A Multi-layered Solution for VET: Change Agents

Monitoring & Evaluation Report February 2022 – December 2023

# **Introduction**

This monitoring and evaluation (M&E) report presents the findings of an evaluation of the "A Multi-layered Solution for VET: Change Agents" project, funded by the European Union (EU) and the Republic of Türkiye. The project aims to enhance the quality of vocational education and training (VET) in Türkiye’s metal sector by establishing a Sectoral Centre for VET Competence Development (SCVCD), modernizing educational content, and aligning VET teacher skills with industry 4.0 standards.

The M&E report covers the period of the project, spanning 23 months, and aims to assess the progress and impact of the project, as well as identify any lessons learned. It provides an overview of the project's implementation, outcomes, and the extent to which it met its objectives.

The M&E report is structured as follows: the first section provides an overview of the M&E framework that is being used to monitor and evaluate the project, including the indicators and targets used to measure progress and impact. The second section presents the key results and achievements of the project, including any changes or impacts that have been observed, based on data and information collected through document reviews, interviews with project staff, and analysis of the provided project documents and monitoring tools. The final section provides a summary of the main conclusions of the M&E process, including any recommendations for future actions or improvements.

The M&E framework is based on the project's objectives and targets as outlined in the application form and is updated accordingly to reflect the progress made. In the first section of the report, the M&E framework is presented with indicators and current values, offering a detailed assessment of how the project's activities contributed to its overarching goals. This final report encapsulates the updated monitoring plan, the comparison of indicators by their baseline and current values, and provides a holistic view of the project’s impact and effectiveness.

# **Overview of the M&E Framework**

**1. Framework Design**

The M&E framework for the "A Multi-layered Solution for VET: Change Agents" project is designed to evaluate the project against its stated objectives and expected outputs. It utilizes both quantitative and qualitative indicators tailored to the project’s specific goals.

**2. Key Indicators**

Indicators focus on the effectiveness of the Sectoral Centre for VET Competence Development (SCVCD), enhancements in VET teachers' skills, and the integration of industry 4.0 standards into VET.

Key metrics include the number of trained VET teachers, the quality and relevance of training modules, the operational status and impact of the SCVCD, and engagement levels of various stakeholders such as students, teachers, and industry partners.

**3. Data Collection Methods**

Data for evaluating the project is primarily collected through document reviews, including project reports, training materials, and feedback from training participants. This includes the analysis of pre- and post-training assessments, feedback forms, and regular monitoring reports.

**4. Evaluation Criteria**

The evaluation criteria for the project focus on the fundamental aspects of its implementation and impact. The primary criterion is the achievement of the project's objectives, such as the establishment of the SCVCD and the enhancement of VET teacher skills. This involves a basic comparison of the planned goals against the actual results achieved during the project timeline. Another key aspect is participant feedback, where general impressions and feedback from VET teachers and other stakeholders are gathered. This feedback helps gauge overall satisfaction with the project and its perceived impact on the participants and the wider educational context.

Lastly, immediate outcomes of the project are assessed. This includes direct results such as the number of teachers trained, the operational status of the SCVCD, and the initial response of the target audience to the project’s various activities.

These simplified criteria ensure a clear and basic assessment of the project, focusing on its essential elements to provide a concise overview of its effectiveness and any areas needing improvement.

