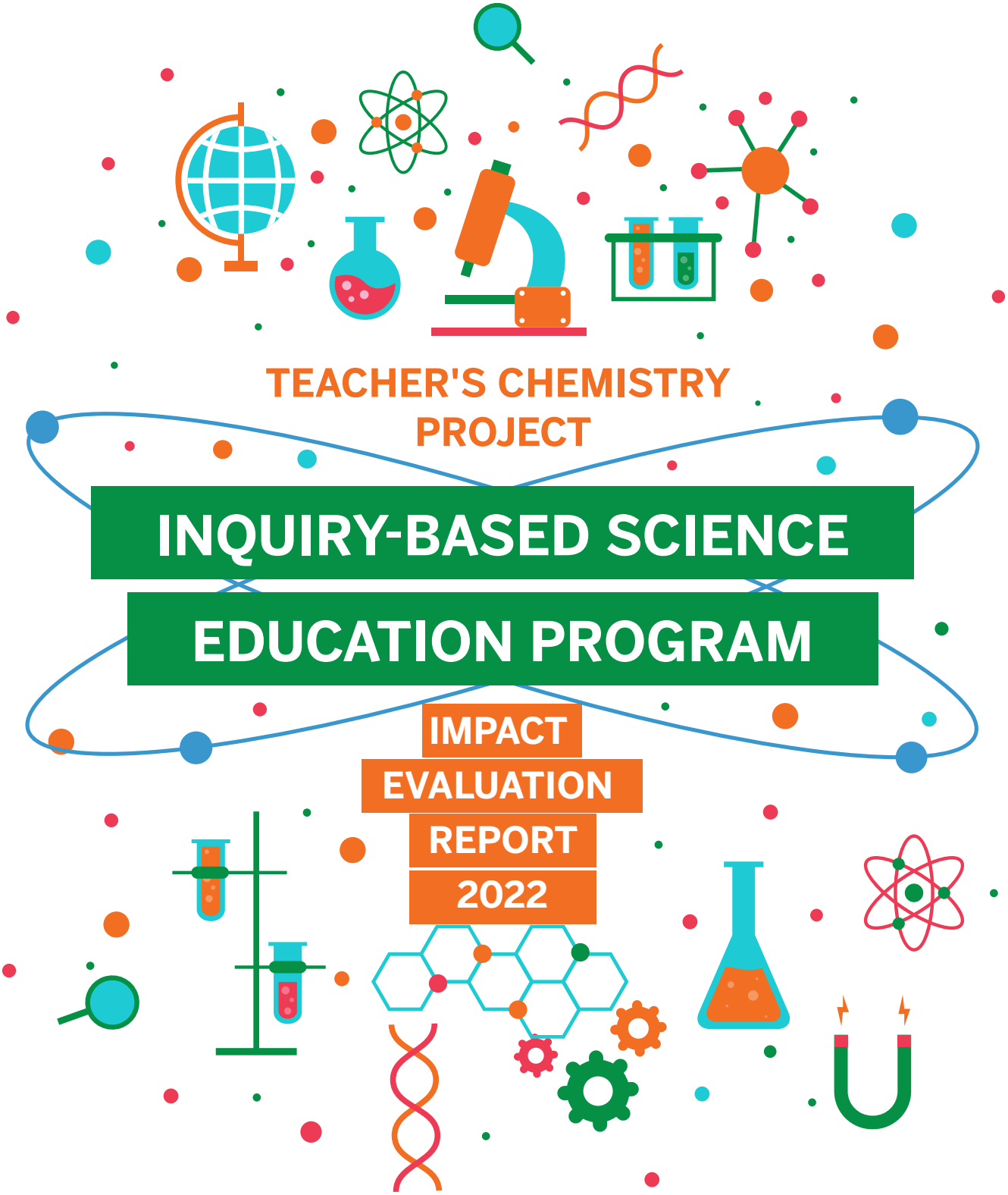

TEACHER'S CHEMISTRY PROJECT

INQUIRY-BASED SCIENCE EDUCATION PROGRAM

IMPACT EVALUATION REPORT 2022

ÖRAV Kurucu | Garanti BBVA

DOW

İş Birliğinde...

SUMMARY

With the **Inquiry-based Science Education**, which has been continuing as a project for the past seven years in cooperation with Dow Turkey, we aim to enable teachers that teach the branches of Science and Chemistry as well as students to approach problems from an interdisciplinary perspective and to gain the necessary knowledge and skill sets through research and inquiry methods, taking into account the requirements of the age we live in. Through this educational program, we reached **331 teachers** and approximately **26,811 students** in 2022.

At the end of the six-day training, which included synchronous (simultaneous/live) and asynchronous (not simultaneous/non-live) content and activities in one session, participants were asked to complete a questionnaire to evaluate the training. The answers to the questions asked in this questionnaire were used to evaluate the content of the training, the planning process and the level of satisfaction with the trainers. In addition, the impact of the training on the teachers was reviewed by analysing the data from the performance scale in this questionnaire and the opinions of the teachers in accordance with the answers to the open-ended questions.

