Design of Curriculum for Woodworking CNC Operators in Turkey

O3 FINAL REPORT

Short-Term Trainings Evaluation Report

by METU PRO-CNC Team

Bu proje T.C. Avrupa Birliği Bakanlığı, AB Eğitim ve Gençlik Programları Merkezi Başkanlığınca (Türkiye Ulusal Ajansı, http://www.ua.gov.tr) yürütülen Erasmus+ Programı (Hayatboyu Öğrenme veya Gençlik Programı) kapsamında ve Avrupa Komisyonu'ndan sağlanan hibeyle gerçekleştirilmiştir.

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Introduction

As the third output of the ProCNC project, the report summarizing the findings of two short term trainings which are conducted in Germany hosted by EBG between 22 - 26 June 2015 and in Italy hosted by Aris between 31 August - 4 September 2015. Primary reason of conducting such short term trainings is to learn how CNC education regarding woodworking industry is conducted and how the curricula are conveyed together with the relation of private sector and governmental institutions effecting both the structure and organizational scheme of such educations.

Before proceeding forward and going into details of short term trainings, it should be noted that both short term trainings have similar structures and can be evaluated in two parts as giving a sample training to have an insight of the CNC education and excursions to several factories and companies to have insight about how the given education is reflected to the professional practice. Even though the short term trainings are structured in similar fashion, weightings of two parts are different as training in Germany is more focused on sample training whereas the training in Italy is more focused on CNC operations in practice and number of excursions were organized by them. Hence, the experiences gained in these two short term trainings are different in essence and any comparison may lead misinterpretations. Yet, two trainings are evaluated in depth to extract maximum information regarding the project.

Analysis of Short Term Training in Germany (C1)

(22 June – 26 June 2015)

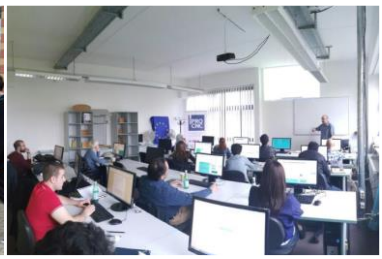
During this period, EBG organized a study visit in Berlin for the participants to observe existing andragogical training in Germany concerning the course that is offered in Germany to get a certification as CNC Operator for wood. The participants was given information how the continuing training is performed: methods, machines, programs, modules, contents, conditions on prior learning etc. so understand which CNC andragogical educational principles are appropriate in which context. Additional we visited a companies and had a look at the CNC operators on the job. Another visit was the company that is marketing the CNC machines, EBG and also TR partners are working with. Here we got info about the hard- and software CNC machines including training. Beyond the training the participants observed the real training and working conditions in the furniture industry and particularly working and training on CNC. One of the reasons for strength and success of German economy is German vocational education and training system and particularly the blue collar workers of enterprises. The companies are asking for qualified and skilled workforce not only in terms of knowledge but also with a practical approach for high qualified training and vocational technique.

EBG´s strength and success is based upon vocational training with a strong practical component and market-oriented development of tailored training activities to the specific needs and requirements. In developing its programs EBG takes into account current labor market trends and vocational qualification requirements and ensures a high level of relevance to the field of practice.

Beyond "technical" part cultural interaction, business culture, training culture (how the trainers and students/workers act with each other's) were also inputs of the study visit. Last but not least exploring the country and its people, history, multiculturalism (people from 190 counties are living in Berlin, though the biggest population are Turks), daily life, remains of the Berlin wall, 2100 bridges of the city.

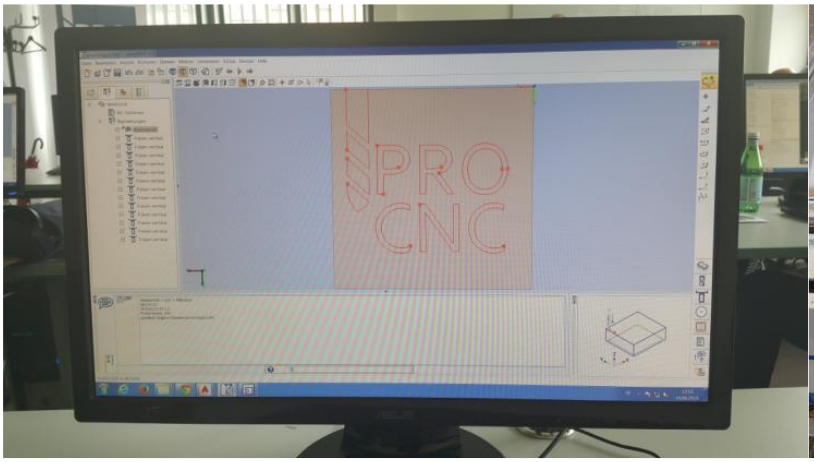
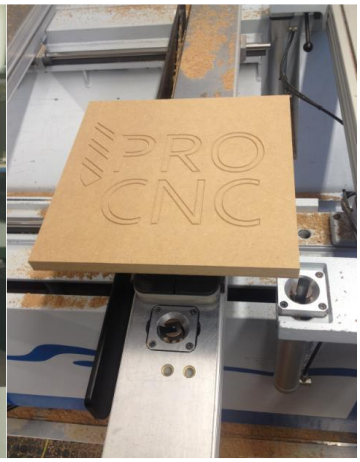
- Monitoring arrangements: Monitoring involved reflecting and was focused on the measurement of the following aspects of the study visit: On quantity and quality of the activities, andragogical educational principles appropriate in which context, knowledge transfer, which broader, long-term effects could be triggered by the visit, the effects produced by the visit and the overall impact.
- Expected use of outcomes, assessment: The knowledge gained from the visit observations will be debriefed and reported for input into the development of the training curriculum. Comparing curricula in each context, the project will then develop the training curriculum. At this site visit, the Steering Committee performed an evaluation of the work and outputs done to date and provide feedback.