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| --- |
| **Overall Objective: To contribute to the establishment of a need-based, transparent, innovative and quality-based education system that addresses the demands of the labour market and promotes equal opportunities for all as a key to social and economic development** |
| **What is our objective?** | **What results do we need to achieve to reach this objective?** | **What indicators can demonstrate our success?** | **What is the baseline for the indicator?** | **What is the current value for the indicator?** | **What is our threshold to assess that the implementation was effective** | **How will we obtain the values for the assigned indicators?** |
| **Objectives** | **Output** | **Indicator** | **Baseline** | **Final Value** | **Target value** | **Medium for Data Collection/Data collector** | **Data Collection Method(s)** |
| **OO: To contribute to the establishment of a need-based, transparent, innovative and quality-based education system that addresses the demands of the labour market and promotes equal opportunities for all as a key to social and economic development** |  | Increased appeal for VET high schools | NA | To be calculated | To be calculated | Statistics and reports published by TUIK, MoNE and CSOs | Document Review |
| Increased employment rate for Metal Technology VET high school graduates in their field | 3% | To be calculated | 5% | Statistics and reports published by TUIK, MoNE and CSOs | Document Review |
| Increased business attention to investing in human capital | NA | To be calculated | To be calculated | Statistics and reports published by TUIK, MoNE and CSOs | Document Review |
| **OC1. To establish a Sectoral Centre for VET Competence Development (SCVCD) in metal technology sector developed in strong cooperation between private, public and civil sector** |  | Number of SCVCDs established | 0 | 1 | 1 | Project documentation and archive | Document Review |
| OP1. A Sectoral Centre for VET Competence Development (SCVCD) in metal technology sector | Establishment of an SCVCD centre | No | Yes | Yes | Project documentation and archive | Document Review |
| **OC2. To support capacity building of VET teachers through quality and need-based innovative educational programs for them to become real change agent** |  | Number of innovative training modules (Digital Workshop) developed | 0 | 1 | 1 | Project documentation and archive | Document Review |
| OP2. A qualititave need analysis of metal technology sector | Number of research reports and people surveyed | 0 | 1 | 1 | Survey forms, Project documentation and archive | Document Review |
| Curriculum development for trainings | 0 | 1 | 1 | Project documentation and archive | Document Review |
| OP3. A research-based innovative 5-day theoretical and practical training program for VET teachers | Number of teachers trained | 0 | 151 | 150 | Registration forms | Document Review |
| Number of training modules | 0 | 1 | 1 | Project documentation and archive | Document Review |
| Number of days and hours of trainings | 0 | 5 days | 5 days | Project documentation and archive | Document Review |
| Number of training booklets | 0 | 1 | 1 | Project documentation and archive | Document Review |
| **OC3. To raise qualified workforce to be employed in the metal industry through quality-based and continuous training and support for VET teachers** |  | Number of Workshop spaces equipped with state-of-the -art technology established | 0 | 1 | 1 | Project documentation and archive | Document Review |
|  | Number of teachers trained | 0 | 151 | 150 | Project documentation and archive, Registration forms | Document Review |
| OP4. Training given by the teachers (as multipliers) to their students | Number of students taught by trained teachers | 0 | 375 | 1500 | Survey platform, pre/post test participants | Document Review |
| **OC4. To increase the use of monitoring and evaluation tools in VET education to improve the quality of teachers’ trainings** | OP5. An online monitoring and evaluation tools | Number of online monitoring and evaluation tools established | 0 | 1 | 1 | Project documentation and archive | Document Review |
| OP6. Follow of assessment test to the participants teachers and their students through the online tool | Number of monitoring and evaluation reports | 0 | 1 | 1 | Project documentation and archive | Document Review |
| **OC5. To promote private sector’s active involvement in VET education and collaborations between private, public and civil stakeholders** |  | Number of private sector companies connecting with VET schools through SCVCD | 0 | 0 | 50 | Project documentation and archive | Document Review |
|  | Number of on-the-job placements provided by enterprises | 0 | 151 | 150 | Project documentation and archive | Document Review |
| **OC6. To raise awareness of the business world on the value of vocational education as a key for social and economic development and qualified human capital** |  | Number of stakeholders informed about school-enterprise cooperation | 0 | 100  | 100 | Project documentation and archive, Registration forms | Media tracking, Document Review |
| OP7. White paper on education programs prepared and implemented in cooperation with the business world | Number of White Papers | 0 | 1 | 1 | Project documentation and archive | Document Review |
| Number of news reports about the project | 0 | 1 | 1 | Media engagement rates, project documentation and archive | Media tracking, Document review |
| Number of visibility and dissemination activities | 0 | 1 | 1 | Media engagement rates, project documentation and archive | Media tracking, Document review |
| Number of project booklets | 0 | 1 | 1 | Project documentation and archive | Document Review |

The final values of our impact indicators, namely 'Increased appeal for VET high schools', 'Increased employment rate for Metal Technology VET high school graduates in their field', and 'Increased business attention to investing in human capital', are currently designated as 'to be calculated'. This approach is grounded in our reliance on comprehensive, empirical data, which is expected to be derived from studies and surveys conducted by National Statistical Agencies.

These agencies, with their expertise in data collection and analysis, are conducting ongoing research and gathering data that is essential for accurately assessing these indicators. The nature of these indicators necessitates a careful and methodical approach to ensure that the data collected is both reliable and valid. This often involves longitudinal studies, widespread surveys, and complex data analysis, which can only be effectively undertaken by specialized agencies with the necessary resources and expertise.

Additionally, the dynamics of labour markets, educational trends, and business investments are subject to change and can be influenced by a variety of factors including economic shifts, policy changes, and societal trends. Consequently, it is imperative to utilize the most current and comprehensive data available, which these agencies are best equipped to provide.

By stating that the final values are 'to be calculated', we acknowledge the importance of basing our project outcomes on robust, empirical evidence. This approach ensures that the results we present are not only accurate but also reflective of the latest trends and changes in the relevant sectors. It also underscores our commitment to maintaining the highest standards of research integrity and reliability in the evaluation of the project's impact

# **Key Results and Achievements**

## **Evaluation of Outcome-1 (OC1)**

**Outcome-1:** “To establish a Sectoral Centre for VET Competence Development (SCVCD) in metal sector developed in strong cooperation between private, public and civil sector.”

The indicators for OC1 have been met, with the establishment of the SCVCD centre and the number of SCVCDs planned now realized. This denotes that the project has achieved its foundational goal of establishing the necessary infrastructure to support vocational education and training in the metal sector.

The creation of the SCVCD centre marks a key initial step towards the project's aims. With this infrastructure in place, the project is positioned to address the next set of objectives, which includes the operationalization of the centre and the commencement of its activities.

It is crucial at this juncture to maintain a pragmatic approach moving forward. The project should continue to track the effectiveness of the SCVCD centre as a resource for VET improvement, ensuring it fully serves its intended purpose and adapts to the sector's needs. The successful establishment of the SCVCDs is a milestone worth noting, and it is equally important to approach the next phases with a focus on sustainability and long-term impact.

## **Evaluation of Outcome-2 (OC2)**

**Outcome-2:** “To support capacity building of VET teachers through quality and need-based innovative educational programs for them to become real change agents.”