The evaluation questionnaire was completed by 189 teachers in 62 different provinces. The percentage of Science/Science and Technology teachers who responded to the questionnaire was 81% and the percentage of Chemistry/Chemical Technology teachers was 19%. The results from the training evaluation questionnaire showed that teachers were very satisfied with the content of the training, the planning process and the training environment. From the quantitative data, it can be concluded that this training covers topics relevant to teachers' needs, that the content is understandable and interesting, and that the topics and studies discussed are applicable in the classroom. It was also noted that participants felt competent in using web-based environments and found the video-based and interaction-based materials in this training useful. It can also be concluded from the responses to this questionnaire that teachers felt that separate and combined synchronous and asynchronous training and the sharing of this training had a positive impact on learning. Teachers also expressed satisfaction in their evaluation of trainers. The results show that ÖRAV trainers are competent in their field, use communication and presentation skills well and have good time management. It can also be concluded that the trainers are successful mentors in social learning groups who encourage participation.

The analysis of the quantitative and qualitative data collected to understand the impact of the training on the teachers shows that the learning objectives of the training were achieved to a great extent. It was observed that the education program made significant contributions to classroom practices and instructional practices, particularly in the area of professional development. Teachers emphasised that they found the topics of science education and inquiry-based science teaching practices useful during the educational program and expressed that they would incorporate the lessons learnt into the classroom environment. It can be concluded that the training has made a difference in the teachers' knowledge, self-efficacy and awareness. The fact that teachers stated that they had not previously used the practices and

methods highlighted in this training in their classrooms and would now use them, that they had discarded their preconceptions about the practices and that they would bring these practices into the classroom can be taken as an indication that the desired behavioral changes might occur among the teachers.

At ÖRAV, we are pleased that the Inquiry-based Science Education program, which focuses on the role of technology in achieving new levels of teacher productivity, is creating new learning spaces for students through teachers, and we hope that the social impact of the education program will spread to broader masses in the future.

Respectfully
Teachers' Academy Foundation (ÖRAV)

INTRODUCTION

Under the in-service training protocol between the Teachers Academy Foundation and the Ministry of National Education, Science and Chemistry teachers were involved in training through the Ministry's management information system MEBBİS. Participants followed the educational content on the Teachers Academy Foundation's distance learning platform, eKampüs. The training consists of synchronous (simultaneous/live) and asynchronous (not simultaneous/non-live) sessions. The first module of the educational program, which starts asynchronously, serves as a preparatory stage. In general, the focus is on basic concepts around distance learning and orientation for online education. In the second module, which continues asynchronously, the 5E learning Method and STEM education were discussed. The synchronous session, which lasted 3 hours the following day, reinforced asynchronous content through participant interaction and emphasised 21st century skills and the integration of technology into education. Laboratory practices and inquiry-based science practices were included in synchronous and asynchronous sessions, which continued at the same pace. Participating teachers who attended all synchronous sessions, viewed the asynchronous content, and completed their assignments received their certificates through MEBBİS, the Ministry of National Education's school management information system.

CHANGE THEORY DESIGN

The theory of change is a theoretical model that helps articulate the goals of a program or project. Basically, it is a roadmap that helps organisations understand whether they have selected the right activities to achieve the set goals and what tools they can use to measure the impact of the program (Carinin and Derine, 2017[1]). The components that make up the theory of change of the Inquiry-based Science Education Program are as follows: (1) Social Impact Goals, (2) Outcomes, (3) Project Results, (4) Activities and (5) Resources. The information on the theory of change of the program is presented in detail for each component below (Figure 1).

Social Impact Goals	Outcomes	Program Outputs	Events	Resources
Educational program. The aims were: Equipping Chemistry and Science teachers with holistic teaching practices. Making teachers create an experience-based classroom experience by understanding the relationship between 21st century skills and STEM education. Raising awareness about the integration of technology into education.	**Through the educational program.** Teachers developed knowledge and skill sets related to the inquiry-based teaching practices. Teacchers learned what Web 2.0 tools they can use in Chemistry and Science lessons. They gained an awareness of student-centered slassroom practices.	**At the end of the educational program.** With 331 teachers completing the educational program, they developed a deep understanding of the inquiry-based approach to science education. Approximately 8.275 students were reached by participating teachers.	**Under the educational program.** A total of 6 hours of synchronous sessions were held. A total of 3 hours of asynchronous sessions were held. During the educational program, applications such as experiments such as experiments, simulations, and animations were also included to support inquiry-based science education.	**Human resources** ÖRAV Centre Team ÖRAV Expert Trainers ÖRAV Part-Time Trainers Ministry of National Education **Technical resources** eKampüs MEBBİS Various Web 2.0 tools

Figure 1. Theory of Change Design

[1]*Cronin, M. J., & Dearing, T. C. (Eds.). (2017). Managing for social impact: Innovations in responsible enterprise. Springer.*

EVALUATION OF THE TRAINING

The teachers who participated in the training were asked to fill in an evaluation questionnaire at the end of the training. The responses of 189 teachers who voluntarily completed this questionnaire were used to evaluate the content of the training, the planning process and their satisfaction with the trainers. The impact of the training on the teachers was monitored by analysing the teachers' responses to the performance scale statements in this questionnaire and the teachers' opinions through open-ended questions.