Days1-3

Presentation of training concepts, didactic and technical structure of the training

1. Presentation of CNC machine, axes and applications
2. Object oriented programming und implementation on CNC machine
3. Parameter and variables for programming (Furniture, door, interior constructions, fair constructions
4. CAD-CAM
5. Creative design of millings, engravings and decorative panels
6. Free forms and their applications; examples on the machine, engraving and inlaying; milling of solid surface materials, for example, Corian; template building and their applications.
7. Handouts for documentation to each topic (paper or e-version)

Location: QEU Wolfener Straße 32/34, 12681 Berlin (training workshop of the cooperation partner of EBG in Berlin)

Day 4 -5 : Excursion to enterprises

In all companies we observed typical CNC operating activities: fair construction, store building, costumer`s individual orders and the renovation.

1. Varius; Messe- Event- Innenausbau GmbH; Tischlermeister Mario Grassmann Zum

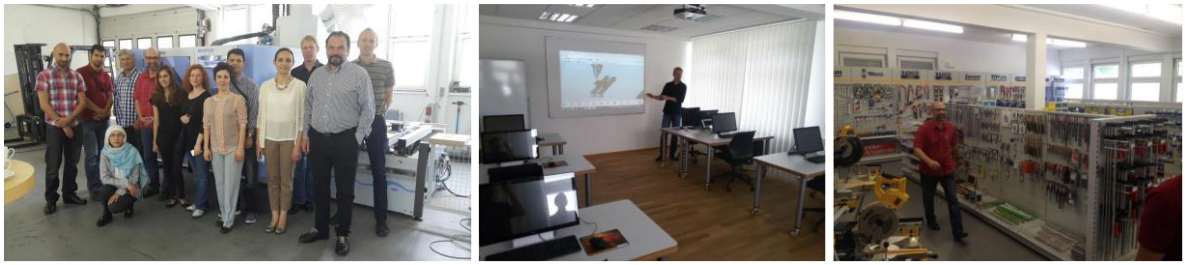
2. Hmr holzmanufaktur richter GmbH Handwerkerstr. 25 D-15366 Berlin – Hoppegarten

3. Tischlerei Streidt Hegermühlenstraße 47 D-15344 Strausberg

4. LIGAS Tischlerarbeiten GmbH Gerichtsstraße 12-13 D-13347 Berlin

5. Heinrich KUPER GmbH & Co. KG Großbeerenstraße 194 – 196 12277 Berlin

Presentation of new CNC techniques by main distributer of CNC machines in Berlin;



EBG trainer: Roberto Lorang and Karl-Heinz Thiemann

Translator: Türkan Yilmaz (German-Turkish)

As mentioned by IKOOR in the scope of "Study Visit Notes", notwithstanding the number of employers, the investment on the machines and equipment is remarkable in the firms that we have visited. Small-scale firm producing in Germany has similar investment scope considering the technology with a medium scale firm with 50-100 employers in Turkey.

The vocational education programs in Berlin are constructed to meet the needs of small-scale business and workshops. Hence this education aims multi-skill operators capable of programming, fabricating and also dealing with the machines' features, maintenance and problems.

Evaluation

Within the scope of PRO CNC Project, a team from Turkish partners including METU Pro CNC core group, and colleagues from IKOOR and OMSIAD paid a visit to EBG in Berlin Germany, from 21 June 2015 to 27 June 2015. The aim of the visit is to understand how CNC education/training in different levels are held in Germany as well as how the quality of such an education is evaluated.

In this context, a three days intensive course/training exemplifying the situation in German practice had been given by Mr. Roberto Lorang (GmbH) as a co-partner of EBG in Berlin.

Structure of the Short Course/Training

The settlement where the course/training had been given is an educational complex where several other professional training programs are held in various fields. The given intensive course/training had theoretical and applied parts for which from cognition of the subject matter had been stressed by "class to workshop" implementations.

The content of the course/training can be considered as an archetype of such an education/training for those who worked or to be worked as CNC woodworking operator. In the beginning of this special program, it was presumed that participants were familiar with mathematics especially with geometry and trigonometry as well as they were capable of using computers and at least were familiar with CAD programs. These presumptions (the level of knowledge expected differ with respect to trainee profiles and duration of the program) are valid for the eligibility of the participants to take such a training.

The content can be summarized as below:

- Introduction of CAM and the role of CAM in the sector
- Introduction of the essential vocabulary of CNC
- Introduction of the basic CNC operations
- Introduction of CNC programming
- Introduction of CAD
- Implementation of what is programmed

As it can be seen that the general content of the training aims to achieve at least three levels of knowledge dimensions factual, conceptual and procedural. In this general framework each lecture is clearly organized for which at first three levels of Bloom's taxonomy describing cognition "remember, understand, apply, analyze, evaluate create" are aimed at. In the following section course content is to be analyzed regarding the cognitive and knowledge dimensions.

Overview of objectives (as participants experienced);