For OC2, the project aimed to enhance the capacity of VET teachers with innovative training modules and comprehensive educational programs. The indicators reflect the creation and implementation of these training resources. Here's a look at the progress made against the planned goals:

* **Innovative Training Modules Development:** The project successfully developed an innovative training module (Digital Workshop), meeting the target of one module. This indicates that the project has provided a new resource to support the capacity building of VET teachers.
* **Qualitative Need Analysis of Metal Sector:** A single research report has been completed, and the necessary number of people have been surveyed, achieving the set goal. This suggests the project has gathered valuable data to inform the content and direction of its training programs.
* **Curriculum Development for Trainings:** The curriculum for the training has been developed as planned, which is a foundational step towards delivering the educational programs.
* **Research-based Innovative Training Program for VET Teachers:** While the target was to train 150 teachers, the project has currently trained 151. This target is one of the most crucial outputs of the project and has been achieved successfully.
* **Training Modules, Duration, and Booklets:** The project has met its objectives of creating one training module and conducting a 5-day training program, along with producing the requisite training booklet. This aligns with the aim of delivering a comprehensive educational experience.

The indicators suggest that the project has successfully developed and initiated the delivery of innovative educational programs for VET teachers. Although there is a shortfall in the number of teachers trained compared to the target, over two-thirds of the goal has been met, which is a substantial achievement. The training days and materials produced have met the expected outcomes, laying a strong foundation for future training sessions.

## **Evaluation of Outcome-3 (OC3)**

**Outcome-3:** “To raise a qualified workforce to be employed in the metal industry through quality-based and continuous training and support for VET teachers.”

This outcome focuses on the practical applications of the training provided to VET teachers, aiming to impact the metal industry directly by enhancing the workforce's qualifications. The progress against the set goals is as follows:

* **Workshop Space Establishment:** The project has successfully established a workshop space equipped with state-of-the-art technology, achieving the target of one such space. This accomplishment is significant as it provides the necessary environment for practical, hands-on training, which is essential for quality-based learning and teaching in the metal sector.
* **Teacher Trainings:** As previously noted in OC2, there have been 151 VET teachers trained out of the targeted 150.
* **Training Dissemination by Teachers:** The number of students taught by these trained teachers has not reached the target of 1500. The number of trained students is 375.

The establishment of the workshop space is a crucial infrastructure development that underpins the project's aims. However, the full potential of this resource has yet to be realized, as indicated by the number of students impacted. The focus now should be on enabling the trained teachers to utilize the workshop space effectively and start training students, thereby expanding the project's reach and contributing to the development of a qualified workforce for the metal industry.

### **Pre/Post Test Results of Teacher Trainings**

#  A Multi-layered Solution for VET: Change Agents | Pre-Post Tests Report

## Introduction

The "A Multi-layered Solution for VET: Change Agents" project, led by MESS Training Foundation, is aimed at enhancing Vocational Education and Training (VET) in the metal sector in Türkiye. This pre-post test report is an integral part of evaluating the project's effectiveness. It examines the impact of the training provided to VET teachers. The report analyzes the baseline competencies and knowledge levels of the participating teachers and assesses the progress made following the training interventions.

The pre-post test analysis is structured to evaluate the changes in knowledge and skills among the 150 VET teachers who participated in the training. The pre-test results provide a snapshot of the teachers' initial understanding and proficiency in various technical areas relevant to the metal sector. The post-test, conducted after the training sessions, offers valuable insights into the advancements in knowledge and skills achieved by the participants. This report presents a detailed analysis of these results, shedding light on the effectiveness of the training program and identifying areas for further development in VET education.

## Pre-Test Results

### Gender Composition of Participants

The gender distribution among the participants reveals a significant male majority, with males making up 89% of the group. Females, in comparison, constitute 11% of the participants. This distribution demonstrates a male-dominated composition in the study, underscoring a noticeable gender imbalance among the participants.

### Age Profile of Participants

The age distribution among the participants indicates a diverse range of ages. The majority falls within the 40-49 age bracket, representing 38% of the participants. This is closely followed by those in the 50-59 age group, which comprises 35%. The 30-39 age range accounts for 22%, suggesting a substantial presence of mid-career individuals. Notably, the younger (20-29) and older (60-70) age groups are less represented, with 1% and 3% respectively. This distribution highlights a concentration of participants in the mid to late career stages.

### Previous Training Engagement

Regarding the participants' prior exposure to similar training, a substantial majority, amounting to 84.46%, indicated that they had not attended a similar training program before. On the other hand, 15.54% of the participants confirmed having previous experience with similar training. This data suggests that the majority of the participants were relatively new to the concepts and skills presented in the current training, highlighting its potential role in introducing new knowledge and competencies to most attendees.

### Work Experience in Relevant Fields

The data on work experience reveals that a vast majority of the participants, 97.30%, reported not having prior work experience in the fields related to the training. In contrast, only a small fraction, 2.70%, indicated that they have experience in these areas. This significant skew towards inexperience underscores the fact that the training program primarily catered to individuals who are newcomers or relatively inexperienced in the specific industrial and technical fields covered by the training.

## Familiarity with Training Concepts

Participants showed varying familiarity with concepts like Digital Transformation, Machine Learning, and Industrial Automation. The rates for familiarity are generally high, but there's also a noticeable rate of indecisiveness, especially in the concept of Machine Learning.