Demographic Information

The 189 teachers who completed the training evaluation questionnaire were asked about their gender, province, sector and length of professional experience. The questionnaire was completed by 141 female (74.6%) and 48 male (25.4%) teachers from 62 different provinces (Figure 2). Of those who worked in 62 different provinces, most teachers were teaching in the three major cities of İzmir (9.5%), Istanbul (9.0%) and Ankara (5.8%).

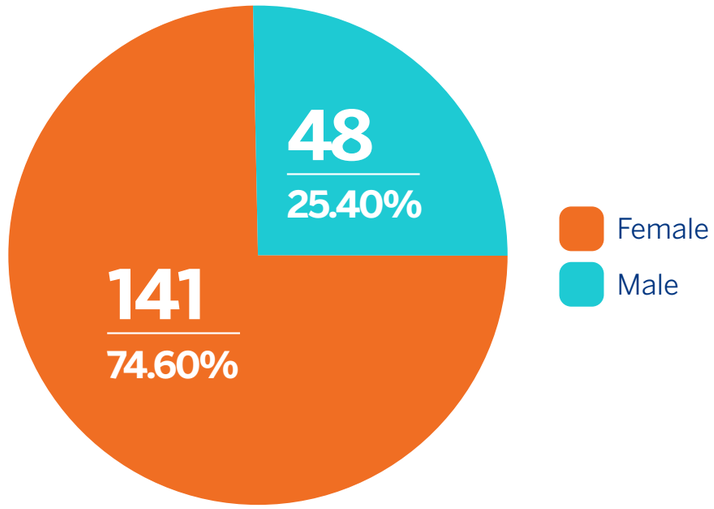

Figure 2. Pie Chart of Gender Distribution

The target group of the project consists of teachers working in the subject areas of **Science/Science and Technology** and **Chemistry/Chemical Technology**. The distribution of teachers who completed the questionnaire by subject area is shown in Figure 3. 81% of the group consisted of teachers working in the field of Science/Science and Technology.

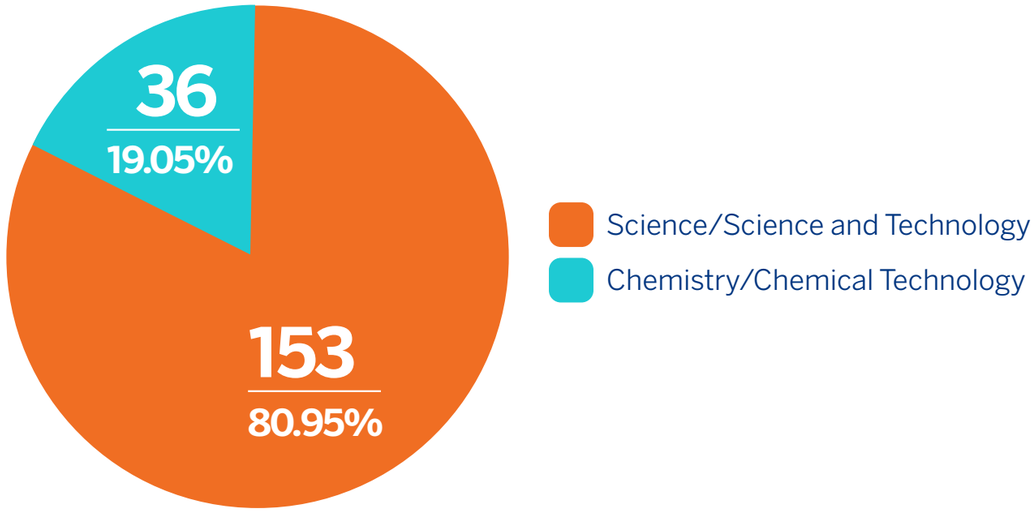

Figure 3. Pie Chart of the Branch Distribution

The professional experience of 189 teachers who completed the questionnaire ranged from 0 to 20 years. It was found that more than 50% of these teachers were in the first 10 years of their professional life. The highest participation rate was among teachers with 6-10 years of professional experience (33%). The distribution of teachers' professional experience is shown in Table 1.

Duration	Frequency	Percentage
Less than 1 year	21	%11
1-5 years	22	%12
6-10 years	**62**	**%33**
11-15 years	40	%21
16-20 years	44	%23

Table 1. Frequency and percentage values of professional experience

Evaluation of the Content and Planning Process of the Training

Inquiry-based science education is an online educational program that aims to enable students to use their natural curiosity, imagination, urge to discover and inquiring minds to arrive at scientific knowledge by using scientific process skills and approaching problems from an interdisciplinary perspective. The 6-day training, which includes synchronous (simultaneous/live) and asynchronous (not simultaneous/non-live) content and studies in integrity, was delivered in eKampüs in a group-based, customised e-learning environment involving only participants in this program. The training started asynchronously and participants were grouped together in the middle and at the end of the training (Figure 4). At the end of the training, participants were asked to complete the training evaluation questionnaire.