1. The level of information/knowledge is very carefully organized and it is given step by step by increasing the level of complexity.
2. Before furthering the education the mindsets of operators should be changed, since in woodworking the work piece is constrained and the machine is moving unlike other machining operations.
3. The understanding of coordinate systems in CNC operations is extremely crucial hence the very first thing is to introduce trainees with this idea.
    a. In this sense the very first three translational axes (x-y-z) are covered and after being sure that the trainees completely understood this subject, other axes are introduced.
    b. It is important to explain trainees that three axes (if they are used in full potentials) can do the same job as multi-axis CNCs.
4. One of the very first act in the training program is to make trainees familiar with their tools and being competent to choose the proper tool both as software and hardware.
5. It is emphasized that trainees should be acquainted with German standards (DIN) as a part of both curriculum and as a part of parametric programming.
6. It is also emphasized the importance of the parametric programming and the importance of introducing parametric programming and macros in the very beginning of training program.
7. It is strongly emphasized that before being sure about the content understood by trainees nothing new is given.
    a. In this context, example problems are assigned in such a way that the complexity of the examples are increasing day by day and yet trainees facing each operation one at a time then at a certain level all the operations(examples are implemented together. (a Typical example is the manufacturing of a standard building door)
    b. Each lecture and each day should be started with the summary of previous hours/lectures in order to improve cognition.
8. An evaluation as a survey is conducted in order to be sure about the achievement of objectives of each subject matter.
9. In relation with these evaluations in the case of necessity is re-given or repeated in order to have a common background in the classroom.
10. Trainees are exposed to examples related with each subject matter and expected to solve them successfully.
    a. Trainees are asked to complete their designs in the classroom especially in machine programming and simulate the process
    b. Then, they are asked to implement their solution immediately in the machine in order to be able to evaluate their process recognize possible problems and to propose solutions.
11. It is strongly stated that the trainees should not experience failure in order not to lose their self-confidence.
12. It is pointed out that the training program should be unbiased to any machine brand or any software; therefore. Different type of machines/software should also be discussed in the program, and trainees should be accustomed with general logic of CNC operations and parametric programming.
13. In the case of implementation on the machine group members should not exceed 2 and each trainee should immediately be introduced with CNC in order to overcome their fear.

14. Customization of examples such as giving file names as the names of trainees is important to improve their confidence and motivate them.
15. Trainees are motivated and forced to be familiar with CNC as a machine in order to solve in-house problems.
    a. They are asked to mount and dismount the basic part of the CNC
    b. They should be able to at least recognize the inherent problem of CNC for asking further help.
    c. They should be able to calibrate the tools in regard with the operations.
    d. They should be responsible about handling the CNC and the workshop.
    e. They should strictly follow safety rules and this is an essential part of the training program.
16. Although success is important, sometimes machines are deliberately failed by the instructor in order to encourage and improve problem solving skills of operators.
17. It is important that trainees should follow the process in the machine which they simulated in the classroom, therefore using webcams in CNC is very helpful as a part of such an education.

Analysis of the Content in relation with project objectives:

A systematic analysis of each lecture is to be carried in relation with Bloom's Taxonomy in order to identify cognitive and knowledge dimensions and then complete course conduct is to be evaluated in a very similar way.

Stage1: Introduction of the very first subject

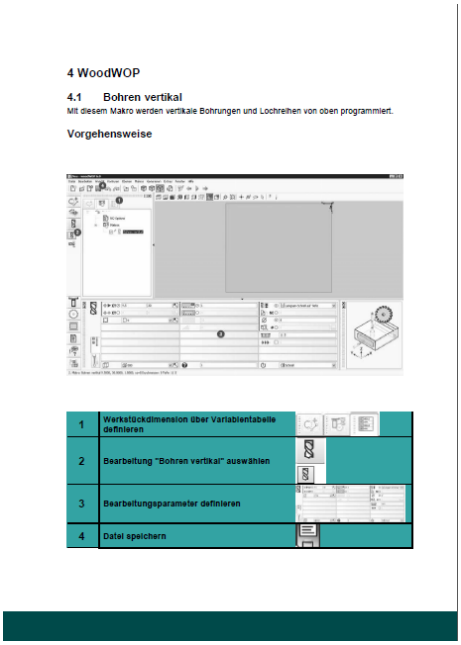


Figure 1: Example worksheet of Stage 1 (obtained from EBG)

Given: Basic Definition, Screenshot which clearly shows necessary vocabulary and introducing and familiarizing trainees with the program.

Recall: Highlighted key points of what is given.

Stage2: Example of what is introduced

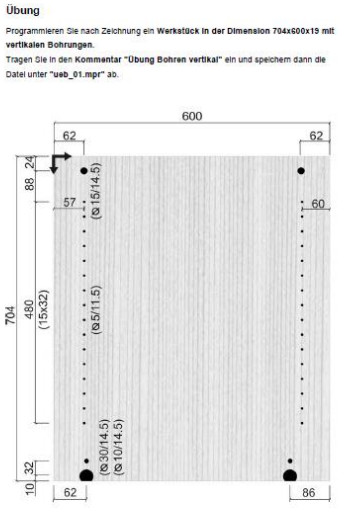


Figure 2: Example worksheet of Stage 2 (obtained from EBG)

Given: Basic Definition, an example to be implemented which is the synthesis of what is given.

Expected: Each student should be able to solve

Stage3: Survey

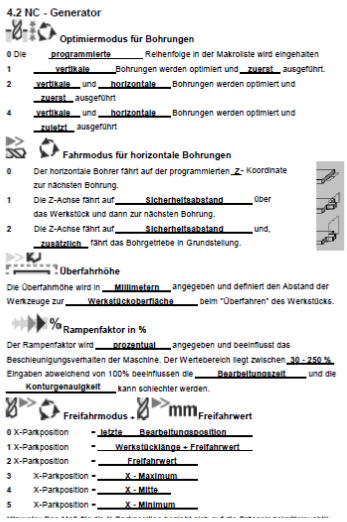
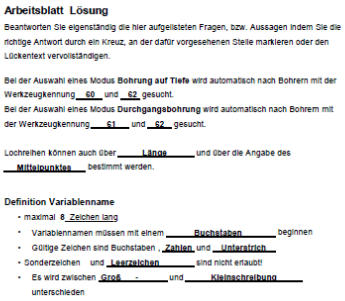


Figure 3: Example worksheet of Stage 3 (obtained from EBG)

Expected: To evaluate students individually

Stage4: Worksheet



Arbeitsblatt Lösung

Beantworten Sie eigenständig die hier aufgelisteten Fragen, bzw. Aussagen indem Sie die richtige Antwort durch ein Kreuz, an der dafür vorgesehenen Stelle markieren oder den Lückentext vervollständigen.

Bei der Auswahl eines Modus **Bohrung auf Tiefe** wird automatisch nach Bohrern mit der Werkzeugkennung **60** und **62** gesucht.
Bei der Auswahl eines Modus **Durchgangsbohrung** wird automatisch nach Bohrern mit der Werkzeugkennung **61** und **62** gesucht.