### **Pre-test Scores**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Category** | **Statement** | **Pre-test Average** | **Pre-test Median** | **Pre-test StD** |
| Welding and Material Knowledge | I am knowledgeable about the examination of materials in the laboratory and the necessary analysis processes. | 2,72 | 3 | 1,10 |
| I know the procedures to be carried out before and after the welding application and am proficient in the welding application. | 2,77 | 3 | 1,30 |
| Computer and Software Systems | I can describe Cyber Physical Systems, Embedded Systems, Manufacturing Execution Systems, and Robot Operating Systems. | 2,72 | 3 | 1,06 |
| I can define terms such as Big Data, Radio Frequency Identification, Internet of Things, Augmented Reality, and Cyber Reality. | 2,84 | 3 | 1,18 |
| I am proficient in using Arduino. | 2,50 | 2 | 1,37 |
| Electrical and Electronic Systems | I can develop electrical, electronic, and pressure circuits. | 2,36 | 2 | 1,16 |
| I can design technical systems with attention to dimension compatibility and part selection. | 2,56 | 3 | 1,16 |
| I can understand technical documents and draw circuit diagrams and part lists. | 2,84 | 3 | 1,14 |
| Process Automation and Control Systems | I understand Piping and Instrumentation Diagram (PID) drawings. | 1,86 | 2 | 0,99 |
| I am knowledgeable about control systems used in process automation. | 2,17 | 2 | 1,03 |
| I am knowledgeable about process automation. | 2,18 | 2 | 1,03 |
| I am knowledgeable about circuit elements, sensors, and pump calculations used in process automation. | 2,18 | 2 | 1,05 |
| General Industrial Knowledge | I know the components that make up a smart factory. | 2,75 | 3 | 1,09 |
| I am knowledgeable about manufacturing processes. | 2,64 | 3 | 1,09 |
| Industrial and Mechanical Systems | I am knowledgeable about hydraulic systems. | 3,03 | 3 | 1,16 |
| I am knowledgeable about pneumatic systems. | 3,12 | 3 | 1,19 |
| I have basic mechanical skills such as assembly, screwing, and setting up pipe systems. | 3,48 | 4 | 1,16 |

To provide a comprehensive understanding of the participants' self-assessed knowledge levels across various technical categories prior to training, we analyze the pre-test average scores. These scores, on a scale of 5, reflect the participants' perceived proficiency in specific areas of welding and material knowledge, computer and software systems, electrical and electronic systems, process automation and control systems, general industrial knowledge, and industrial and mechanical systems. By examining these scores, we can identify which areas participants felt most and least confident in before undergoing the training program.

**Highest Confidence Category: Industrial and Mechanical Systems**

Participants displayed the highest self-assessed proficiency in this category. Their confidence was particularly notable in areas related to hydraulic and pneumatic systems, as well as basic mechanical skills.

**Area with Scope for Improvement: Process Automation and Control Systems**

This category saw the lowest average scores, indicating a relative lack of confidence or knowledge among participants in understanding Piping and Instrumentation Diagrams (PID) and the fundamentals of process automation and control systems.

**Observations on Other Categories**

* **Welding and Material Knowledge**: Participants showed a moderate level of self-assessed knowledge in this category.
* **Computer and Software Systems**: There was a mixed level of self-assessed understanding, with participants feeling more confident in certain areas like Big Data and IoT than others.
* **Electrical and Electronic Systems**: Scores in this category indicated variability in self-assessed knowledge, with some areas being better understood than others.
* **General Industrial Knowledge**: Participants had a moderate level of self-perceived understanding regarding the components of a smart factory and manufacturing processes.

The majority of statements have a median score of 3, which suggests that the middle response for these items is neutral. This indicates that participants neither agree nor disagree strongly, and it represents a central tendency in their responses.

The standard deviations range between 0.99 to 1.37, with no extreme values. This range implies that while there are differences in how participants rate their knowledge or skills, these differences are not excessively large for any of the statements.

## Post-test Results

Upon the completion of 11 training sessions involving 150 participants, a post-training evaluation was conducted to assess the efficacy of the program. The following is an analytical comparison of the post-test outcomes relative to the pre-test results, providing insights into the knowledge and skill advancements achieved by the participants.

### General Participant Feedback

The participant feedback regarding the equilibrium between practical exercises and theoretical application within the training suggests a predominantly positive reception. 57.02% of the participants express agreement that the training was well-conceived in terms of this balance, indicating satisfaction with the integration of hands-on practice and conceptual learning. Complementing this, a significant 29.75% fully endorse this sentiment, strongly agreeing that the training excelled in meshing practicality with theory.

On the other hand, 10.74% of participants maintain a neutral stance, which could imply that the training met their expectations but did not particularly stand out in either direction. Only a small fraction, amounting to 1.65%, express disagreement, while an even smaller contingent of 0.83% registers strong discontent. This divergence in views suggests that while the training was generally effective for the majority, there were a few participants for whom the practical and theoretical aspects did not align optimally. Overall, the feedback highlights the training's success in achieving a constructive balance, albeit with room for refinement to accommodate the needs of all participants.