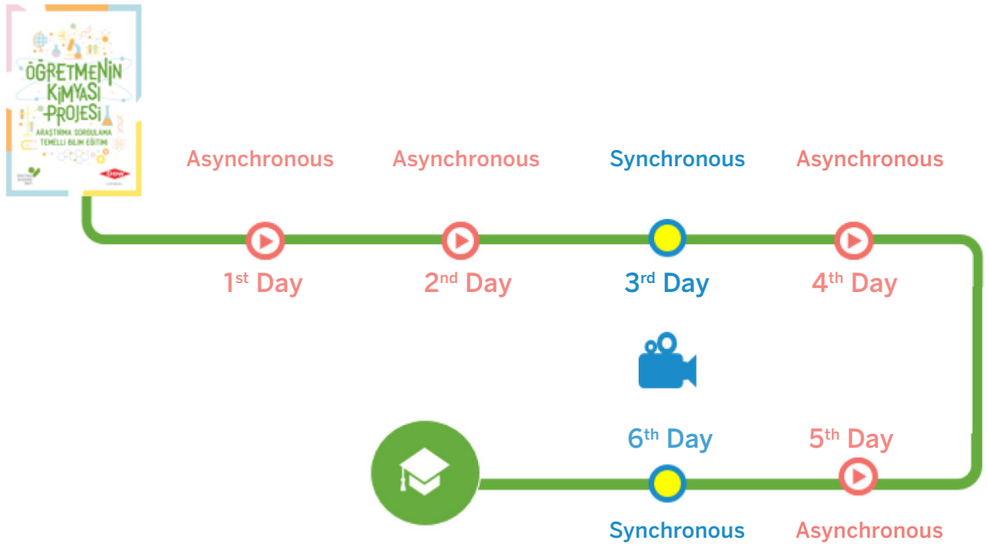

Figure 4. Training Plan

The questions in this questionnaire aim to assess teachers' views on the content and planning process of the program. In this context, teachers were first asked to rate their satisfaction with the content of the training they had received on a scale of 10. The mean was calculated from the answers of 189 teachers and a value of 9.43 was determined. The individual analysis of the ratings showed that the percentage of those who gave 10 out of 10 points for the content of the training was 70.7%, the percentage of those who gave 9 points was 14.9% and the percentage of those who gave 8 points was 7.4%. Analysing the distribution of points for satisfaction with content shown in Table 2, 95.7% of the participants gave a score of 7 and above, the lowest score was 4 and only one person gave 4 points and three people gave 5 points. This shows that the level of satisfaction with the content is quite high.

Score	Frequency	Percentage	Cumulative Percentage
10	133	70.7	70.7
9	28	14.9	85.6
8	14	7.4	93.1
7	5	2.7	95.7
6	4	2.1	97.9
5	3	1.6	99.5
4	1	0.5	100

Table 2. Frequency and percentages of content ratings

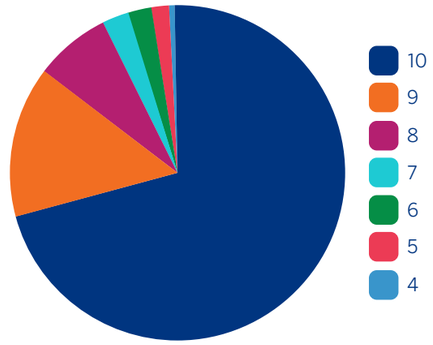

Figure 5. Pie Chart of Content Satisfaction

The level of satisfaction with the training planning process was also rated with 10 points and the mean was 9.40 points. When the ratings were analysed individually, it was found that 70.7% of the participants gave 10 out of 10 points, 14.9% gave 9 points and 6.9% gave 8 points. When the distribution of points for satisfaction with content shown in Table 3 was analysed, it was found that 95.2% of the participants gave a score of 7 and above, the lowest score was 4 and only 2 people gave 4 points and 4 people gave 5 points. This shows that satisfaction with the planning process is also quite high.

Score	Frequency	Percentage	Cumulative Percentage
10	133	70.7	70.7
9	28	14.9	85.6
8	13	6.9	92.6
7	5	2.7	95.2
6	3	1.6	96.8
5	4	2.1	98.9
4	2	1.1	100

