature does the final mix begin to thicken?
.....

b) Now repeat the step of gelatin softening using
i. Water heated at 40 °C, and
ii. Water heated at 70 °C

Write down the differences compared to using cold water

.....
.....
.....
.....

c) Repeat with cold water but using 2 and after ½ sheets of gelatin. Are there any differences?

.....
.....
.....
.....

Step 2: Observations

a) Do you believe that the ingredients used instead of those of the initial recipe affect the final texture of the cheesecake? If yes in which way?

.....
.....
.....

b) How does the new cheesecake taste?

.....
.....
.....

Step 3 ... Final conclusion


After all, is your recipe suitable for a tasty and well textured cheesecake? If not could you suggest any changes for a better result?

.....
.....
.....
.....
.....
.....

Figure 4: Worksheet 4 for CS3

Worksheet 5

Understanding...



1) In carrying out the recipe, what were the changes observed in the physical state of the ingredients and the final mix?

2) How is physical condition affected by temperature?

3) How does temperature, stirring speed and time affect the final homogeneity of the mixture?

4) How does the ability of gelatin to absorb the same amount of water change, depending on the temperature and the quantity used;

5) Finally, in which ways we could make our nutrition healthier? How could this affect food's taste?

implemented for assessment of *forming coherent arguments*. Students were provided with a rubric for this task (Table 2).

Table 1: Three-point rubric used for assessment of students' skills in CS3

Assessed skill	2 Acceptable	1 Needs improvement	0 Poor/NA	Evidence from... (context of assessment)
Forming hypothesis	Yes (no gaps)	Needs improvement (some gaps exist)	No	Worksheet 2, Activity 1 Description: Rewrite the recipe from worksheet 1, replacing as much ingredients as you can in order to reduce fats... Justify your answer.
Testing hypothesis	Yes (no gaps)	Needs improvement (some gaps exist)	No	Worksheet 4, Step 3 Question: After all, is your recipe suitable for a tasty and well-textured cheesecake? If not could you suggest any changes for a better result?
Observing	The answer is correct (no gaps)	Needs improvement (some gaps exist)	Is irrelevant or incorrect	Worksheet 4, Step 2 Question 1: Do you believe that the ingredients used instead of these of the initial recipe, affect the final texture of the cheesecake? If yes in which way? Question 2: How does the new cheesecake taste?
Making comparisons	The answer is correct (no gaps)	Needs improvement (some gaps exist)	Is irrelevant or incorrect	Worksheet 3, Activity 3, Compare Question: Compare the results of the first and second bar graph.
Understanding	The answer is correct (no gaps)	Needs improvement (some gaps exist)	Is irrelevant or incorrect	Worksheet 5 All questions

Table 2: Three-point rubric for peer-assessment of forming coherent arguments in CS3

	1 - Poor	2 - Needs improvement	3 - Acceptable
Does the answer seem right?	No	Needs improvement (some gaps exist)	Yes (no gaps)
Do they use arguments in order to convince you?	No	Needs improvement (some gaps exist)	Yes (no gaps)
Is the argumentation being put forward complete?	No	Needs improvement (some gaps exist)	Yes (no gaps)
Does the argumentation put forward seem right?	No	Needs improvement (some gaps exist)	Yes (no gaps)

(iv) Evidence collected

Teacher opinion

The teacher was very satisfied with the inquiry experience. The students were enthusiastic and they asked for more lessons like this.

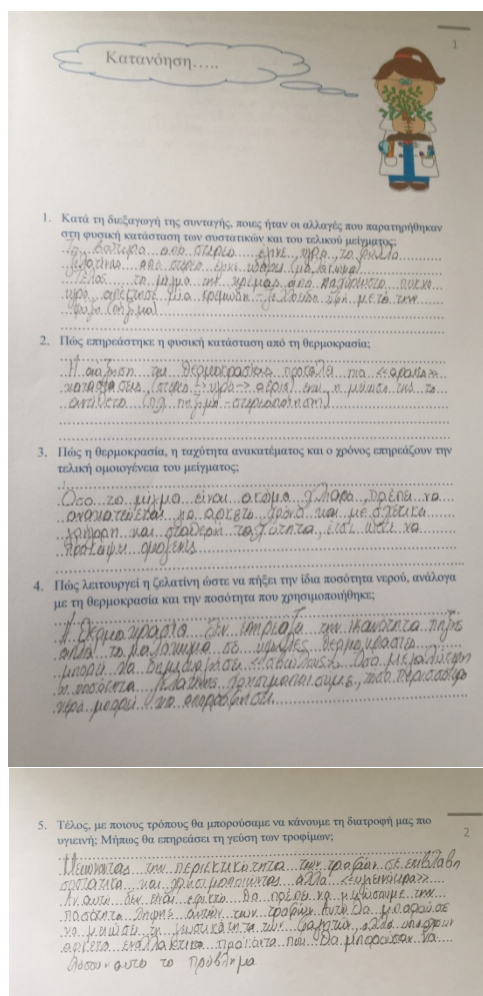


Figure 7: Sample of student work for worksheet 5 - Understanding

Worksheet 5: Understanding

- 1) In carrying out the recipe, what were the changes observed in the physical state of the ingredients and the final mix? **We observed that butter changed state from solid became liquid (melting). The gelatin sheet from solid state became watery (softening). Finally, the mixture of cream after cooling obtained a creamy texture from viscous concentrated liquid (thickening).**
- 2) How is physical condition affected by temperature? **We observed that the increase in temperature causes more dilute state (solid=> liquid=> gas) and its reduction causes the opposite effect (eg thickening, solidification).**
- 3) How does temperature, stirring speed and time affect the final homogeneity of the mixture? **While the mixture is still warm we must stir it for a sufficient time and at a relatively fast speed so as to get a homogeneous state.**
- 4) How does the ability of gelatin to absorb the same amount of water change, depending on the temperature and the quantity used? **The temperature does not affect the process of getting gelling. If we do this process at high temperatures can generate pellets. The greater amount of gelatin used, the more water can be absorbed.**
- 5) Finally, in which ways we could make our nutrition healthier? How could this affect food's taste? **By reducing the content of harmful food ingredients and using other healthier. If this is not possible we can reduce the amount of intake of these foods. This could reduce the palatability of the food, but we have several alternatives that could solve this problem.**

(v) Use of assessment data

The teacher feels more confident after the lesson concerning the assessment of inquiry skills. He had some experience in IBSE in class but not for assessing inquiry skills. Through SAILS Teacher Education Programme he gained some experience on how to assess inquiry skills and for the first time he managed to implement it in class. He believes that it is a matter of practice for all teachers. The only disadvantage is the time needed for inquiry lessons and the narrow time schedule of the curricula in Greece.

(vi) Advice for teachers implementing the unit

New teachers need to have real practice in inquiry-based lessons along with assessment techniques and practices. For this purpose, it would be useful to implement well-prepared inquiry topics.