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| --- | --- | --- | --- | --- | --- |
| **Category** | **Statement** | **Pre-test Average** | **Post-test Average** | **Difference %** | **Difference in Average** |
| Welding and Material Knowledge | I am knowledgeable about the examination of materials in the laboratory and the necessary analysis processes. | 2,72 | 3,95 | 45,15 | 1,23 |
| I know the procedures to be carried out before and after the welding application and am proficient in the welding application. | 2,77 | 3,73 | 34,65 | 0,96 |
| Computer and Software Systems | I can describe Cyber Physical Systems, Embedded Systems, Manufacturing Execution Systems, and Robot Operating Systems. | 2,72 | 3,99 | 46,97 | 1,28 |
| I can define terms such as Big Data, Radio Frequency Identification, Internet of Things, Augmented Reality, and Cyber Reality. | 2,84 | 4,16 | 46,55 | 1,32 |
| I am proficient in using Arduino. | 2,50 | 3,55 | 41,90 | 1,05 |
| Electrical and Electronic Systems | I can develop electrical, electronic, and pressure circuits. | 2,36 | 3,81 | 61,09 | 1,44 |
| I can design technical systems with attention to dimension compatibility and part selection. | 2,56 | 3,83 | 49,38 | 1,26 |
| I can understand technical documents and draw circuit diagrams and part lists. | 2,84 | 3,94 | 38,39 | 1,09 |
| Process Automation and Control Systems | I understand Piping and Instrumentation Diagram (PID) drawings. | 1,86 | 3,79 | 103,00 | 1,92 |
| I am knowledgeable about control systems used in process automation. | 2,17 | 4,02 | 85,52 | 1,85 |
| I am knowledgeable about process automation. | 2,18 | 4,03 | 85,31 | 1,86 |
| I am knowledgeable about circuit elements, sensors, and pump calculations used in process automation. | 2,18 | 3,98 | 82,76 | 1,80 |
| General Industrial Knowledge | I know the components that make up a smart factory. | 2,75 | 4,23 | 53,82 | 1,48 |
| I am knowledgeable about manufacturing processes. | 2,64 | 4,00 | 51,41 | 1,36 |
| Industrial and Mechanical Systems | I am knowledgeable about hydraulic systems. | 3,03 | 4,10 | 34,99 | 1,06 |
| I am knowledgeable about pneumatic systems. | 3,12 | 4,17 | 33,52 | 1,05 |
| I have basic mechanical skills such as assembly, screwing, and setting up pipe systems. | 3,48 | 4,17 | 19,97 | 0,69 |

## Statistical Significance

In the context of the project, statistical significance is a measure of whether the observed differences in the pre-post test results are likely to be genuine or if they could have occurred by random chance. The Paired t-test, a parametric test, and the Wilcoxon Signed-Rank Test, a non-parametric test, were both employed to compare the scores from before and after the training program. A p-value, derived from these tests, is a probability that measures the evidence against a null hypothesis—which in this case assumes there is no effect of the training. The closer the p-value is to zero, the stronger the evidence to reject the null hypothesis. In the collected data, p-values are at or close to zero for all items tested, which provides strong statistical evidence that the training had a significant effect on the participants' knowledge and skills. This conclusion is supported regardless of the distribution of the data, whether it is assumed to be normal (as required by the Paired t-test) or not (as the Wilcoxon Signed-Rank Test does not assume normality). The consistency of results across both types of tests reinforces the reliability of the findings that the training program effectively improved the competencies of VET teachers in the metal sector.

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| --- | --- | --- | --- |
| **Category** | **Statement** | **Paired t-test p-value** | **Wilcoxon Signed-Rank Test p-value** |
| Welding and Material Knowledge | I am knowledgeable about the examination of materials in the laboratory and the necessary analysis processes. | <0.05 | <0.05 |
| I know the procedures to be carried out before and after the welding application and am proficient in the welding application. | <0.05 | <0.05 |
| Computer and Software Systems | I can describe Cyber Physical Systems, Embedded Systems, Manufacturing Execution Systems, and Robot Operating Systems. | <0.05 | <0.05 |
| I can define terms such as Big Data, Radio Frequency Identification, Internet of Things, Augmented Reality, and Cyber Reality. | <0.05 | <0.05 |
| I am proficient in using Arduino. | <0.05 | <0.05 |
| Electrical and Electronic Systems | I can develop electrical, electronic, and pressure circuits. | <0.05 | <0.05 |
| I can design technical systems with attention to dimension compatibility and part selection. | <0.05 | <0.05 |
| I can understand technical documents and draw circuit diagrams and part lists. | <0.05 | <0.05 |
| Process Automation and Control Systems | I understand Piping and Instrumentation Diagram (PID) drawings. | <0.05 | <0.05 |
| I am knowledgeable about control systems used in process automation. | <0.05 | <0.05 |
| I am knowledgeable about process automation. | <0.05 | <0.05 |
| I am knowledgeable about circuit elements, sensors, and pump calculations used in process automation. | <0.05 | <0.05 |
| General Industrial Knowledge | I know the components that make up a smart factory. | <0.05 | <0.05 |
| I am knowledgeable about manufacturing processes. | <0.05 | <0.05 |
| Industrial and Mechanical Systems | I am knowledgeable about hydraulic systems. | <0.05 | <0.05 |
| I am knowledgeable about pneumatic systems. | <0.05 | <0.05 |
| I have basic mechanical skills such as assembly, screwing, and setting up pipe systems. | <0.05 | <0.05 |

## Conclusion

The pre-post evaluation of the "A Multi-layered Solution for VET: Change Agents" project demonstrates significant improvements in the knowledge and skills of the VET teachers who underwent the training. The training effectively addressed key areas in the metal sector, resulting in marked enhancements in understanding complex concepts and practical skills, as reflected in the substantial percentage increases across various technical categories.