Table 3. Frequency and percentage of planning process

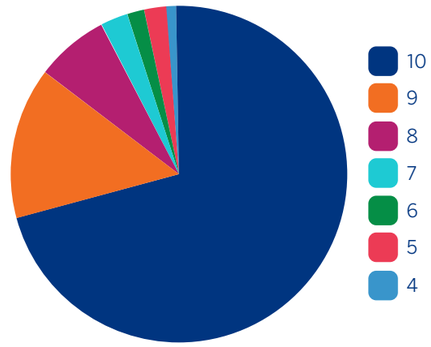

Figure 6. Pie Chart of Planning Satisfaction

In addition to the general satisfaction ratings, teachers were presented with a scale of 6 statements about the content, duration and planning processes of the training and asked to what extent they agreed with these statements. On a scale of "1: Strongly Disagree" to "5: Strongly Agree", the teachers answered "Agree" and "Strongly Agree" for all statements with a minimum of 75% and a maximum of 82%. The individual items and the mean values of the responses to the items are shown in the bar chart in Figure 7. The mean scores vary between 3.84 and 3.96 out of 5. These results show that the participants considered the information provided before the training and the time allocated for the training to be sufficient. Furthermore, it can be concluded from this evaluation that the training covers topics that meet teachers' needs, that the content is understandable and interesting, and that the topics and studies covered are applicable in the classroom.

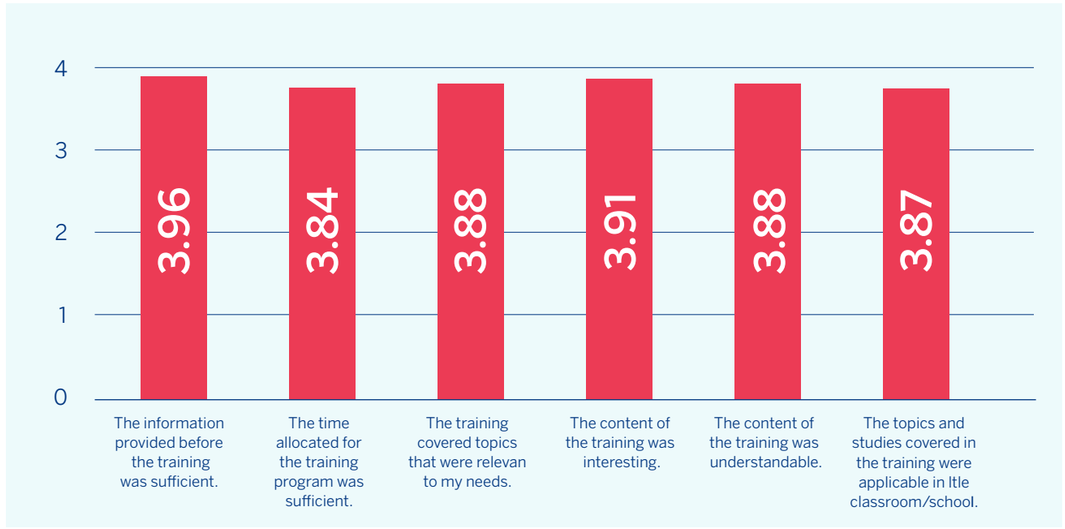

Figure 7. Bar Chart of Content, Timing and Planning Scale

Teachers were presented with a 6-point scale that included statements about the environment of this six-day training, which was delivered synchronously and asynchronously via video content and interactively in an online environment. The scale ranged from "1: Strongly Disagree" to "5: Strongly Agree" and teachers responded "agree" and "strongly agree" for all statements with a minimum of 86% and a maximum of 93%. The individual items and the mean values of the responses to the items are shown in the bar chart in Figure 8. It can be seen that the mean scores range from 4.08 to 4.52 out of 5. These results show that the participants felt competent in using web-based environments and found the video-based and interaction-based materials used in this training useful. It also suggests that teachers felt that both separate and combined synchronous and asynchronous training had a positive effect on learning.