Lochreihen können auch über **Länge** und über die Angabe des **Mittelpunktes** bestimmt werden.

Definition Variablenname

- maximal 8 Zeichen lang
- Variablennamen müssen mit einem **Buchstaben** beginnen
- Gültige Zeichen sind Buchstaben , **Zahlen** und **Unterstrich**
- Sonderzeichen und **Leerzeichen** sind nicht erlaubt!
- Es wird zwischen **Groß - -** und **Kleinschreibung** unterschieden

Figure 4: Example worksheet of Stage 4 (obtained from EBG)

Expected: To evaluate the level of the class

These four stages should then be analyzed by using the matrices given below:

	COGNITIVE						
KNOWLEDGE		REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
FACTUAL							
CONCEPTUAL							
PROCEDURAL							
METACOGNITIVE							

Accordingly first evaluation was submitted by course instructor Mr.Lorang. The aim of this evaluation is to compare instructor and learners perspectives as well as to analyze objectives and outcomes.

Table 1: Evaluation of the education by Mr.Lorang based on Bloom's Taxonomy(in German)

ZIELE DER AUSBILDUNG	WISSEN	KOGNITIVEN	DENKEN SIE DARAN	VERSTEHEN	GELTEN	ANALYSIEREN	BEWERTEN	ERSTELLEN
1. Tag: Vorstellung der Ausbildungskonzepte. Kurze Ausbildung, bis 5 Tage. Intensive Ausbildung, über ein Semester. Wie viele Achsen an CNC- Maschinen, für welchen Anwendungszweck? Vorstellung der CNC- Maschine der QE&U.	SACHLICHE		X	X	X			
	KONZEPTIONELLE		X	X		X	X	
	PROZEDURALE		X	X		X		X
	METAKOGNITIVE			X		X	X	X
2. Tag: Didaktischer und schulungstechnischer Aufbau der Weiterbildung. Beispiele der Programmierung und deren Umsetzung an der Maschine. Direkte Programmierung in Parametern und Variablen. Bereiche: Möbelbau, Messebau, Türen und Innenausbau (Bauelemente).	SACHLICHE		X	X		X		X
	KONZEPTIONELLE		X	X		X	X	X
	PROZEDURALE			X		X		X
	METAKOGNITIVE		X			X	X	X
3.Tag: Einbindung weiterer Software (CAD-CAM). Kreative Gestaltung von Fräsungen, Gravuren und Dekorplatten. Freiformen und deren Anwendungen. Beispiele an der Maschine, Gravuren und Einlegearbeiten. Fräsen von Mineralwerkstoffen z.B. Corian. Schablonenbau und deren Anwendungen.	SACHLICHE		X			X	X	X
	KONZEPTIONELLE			X		X		X
	PROZEDURALE		X			X	X	
	METAKOGNITIVE				X	X		X
4.Tag: Exkursionen in vier Betriebe. In allen Betrieben werden uns typische CNC- Arbeiten der betrieblichen Ausrichtung gezeigt. Also vom Messebau, über Ladenausbau, zum Privatkunden und zur Sanierung.	SACHLICHE		X	X	X			
	KONZEPTIONELLE		X			X	X	X
	PROZEDURALE		X			X		X
	METAKOGNITIVE					X	X	X
5.Tag: Vorführung der neuesten CNC-Technik beim zentralen Händler in Berlin.	SACHLICHE		X	X	X	X	X	X
	KONZEPTIONELLE		X			X		X
	PROZEDURALE		X			X	X	X
	METAKOGNITIVE							

Table 2: Evaluation of the education by Mr.Lorang based on Bloom's Taxonomy(translated in English)

OBJECTIVES OF EDUCATION	KNOWLEDGE / COGNITIVE	REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
Day 1: Presentation of the training concepts. Short training, to 5 days. Intensive training, over a semester. How many axes CNC machines, for which application? Presentation of the CNC machine of QE & U.	FACTUAL	X	X	X			
	CONCEPTUAL	X	X		X	X	
	PROCEDURAL	X	X		X		X
	METACOGNITIVE		X		X	X	X
Day 2: Educational and Training technical structure of the training. Examples of programming and its implementation on the machine. Direct programming in parameters and variables. Areas: furniture, stand, doors and interior fittings (components).	FACTUAL	X	X		X		X
	CONCEPTUAL	X	X		X	X	X
	PROCEDURAL		X		X		X
	METACOGNITIVE	X			X	X	X
Day 3: integration of additional software (CAD-CAM). Creative design of millings, engravings and decorative panels. Free forms and their applications. Examples on the machine, engraving and inlaying. Milling of solid surface materials, for example, Corian. Template building and their applications.	FACTUAL	X			X	X	X
	CONCEPTUAL		X		X		X
	PROCEDURAL	X			X	X	
	METACOGNITIVE			X	X		X
Day 4: Excursions in four farms. In all companies we work typical CNC are shown operating orientation. So the trade fair construction, overweight expansion, for private clients and for remediation**.**	FACTUAL	X	X	X			
	CONCEPTUAL	X			X	X	X
	PROCEDURAL	X			X		X
	METACOGNITIVE				X	X	X
Day 5: Demonstration of the latest CNC technology at central distributors in Berlin	FACTUAL	X	X	X	X	X	X
	CONCEPTUAL	X			X		X
	PROCEDURAL	X			X	X	X
	METACOGNITIVE						

Table 3 :Evaluation of the education by METU-ProCNC team based on Bloom's Taxonomy