The gender and age distribution among participants, as well as their previous training and work experience, were diverse. Despite the variation in initial familiarity with the training concepts, the significant positive shifts in post-test averages suggest that the program was successful in elevating the participants' proficiency levels.

Feedback on the training's structure, which balanced practical exercises with theoretical applications, was overwhelmingly positive. A majority of participants agreed that the training was well-conceived, indicating satisfaction with the integration of hands-on practice and conceptual learning. While there was a small degree of neutral and dissatisfied responses, this feedback provides valuable insights for future refinement of the program.

Overall, the training not only achieved its aim of enhancing VET education but also set a precedent for future programs aiming to bridge the gap between current competencies and the evolving demands of the metal sector. The data underscores a clear advancement in participant capabilities, promising a more skilled workforce and contributing positively to the sector's development.

## Pre-Post Test Results of Student Trainings

This report encapsulates the outcomes of the prepost tests conducted as part of the project. The program, primarily geared towards the professional development of VET teachers, has a significant impact on the education of over students, emphasizing the delivery of high-quality, industry-relevant training. These results are a testament to the program’s efficacy in bridging the gap between educational training and industry demands, aiming to cultivate a highly skilled workforce in the metal sector.

## Gender Composition of Participants

The gender distribution among the participants shows a pronounced male predominance, with males constituting 82.01% of the group. Females account for 17.99% of the participants.

## Grade Distribution of the Participants

The distribution of participants across different grades indicates a varied representation. Students from the 9th grade form the largest group, accounting for 36% of the total participants. Those in the 10th grade represent 22%, demonstrating a slightly lower participation rate. The 11th grade students constitute a significant portion as well, making up 31% of the group. However, 12th graders have the least representation, comprising only 11% of the participants.

## Previous Training Engagement

The engagement in previous training among the participants is notably skewed, with only 2.93% affirming prior involvement. The vast majority, 97.07%, indicate no previous engagement in such training. This substantial disparity highlights a predominance of participants new to this type of training, suggesting an opportunity for foundational learning and skill development within the group.

## Work Experience in Relevant Fields

Regarding previous work experience among the participants, a small fraction, 3.35%, have had such experience. In contrast, the overwhelming majority, 96.65%, have not engaged in work prior to this program. This distribution highlights a group predominantly comprised of individuals new to the workforce.

## Familiarity with Training Concepts

The familiarity with key concepts among the participants varies: 59.41% are familiar with Digital Transformation, 49.79% with Machine Learning, and 57.74% with Industrial Automation. Those not familiar comprise 16.74% for Digital Transformation, 25.52% for Machine Learning, and 21.76% for Industrial Automation. Participants who are undecided about their familiarity are 23.85% for Digital Transformation, 24.69% for Machine Learning, and 20.50% for Industrial Automation. This suggests a majority are acquainted with each concept, with the least familiarity observed in Machine Learning.

|  |  |  |
| --- | --- | --- |
| **Category** | **Statement** | **Pre-test Average** |
| Welding and Material Knowledge | I am knowledgeable about the examination of materials in the laboratory and the necessary analysis processes. | 2,55 |
| I know the procedures to be carried out before and after the welding application and am proficient in the welding application. | 2,39 |
| Computer and Software Systems | I can describe Cyber Physical Systems, Embedded Systems, Manufacturing Execution Systems, and Robot Operating Systems. | 2,49 |
| I can define terms such as Big Data, Radio Frequency Identification, Internet of Things, Augmented Reality, and Cyber Reality. | 2,61 |
| I am proficient in using Arduino. | 2,47 |
| Electrical and Electronic Systems | I can develop electrical, electronic, and pressure circuits. | 2,64 |
| I can design technical systems with attention to dimension compatibility and part selection. | 2,80 |
| I can understand technical documents and draw circuit diagrams and part lists. | 2,92 |
| Process Automation and Control Systems | I understand Piping and Instrumentation Diagram (PID) drawings. | 1,83 |
| I am knowledgeable about control systems used in process automation. | 2,92 |
| I am knowledgeable about process automation. | 1,91 |
| I am knowledgeable about circuit elements, sensors, and pump calculations used in process automation. | 1,99 |
| General Industrial Knowledge | I know the components that make up a smart factory. | 2,29 |
| I am knowledgeable about manufacturing processes. | 2,12 |
| Industrial and Mechanical Systems | I am knowledgeable about hydraulic systems. | 2,45 |
| I am knowledgeable about pneumatic systems. | 1,87 |
| I have basic mechanical skills such as assembly, screwing, and setting up pipe systems. | 3,31 |

## Pre-test Results

The best-performing category among participants is "Industrial and Mechanical Systems," particularly in basic mechanical skills like assembly and setting up pipe systems, with an average score of 3.31. The lowest scores are in "Process Automation and Control Systems," specifically understanding Piping and Instrumentation Diagram (PID) drawings, with an average of 1.83. These results indicate a strong foundation in practical mechanical skills and a need for improvement in understanding complex automation diagrams.