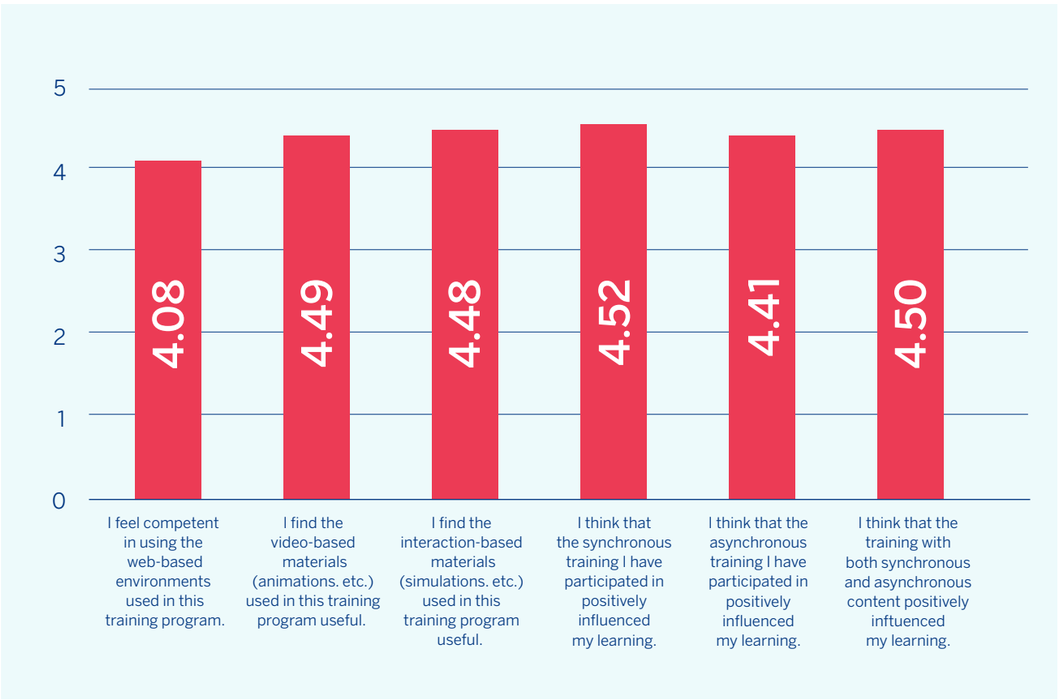

Figure 8. Bar Chart of Training Environment Scale

From the responses to the open-ended question asking teachers for their opinions, it can be inferred that teachers found this training very productive and enjoyable. Below are examples of statements in which the teachers expressed their satisfaction with the content, practice and training environment.

"I had a very pleasant and productive training process. The learning was as fun as you can make it in online conditions without being there in person."

Science/Science and Technology, 0-1 year, İzmir

"It is obvious that your content came from a teacher because you offered solutions to our classroom problems."

Science/Science and Technology, 11-15 years, Kocaeli

"The harmony and energy of your team was great. I left my busy schedule and sat in front of the screen with enthusiasm. The interactivity during the training helped me keep my mind active. I liked the fact that the asynchronous videos contained science activities intertwined with life"

Science / Science and Technology, 1-5 years, Şanlıurfa

"I wish such useful training that support the professional development of science teachers would continue. You are really achieving very important things. I wish you every success."

Science/Science and Technology, 11-15 years, İzmir

Evaluation of the Trainers

ÖRAV trainers have at least 5 years of teaching experience at the K-12 level, a developmental mindset and curiosity about learning, and the ability to actively use educational technology. Our trainers engage in innovative activities beyond the routine work in their field/sector, go through three phases of in-service training before assuming the role of trainer under the umbrella of ÖRAV and can take an active role in education after successful completion of the super vision processes.

In the evaluation questionnaire, participating teachers were also asked about their satisfaction with the trainers and asked to rate their overall satisfaction on a scale of 10. The mean of the answers given was 9.65. A detailed analysis of the responses shows that the percentage of those who gave 10 out of 10 points is 81.4%, the percentage of those who gave 9 points is 12.2% and the percentage of those who gave 8 points is 2.7%. Table 4 shows the distribution of points for overall satisfaction with the trainer. It can be seen that 97.3% of the participants gave a score of 7 and above and only 1 person gave 2 points and 2 people gave 5 points. This shows that the overall satisfaction with the trainer is quite high.

Score	Frequency	Percentage	Cumulative Percentage
10	153	81.4	81.4
9	23	12.2	93.6
8	5	2.7	96.3
7	2	1.1	97.3
6	2	1.1	98.4
5	2	1.1	99.5
2	1	0.5	100.0

Table 4. Frequency and percentage of Trainer Satisfaction

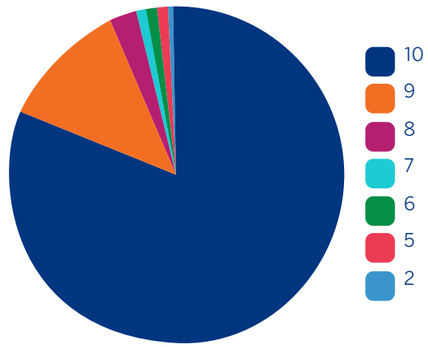

Figure 9. Pie Chart of Trainer Satisfaction

In addition, teachers were presented with 5 characteristics of the trainer and asked to rate them separately on a scale of 10. Figure 10 shows the characteristics and the mean scores of the responses out of 10 in a bar chart. It can be seen that the mean scores of the trainer characteristics range from 9.65 to 9.69. These results show that the teachers consider the trainer to be competent in his/her subject area, good at communication and presentation and good at time management. It can also be concluded that the trainers are mentors in social learning groups who encourage participation.