OBJECTIVES OF EDUCATION	KNOWLEDGE	COGNITIVE	REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
Day 1: Presentation of the training concepts. Short training, to 5 days. Intensive training, over a semester. How many axes CNC machines, for which application? Presentation of the CNC machine of QE & U.	FACTUAL		X	X			X	
	CONCEPTUAL		X	X	X			
	PROCEDURAL							
	METACOGNITIVE		X					
Day 2: Educational and Training technical structure of the training. Examples of programming and its implementation on the machine. Direct programming in parameters and variables. Areas: furniture, stand, doors and interior fittings (components).	FACTUAL		X	X	X	X		
	CONCEPTUAL		X	X	X	X		
	PROCEDURAL		X	X	X	X	X	X
	METACOGNITIVE		X	X	X			
Day 3: integration of additional software (CAD-CAM). Creative design of millings, engravings and decorative panels. Free forms and their applications. Examples on the machine, engraving and inlaying. Milling of solid surface materials, for example, Corian. Template building and their applications.	FACTUAL		X	X	X	X	X	X
	CONCEPTUAL		X	X	X	X	X	
	PROCEDURAL		X	X	X	X	X	
	METACOGNITIVE		X	X	X			
Day 4: Excursions in four farms. In all companies we work typical CNC are shown operating orientation. So the trade fair construction, overweight expansion, for private clients and for remediation**.**	FACTUAL							
	CONCEPTUAL							
	PROCEDURAL							
	METACOGNITIVE							
Day 5: Demonstration of the latest CNC technology at central distributors in Berlin	FACTUAL							
	CONCEPTUAL							
	PROCEDURAL							
	METACOGNITIVE							

Comparison of these table and the course outline given in previous pages shows that what instructor aims and how the course is conducted (course content, examples etc.) are coherent but when the table filled by instructor and METU team is compared, learning outcomes in other words how learners benefit from the education has some differences. It is seen that learners felt more comfortable in remembering, understanding and analyzing and they develop a background on factual, conceptual and procedural knowledge. On the other hand, the higher level of learning including evaluation and creation is not fulfilled completely. This result is remarkable since one of the major criticism in educational systems in general is contemporary education can attain only these three levels and the efforts should be attaining all these five levels, as experienced in this short term training. The discrepancy between what is aimed by the training and what is achieved may have different reasons like;

1. Background of learners
    1.1. Age
    1.2. Education
    1.3. Experience
        1.3.1.Type of sector experience
        1.3.2.Experience on CAD/CAM
        1.3.3.Craftsman Skills
2. Duration of the overall training
3. Number of tasks to be solved
4. Duration of on-the-job training by applying what is learnt

Evaluation sheet for participants

At the end of the sample training, Mr. Lorang asked participants to fill a similar evaluation sheet regarding the sample training which are statistically evaluated below. The data obtained from these evaluation sheets shows how the structure and conveying of the courses are successful from the perspective of participants. Details of the evaluation can be found in the Appendix 1. Evaluation Sheet for Participants.

Analysis of Short-Term Training in Italy (C2)

(31 August – 4 September 2015)

Second training trip was organized by Aris to Terni and around in Italy which is one of the hotspots for metal and woodworking industry in Umbria region. This trip is more focused on site visits and to experience how and in which level such technical trainings are transposed to the practice. In the scope of the visit, first a brief on how such technical trainings in formal and informal education is structured was given in Centro di Formazione Professionale di Terni. The remarkable feature of informal technical training in Italy is the aim of not only based on training of professionals who are already in the sector, or who will be in future, but also such trainings are for youngsters who were not able to complete their formal education which is a must in Italy. In this sense, these trainings help such youngsters either to have a profession or after completing these trainings to have a second chance to complete their formal education to continue further.

- the introduction of the center
- aims and objectives of it
- Management and Structure
- Presence of these centers in different regions and the articulation of public education.
- Budgeting (EU)
- Diversity of types of educations.
- The curriculum (There is a suggested curriculum and how this curriculum conveyed is a subject matter of the center. In this organization, the needs of the public and youngsters determine the organization of the content)

Day 1

1. Meeting for training in CFP – Centro di Formazione Professionale di Terni
2. Presentation on training policies and new program guidelines in Umbria
3. Presentation on training system with respect to training concepts, didactic and technical structure of the training

Location: CFP di Terni Strada di Pentima, nr. 4 - 05100 Terni (TR) (A training facility in Terni with regional accreditation)


Day 2

1. Demonstration of training in CFP di Terni

Location: CFP di Terni Strada di Pentima, nr. 4 - 05100 Terni (TR)

2. Visit to laboratories of the CFP Narni at the fortress of Narni

Location: Centro di Formazione Professionale di Narni - Via Flaminia Ternana 37/39

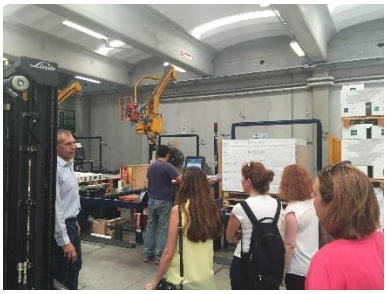
Days 3-5

Excursion to 4 enterprises:

1. Falegnameria Cardarelli S.R.L.; Via del Lavoro, nr. 30/32 - 06044 Castel Ritaldi (PG)

2. Paolini S.N.C. ; S.S. Flaminia km 131-132 (PG) - 06049 Spoleto (PG)
3. Paolini S.P.A. ; Via Flaminia Ternana, nr. 292 - 05035 Narni (TR)

4. Margaritelli S.P.A ; Miralduolo di Torgiano, 06089 Torgiano (PG)


In all of the enterprises, we observed woodworking operations in general and we had discussions on the relations between private sector and woodworking education. We also had the chance to observe how and to what extend CNC machines are utilized in industry.

Evaluation

Within the scope of PRO CNC Project, a team from Turkish partners including METU ProCNC group, and colleagues from IKOOR and OMSIAD paid a visit to Aris in Terni, Italy, from 31 August 2015 to 04 September 2015. The aim of the visit is to understand how CNC education/training in different levels are held in Italy as well as how connection between private sector and education institutions is established.