## Post-test Results

Following the period of teacher-led training, the students have self-assessed themselves through a post-test to evaluate the impact and efficacy of the instruction received. This post-test serves as a critical tool to measure the enhancement of students' skills and knowledge in the relevant technical domains. The results encapsulate the educational gains post-training and provide insights into areas of strength and opportunities for further development in the curriculum.

The feedback on the training's balance between theory and practice indicates a positive reception. A majority of the respondents, 68.59%, agree (38.94%) or strongly agree (29.65%) that the training was well-structured. Neutral responses are also notable at 21.68%, suggesting some ambivalence. However, a minority of 9.73% disagree (5.75%) or strongly disagree (3.98%) with the statement, implying some areas may need improvement. Overall, the sentiment skews towards a favourable perception of the training's practical application.

The table below shows that the knowledge area with the lowest pre-test score was "Process Automation and Control Systems" for Piping and Instrumentation Diagrams at 1.83, which saw a significant post-test increase to 2.94. In contrast, "Industrial and Mechanical Systems" had higher initial knowledge levels, particularly in basic mechanical skills with a pre-test score of 3.31, which saw a smaller increase to 3.86 post-test. The data suggests targeted training has effectively raised knowledge where it was initially lowest, and areas with higher pre-test knowledge saw less dramatic but still positive improvements.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Category** | **Statement** | **Pre-test Average** | **Post-Test Average** | **Difference in Average** | **Difference in Percentage** |
| Welding and Material Knowledge | I am knowledgeable about the examination of materials in the laboratory and the necessary analysis processes. | 2,55 | 3,53 | 0,98 | 38,42 |
| I know the procedures to be carried out before and after the welding application and am proficient in the welding application. | 2,39 | 3,38 | 0,98 | 41,08 |
| Computer and Software Systems | I can describe Cyber Physical Systems, Embedded Systems, Manufacturing Execution Systems, and Robot Operating Systems. | 2,49 | 3,39 | 0,90 | 36,13 |
| I can define terms such as Big Data, Radio Frequency Identification, Internet of Things, Augmented Reality, and Cyber Reality. | 2,61 | 3,53 | 0,92 | 35,47 |
| I am proficient in using Arduino. | 2,47 | 3,38 | 0,91 | 36,95 |
| Electrical and Electronic Systems | I can develop electrical, electronic, and pressure circuits. | 2,64 | 3,51 | 0,86 | 32,59 |
| I can design technical systems with attention to dimension compatibility and part selection. | 2,80 | 3,59 | 0,79 | 28,06 |
| I can understand technical documents and draw circuit diagrams and part lists. | 2,92 | 3,54 | 0,62 | 21,35 |
| Process Automation and Control Systems | I understand Piping and Instrumentation Diagram (PID) drawings. | 1,83 | 2,94 | 1,11 | 60,50 |
| I am knowledgeable about control systems used in process automation. | 2,92 | 3,16 | 1,30 | 69,66 |
| I am knowledgeable about process automation. | 1,91 | 3,19 | 1,28 | 67,32 |
| I am knowledgeable about circuit elements, sensors, and pump calculations used in process automation. | 1,99 | 3,16 | 1,17 | 58,61 |
| General Industrial Knowledge | I know the components that make up a smart factory. | 2,29 | 3,58 | 1,28 | 56,02 |
| I am knowledgeable about manufacturing processes. | 2,12 | 3,21 | 1,10 | 51,78 |
| Industrial and Mechanical Systems | I am knowledgeable about hydraulic systems. | 2,45 | 3,42 | 0,97 | 39,66 |
| I am knowledgeable about pneumatic systems. | 1,87 | 3,22 | 1,35 | 72,42 |
| I have basic mechanical skills such as assembly, screwing, and setting up pipe systems. | 3,31 | 3,86 | 0,55 | 16,56 |

## Conclusion

The post-test results reflect a substantial enhancement in the students' technical knowledge and skills following the teacher-led training sessions. The most significant improvements were observed in the areas initially identified as weaker, demonstrating the effectiveness of the targeted instructional strategies. While the overall trend shows a positive shift towards stronger understanding and proficiency, the results also highlight the need for ongoing educational support in certain areas to ensure that all students achieve a level of competence that meets industry standards. The feedback received points to a successful training module, with the majority expressing satisfaction with the balance of theory and practice. This constructive outcome provides a robust foundation for the continuous development of the vocational program and underscores the value of such comprehensive training initiatives.

The results not only quantify the progress made but also highlight the training program's comprehensive nature and its alignment with the skill demands of the metal sector. The increase in scores, particularly in areas of previous weakness, reflects an effective curriculum that engages students and bridges knowledge gaps. As we move forward, these insights will be instrumental in refining the training modules, ensuring that the curriculum remains responsive to student needs and industry trends. This continuous improvement cycle is crucial to maintaining the program's relevance and its contribution to the development of a skilled and adaptable workforce.

## **Evaluation of Outcome-4 (OC4)**

**Outcome-4:** “To increase the use of monitoring and evaluation tools in VET education to improve the quality of teachers’ trainings.”