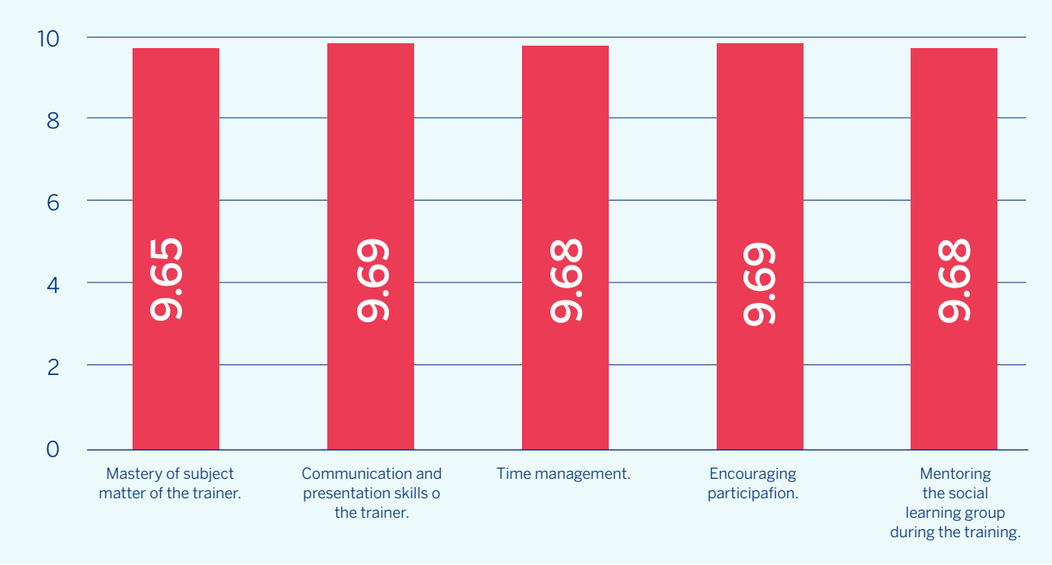

Figure 10. Bar Chart of the Trainer Scale

The Impact of the Training on the Teachers

To understand the impact of Inquiry-Based Science Education on teachers, both quantitative and qualitative measurement tools were used. The training objective scale included in the training evaluation questionnaire was designed to determine whether teachers had achieved the desired level of knowledge, self-efficacy and awareness. In this scale with 24 statements, teachers were asked to give an answer between "1: Strongly Disagree" and "5: Strongly Agree" to indicate to what extent they agree with these statements. Participants' responses are expected to be 5 across the scale. However, there are 4 reverse items in the scale. For these items, participants' responses are expected to gravitate towards 1. These items are marked with different colours in the bar chart (Figure 11), which shows the average responses of the participants to the 24 items. As can be seen from the chart, the mean scores of the other items are above 4, while the average scores of the reversed items are below 3. These results show that the targeted outcomes were achieved at the end of the training.