In this context, members of Aris and CFP (Centro di Formazione Professionale di Terni) gave a presentation on the education system on the first day, followed by a demonstration of training by Stefano Sopranzi from CFP di Terni on the second day. Last three days were reserved for excursions to companies. Hence, even though short course/training demonstration provided was significantly short to make a meaningful and objective evaluation of the whole curriculum, participants had chance to have a general idea about the general structure of the education and to observe the relation and reflections of CNC education and private sector.

Details of Training Institution

The settlement where the course/training had been given is a public educational complex like the settlement in Germany where several other professional training programs are held in various fields. The settlement had facilities such as classrooms and workshops enabling students to implement “class to workshop” approach. However, distinctly from the settlement in Germany, the settlement in Italy, Centro di Formazione Professionale di Terni (CFP), is focused not only on CNC and woodworking education but is a facility providing vocational training in several domains such as beauty schools, cooking, etc. The main target of CFP di Terni is the young adults who failed to complete their education in high school level and the aim is to provide them vocational skills and certificates so that such people can either continue their education in university level or being employed.

CFP is established and financed by European Union and Umbria region. 92% of the budget provided by EU while 8% is provided by Umbria region and the companies in metal-based production sector.

CFP is not only a training center for vocational education of young people but also a place for reintegration of socially problematic students to society. Aims of the facility includes replacing the obsolete skills of the existing employees in addition to training highly qualified new employees to relevant sectors. In this facility, 200 students from 15 years old to 18 years old are trained, moreover some courses for adults are also offered.

Key aspect of the institution is its relation with the regional industrial authorities and enterprises that employ the graduates of the center. This cross-relation ensures the proper interaction between labor market, industry and training center which results in accumulation of the experience on technical knowledge and methodology, optimization of the training programs and skills required for a highly qualified worker. Hence, training guarantees that graduates are qualified to work on the specific field, employers are able to find the required and qualified labor force that they need. This approach also increases the graduates' possibility of finding a job.

Although training center is focused on offering courses for industrial subjects like mechatronics, automotive, thermo hydraulics, photovoltaic systems, welding, computer aided drawing, computer numeric control; some other courses and programs are present for culinary, hairdressing, esthetics and makeup, tourism, e-trade, informatics.

As CFP Terni is a public institution, education is free of charge and all the training documents and materials are provided. According to the statistics shared by Mr. Fabio Narciso and Mr. Massimo Mansueti, 80% of the participants find a job, related to the provided training.

General Findings of Short Term Training in Italy

As the short term training in Italy is more focused on excursion rather than demo training, the general findings from the excursions are combined with the observations in demo training and listed in categories as below:

Observations regarding policy of Italy towards Professional training and relation with private sector

- Italian vocational education training (VET) system is conducted by means of 4 types of institutions/training centers as follows:
    - VET in formal secondary education system (public and private recognized secondary schools institutes) for training at EQF levels 3 and 4;
    - VET in professional training centers accredited by the public authority competent in VET for training at EQF levels 2, 3, 4 and 5;
    - Post-secondary non-academic vocational education institutions for training at EQF levels 5
    - Vocational education at academic level, for training at EQF level 6 and higher.
- Students when they reach the age 16 have to choose either to continue their education regularly or to follow the path for professional qualification.
- It is aimed to educate professionals to serve in the private enterprises in keeping with the needs of industry via continuous feedback. This contact between the institutions and the sectors gains the responsiveness in a very direct way since it is apparent that, as technology is involved more, the industry changes faster than the educational materials.

- Each and every region in Italy regulates its own training programme. The regions are responsible to accredit and monitor the institutions. However, the frame work is defined by central education system by conforming vocational qualifications as defined in ESCO v0.
- It is also stated that all the institutions were public until 2000, public and private agencies have engaged since then to be able to advance the trainings
- The rate of unemployment in Italy is around 30 percent, moreover; the rate is considerably higher among youngsters. One of the major problems regarding employment all across the country is stated as the requalification of the ones who lose their jobs.
- The enterprises must employ their former interns after graduation, otherwise; the companies are enforced to stay out the system and they cannot take advantage of educational support.
- The funding is utilized both for training of the youth and for supporting enterprises in order to create new job.

Observations regarding demo training and general vocational education in Italy according to the trainer's perspective:

- An introduction to the interface, initialization procedure, default resetting, warm up time of the machine is given.
- How to change the tool and set the cutting speed is showed
- A brief information about the precision of the CNC machine
- It is stated that the fixed ambient temperature is important
- How to open the door of the CNC machine and how to fix the workpiece are introduced
- The idea about allowable materials to work with and how to choose them explained.
- It is told what the differences between steel and woodworking might be.
- The audience is warned about possible dangerous situations while working with CNCs.
- Mode of the machine is explained (edit mode / working mode)

According to the trainer:

- The course materials such as handouts, pptx etc. cannot force students to buy stuff, so they deliver everything.
- Both written and oral exams are conducted monthly and regular assignments reinforce the knowledge.
- At the beginning of the education, the trainees are not allowed operate the machines without any supervisor. However, they can work alone after one year of the training.
- The trainees are able to program CNC machines at the end of the education.
- It is asked whether the trainees can read drawings and it is found out that they
- It is possible for trainees to read a CAD drawing after one year of education. This situation is different for adults. They can read the drawing and program the machine with on board keyboard of the CNC.
- The trainees cannot repair the machine but they can understand the problem. They know the basics of the machine.