This outcome targets the systemic improvement of VET teacher training quality through the use of monitoring and evaluation tools. The indicators suggest the project's efforts to embed these tools within the VET system:

* **Online Monitoring and Evaluation Tools:** The project has successfully established one online monitoring and evaluation tool, meeting the planned target. The implementation of this tool represents a forward step in incorporating data-driven approaches to assess and enhance the quality of VET teacher training.

## **Evaluation of Outcome-5 (OC5)**

**Outcome-5:** "To promote private sector’s active involvement in VET education and collaborations between private, public and civil stakeholders."

This outcome targets the integration of the private sector into the vocational education framework to ensure that training is aligned with current industry practices and needs:

* **Private Sector Engagement with VET Schools:** Thus far, there has not been any reported progress in increasing the number of private sector companies connecting with VET schools through the SCVCD, with the initial target set at 50.
* **On-the-Job Placements:** There have been 108 on-the-job placements provided, indicating robust participation and fulfilling a portion of the target of 150 placements. These placements occurred across five different factories, including Mercedes-Benz Hoşdere Factory, Ford-Otosan Gölcük Factory, Arfesan Fren Sanayi, Aygaz Gebze Factory, Arçelik Çayırova Factory, and also the MEXT Technology Center. This accomplishment showcases the project's success in facilitating practical, hands-on industry experience for VET teachers, which is vital for their professional development and for bringing industry-relevant knowledge into VET classrooms.

The provision of on-the-job placements in various industrial settings is a clear indicator of active collaboration between VET schools and the private sector. It serves as an effective measure to not only enhance the skills of VET teachers but also to solidify the link between vocational education and industry requirements.

## **Evaluation of Outcome-6 (OC6)**

**Outcome-6:** "To raise awareness of the business world on the value of vocational education as a key for social and economic development and qualified human capital."

In assessing the progress towards this outcome, several indicators were set to measure the effectiveness of the awareness-raising efforts:

* **Stakeholder Engagement:** The target was to inform 100 stakeholders about school-enterprise cooperation. This indicator has been achieved thanks to the closing event.
* **White Paper on Education Programs:** A White Paper was planned to encapsulate the project's experiences, the training, with the goal of advocating for this model to be replicated in other VET schools and fields. This White Paper has been completed, meeting the project's objective. The document is expected to serve as a detailed record of the project's approach and outcomes, offering insights and recommendations for future vocational education strategies​.
* **Dissemination Activities:** The project aimed to conduct various visibility and dissemination activities, including news reports and the production of project booklets. The target for these activities was to create at least one of each, and the project has achieved this goal. These efforts are crucial for sharing the project's achievements and lessons with a broader audience, thereby contributing to the project's overall goal of raising awareness​.

In light of this, the successful development and dissemination of the White Paper and related visibility activities represent a positive step towards OC6. However, the engagement of stakeholders as measured by the first indicator suggests an area where additional attention is needed. Future efforts could benefit from a strategic approach to stakeholder engagement, possibly leveraging the contents of the White Paper and the visibility activities to foster deeper connections with the private sector.

As the project moves forward, the focus could be on utilizing the White Paper as a platform for dialogue and partnership-building, aiming to reach the target of stakeholder engagement and to further promote the integration of vocational education with industry needs.

# **Conclusion & Recommendations**

 The "A Multi-layered Solution for VET: Change Agents" project has made significant strides in enhancing Vocational Education and Training (VET) in Türkiye’s metal sector. The establishment of the Sectoral Centre for VET Competence Development (SCVCD) stands as a cornerstone achievement, providing a robust platform for teacher training and curriculum development.

Through this project, VET teachers have acquired advanced skills and knowledge, making them effective facilitators for the next generation of skilled professionals in the metal industry. The training programs, tailored to meet the demands of Industry 4.0, have resulted in a noticeable improvement in both the teachers' and students' competencies, as evidenced by the post-test results.

A key takeaway from this project is the critical role of continuous and quality-based training, which is vital in bridging the gap between educational institutions and industry requirements. The integration of modern technologies and methodologies in the training curriculum has proven effective in enhancing the participants' technical and practical skills.

The project's success also underscores the importance of public-private partnerships in VET. The involvement of industry stakeholders in the training process has ensured that the curriculum remains relevant and aligned with current industry standards and practices. This collaboration has been instrumental in creating a more dynamic and responsive VET system.

For future initiatives, it is recommended to further leverage the SCVCD as a hub for innovation and continuous learning. There is a need to expand the reach of the training programs to include more teachers and students, ensuring a wider impact. Additionally, maintaining an up-to-date curriculum that aligns with the evolving needs of the metal sector is crucial.

Another recommendation is to enhance the monitoring and evaluation mechanisms to continually assess the effectiveness of the training programs. This approach will allow for timely adjustments and improvements, ensuring that the training remains effective and impactful.

Continued engagement with industry partners is also essential. Strengthening these relationships will provide valuable insights into the changing needs of the sector, allowing for more targeted and practical training modules.

In conclusion, the "A Multi-layered Solution for VET: Change Agents" project has laid a strong foundation for the future of VET in Türkiye’s metal sector. The achievements of the SCVCD, the enhanced capabilities of VET teachers, and the positive impact on students' skills are testament to the project's success. The recommendations provided aim to build upon this success, ensuring that the VET system remains a vital contributor to the development of a skilled and competent workforce in the metal industry.