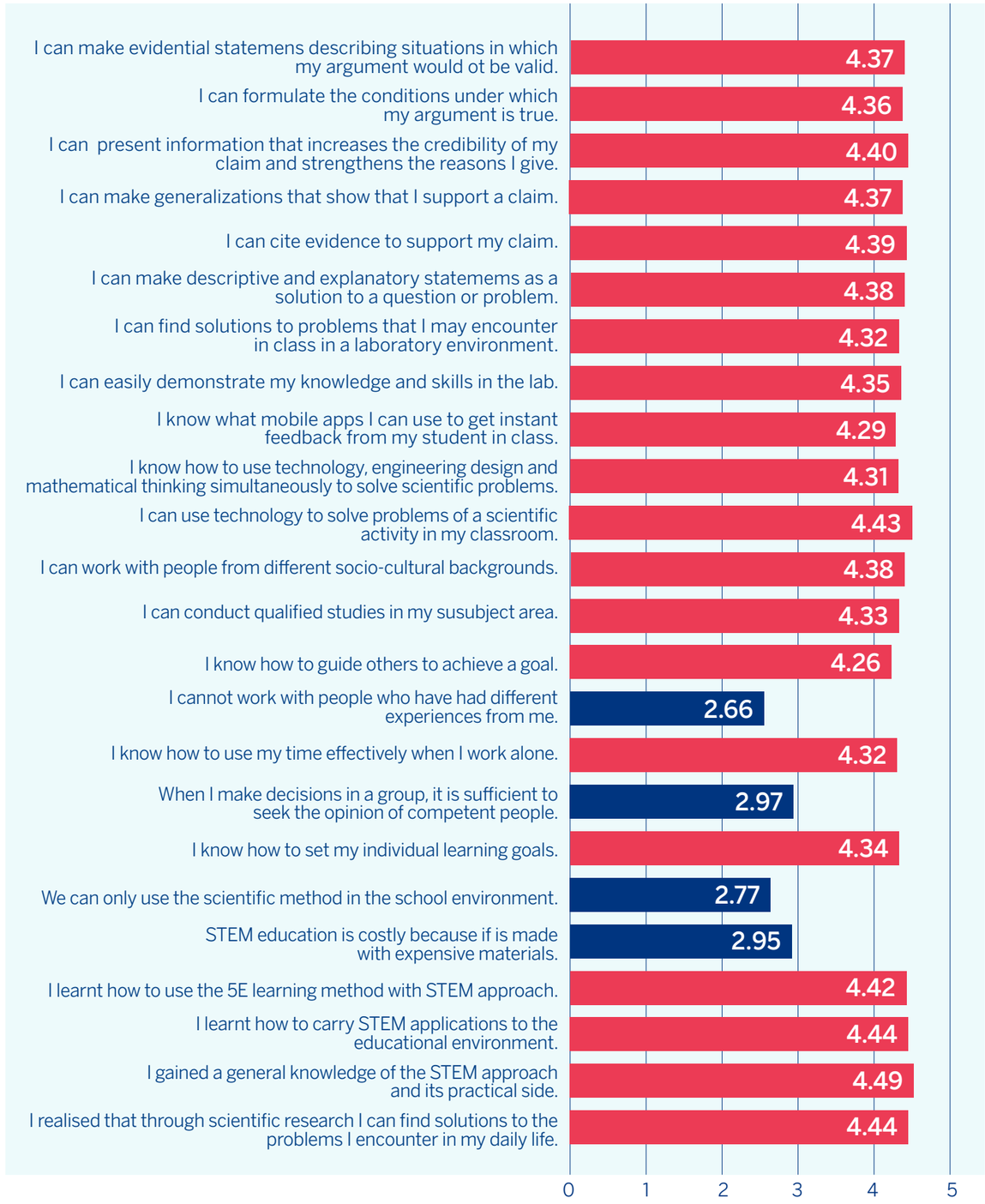

Figure 11. Bar Chart of the Training Objective Scale

The impact of the training on teachers was also tested through open-ended questions in the training evaluation questionnaire. Firstly, teachers were asked the following question: "What can this training change about you? For example, what will you do differently after this training?" The analysis of the teachers' responses revealed that the answers could be divided into two categories: **"teaching practice"** and **"classroom practice"**. Teachers indicated that they know more about methods they can use in the classroom and that they want to use these practices effectively in the classroom. They also indicated that they gained new knowledge and skills to support their own teaching and will apply these in their own classrooms. The following are examples of what teachers said.

"I will do more STEM activities in my classroom to improve my students' reasoning skills and create more space for discussion."

Science / Science and Technology Teacher, 0-1 year, İzmir

"I will work more with arguments. I will prepare animations. I will use more web tools."

Science/Science and Technology Teacher, 16-20 years, Eskişehir

Also, teachers who had some prejudices and reservations about STEM before participating in the training program also stated that this training freed them from these prejudices and reservations. One of our participants said the following:

"My negative thoughts about STEM activities have completely changed and I think that I should include STEM activities in my teaching."

Science / Science and Technology Teacher, 0-1 year, İzmir

In addition, participants were openly asked, "What practices would you like to do with your students immediately after this training?" Almost all practices were mentioned. Examples of what teachers said about the practices they would like to try first are given below.

"I would like to do a study with my students on biomimicry examples. The STEM curriculum is one of the things I want to implement right away."

Science / Science and Technology Teacher, 11-15 years, Bolu

"Concept caricature, argumentation-based teaching"

Science / Science and Technology Teacher, 1-5 years, İzmir

CONCLUSION

In a globally and digitally connected world, all students, from early education to adult learning, need new knowledge and skill sets to succeed. Given the role teachers play in adapting to and leading all of these processes of societal change and transformation, it is critical for teachers to acquire 21st century skills to successfully prepare students for their educational lives and future careers. In this context, the Inquiry-based Science Education Project, designed keeping in mind the demands of the current age, aims at interdisciplinary and in-depth learning of individuals by combining science education with experimentation again. This way, the students were supported by the participating teachers to take a holistic perspective by associating information learnt in the classroom with their daily lives. The Inquiry-based Science Education, which was conducted online in the 2020-2021 academic year as part of the COVID-19 pandemic measures, was also conducted online in the following years. As emphasised in the section of the report discussing participating teachers' evaluations of the learning environment, a well-designed online educational program was found to contribute significantly to teachers' professional development. Online professional and personal development training organised by the Teachers Academy Foundation not only benefits teachers' flexibility and versatility, but also allows teachers to build learning communities among their colleagues. The social learning groups created in our learning management system, eKampüs, specifically for the Inquiry-based Science Education Project, have opened up an area where participants can be inspired by each other and turn that inspiration into new aspirations by doing away with place-based constraints.

The participating teachers indicated that the Inquiry-Based Science Education contributed to their professional development and expressed their satisfaction with the training content, the training environment, the planning process and the trainer. In analysing the quantitative and qualitative data collected to understand the impact of Inquiry-Based Science Education on teachers, it can be inferred that the outcomes of the training were achieved to a great extent. It was found that the results of the training objective scale and the answers to the open-ended questions were consistent with each other. In the analyses conducted based on the responses to the open-ended questions, it was found that the education program made significant contributions to classroom practices and instructional practices, particularly in the area of professional development. Teachers emphasised that they found the topics of Science Education and inquiry-based science teaching practices useful during the educational program and expressed that they would incorporate the lessons learnt into the classroom environment. It can be concluded that the training influenced the acquisition of basic program outcomes such as interdisciplinary working, knowledge of the place of science, especially chemistry, in life, increased self-efficacy in related subjects and the development of problem-solving skills. The fact that teachers indicated that they had not previously used the practices and methods highlighted in this training in their classrooms and would use them from now on, and that they discarded their preconceptions about the practices and would bring these practices into the classroom, are indications that desirable changes in teachers' behavior may occur.

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