Analysis of the Content in relation with project objectives:

The demonstration of education is also evaluated with Bloom's taxonomy in order to be coherent with the analysis of training in Germany. However the nature of the visit in Italy is much different than the one in Germany. The brief introduction to the education system in Italy and the demonstration of how the curriculum is conveyed was realized only in one day, therefore assessment of the education by the participants and the project team is not realistic. Although participants complete the evaluation matrix according to their in situ experience, the whole assessment of the education is requested from the trainer (Stefano Sopranzi) who is responsible in teaching CNC operations in the center. He was asked to fill the evaluation matrix by considering full curriculum to have an idea of the education system in Umbria region in full scale. The matrices filled by Stefano Sopranzi and METU Team are shown below:

Table 4: Evaluation of the education by Mr. Sopranzi based on Bloom's Taxonomy

KNOWLEDGE / COGNITIVE	REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
FACTUAL	X	X				
CONCEPTUAL	X	X	X	X		
PROCEDURAL	X	X	X	X	X	X
METACOGNITIVE	X	X	X	X	X	X

Table 5: Evaluation of the demo education by METU-ProCNC team based on Bloom's Taxonomy

KNOWLEDGE / COGNITIVE	REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
FACTUAL	X	X				
CONCEPTUAL	X	X				
PROCEDURAL	X	X	X			
METACOGNITIVE						

Here, it should be noted that Mr. Sopranzi evaluated the matrix for all education system whereas METU ProCNC Team evaluated the same matrix with respect to one-day demo education.

The details of which subjects are given and the respective durations are also shared by Aris and can be accessed from Appendix 2. Even though, the courses and course hours given throughout the three year education does not give direct information about how the courses are conveyed and whether they conform Bloom's taxonomy or not, it explains the discrepancy between the evaluation matrices filled by Mr. Sopranzi and METU-ProcNC Team.

Conclusion

Both of the short term trainings were found to be fruitful enabling project members to have insight of how the curricula for CNC education in EU is formulated, conveyed and structured. Even though weightings of demo training and excursions show major differences between Germany and Italy, participants had chance to observe how and under what conditions adults are educated to have professional skills and how the relation between educational institutions and private sector is constructed.

One of the primary findings is that the structure of the curriculum is similar in Germany, Italy and Turkey as they all have to conform to Esco. The contents of these curricula are also found to be similar which is reasonable as the learning material is dependent on the technology and all three countries are using similar CNC machines and technology. However, it is observed that as the involvement of private sector in the education process in terms of both internship opportunities (like in Italy) and/or conduction of application part of the education (like in Germany) increases the efficiency of the education in general as private sector has chance to reach latest technology faster than formal and informal education through public or private institutions hence content of curricula is adapted more frequently to latest technological developments. In addition, this close contact of private sector and educational institutions provides students job opportunities which is observed with the increase of motivation.

Furthermore, it is noted that the institution visited in Italy (CFP di Terni) is a professional training center accredited by the public authority competent in VET. These institutions have a major task of supporting unemployed youth and to help them to have an occupation and/or give a second chance to complete their formal education, especially for people who have problems in their education life and dropped out in the scope of Youth Guarantee Program of EU Commission. As mentioned in O1 report of the project, youth unemployment is a major issue in both EU and Turkey and motivating and providing job opportunities by training them to acquire necessary skills and competencies is seen as a necessary act to reduce youth unemployment.

Second important finding of these trainings is that the importance of assessment and application steps in general education. Even though the material used in Italy is more text based with respect to the training in Germany, both education systems frequently utilizes assessment (both self-assessment forms and exams, quizzes, etc.) and application steps which enhances metacognitive learning processes.

Thirdly, it is observed EQF levels which CNC operators are trained by each different institutions/ training center type being defined like in Italy education system enable to construct the frame of every institution. Hence, the workload for vocational training is distributed among key actors in a well-defined way. A similar structure shall be constructed in Turkey including every education centers to increase the efficiency of overall education system.

As a result, two short term trainings gave opportunity to validate the findings of O1 and O2 outputs of the project by experiencing first hand. Also, it is concluded that the curriculum to be developed in the scope of this project need to be focused on how the curriculum is conveyed by increasing the weighting application and assessment stages rather the changing the content of the current curriculum.

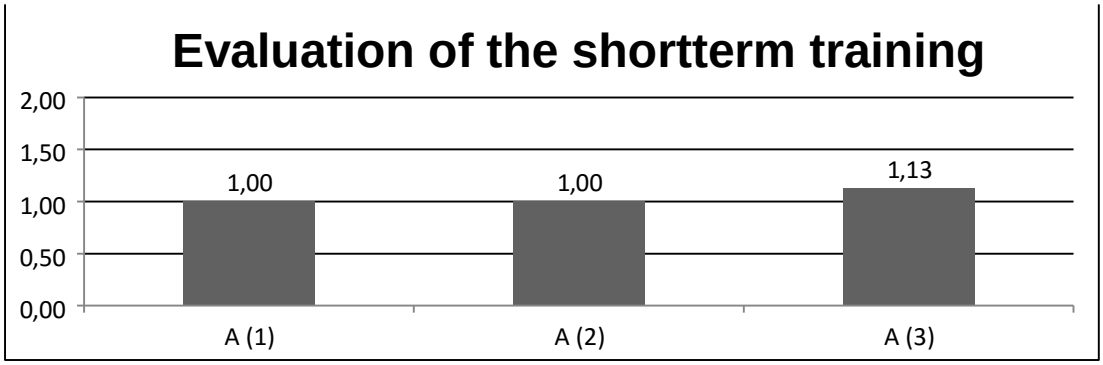
Appendices

Appendix 1. Evaluation Sheet for Participants

(1 excellent, 2 good, 3 sufficiently, 4 unsatisfactorily)

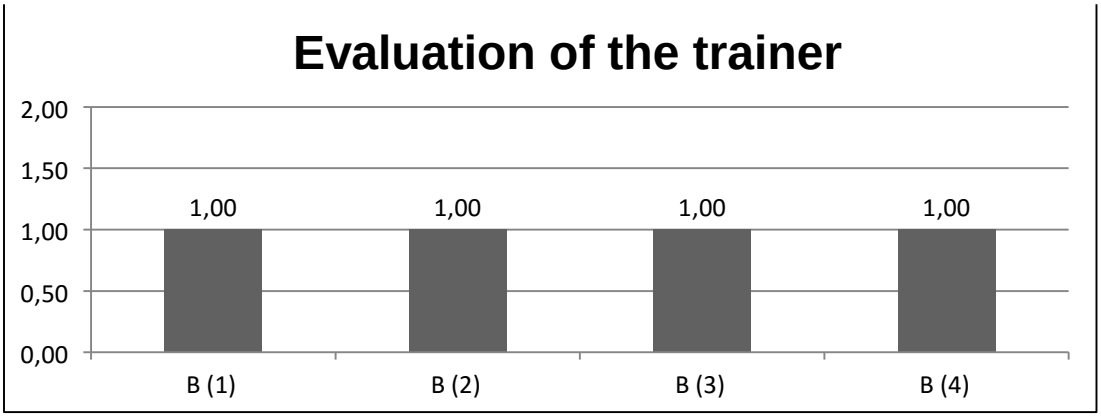
A. How was the training?

1. The topics match to my needs and met my expectations
2. The technical equipment was appropriate (machines PC and tools)
3. The training was very efficient and I gain relevant knowledge and information

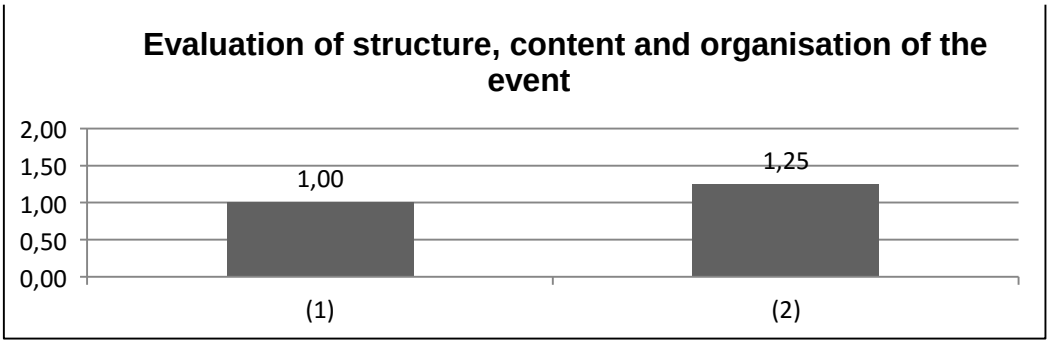


B. How was the performance of the trainer?

1. He has the appropriate subject competence and knowledge as well didactic experience
2. He takes the needs and expectations of participants into account and support them
3. He gives feedback to questions and problems of participants
4. He gives participants the opportunity to build their own expertise

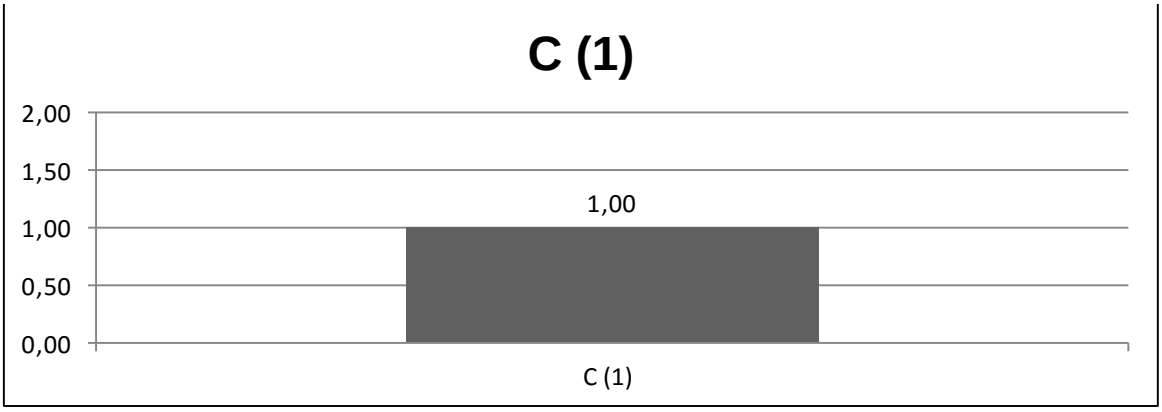


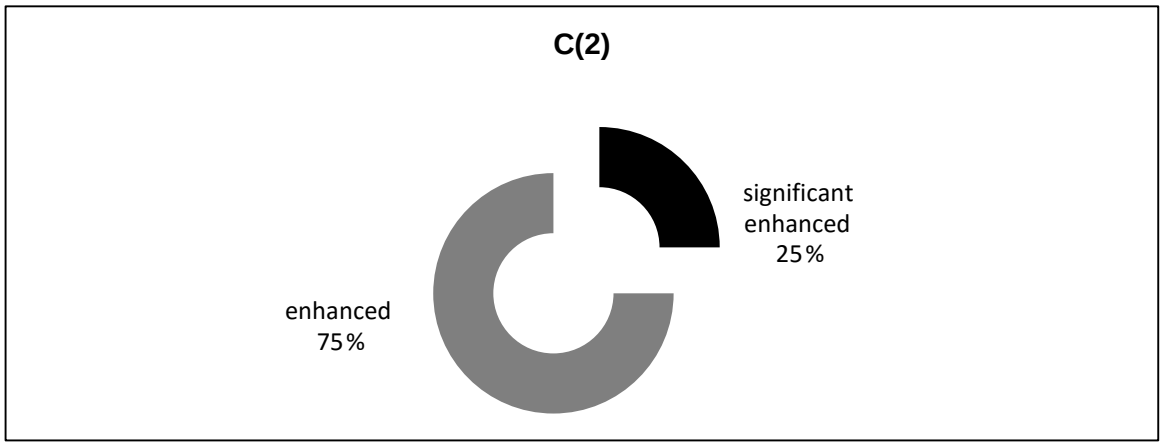
Structure, content and organization of the training



C. *Evaluation of the Design as a whole*

1. Summed up; I give the point …
2. The short term training improved my knowledge concerning CNC technic and training
3. If I would again have to choose a provider for this training I would choose





C (3) all participants would choose this training

Appendix 2. Tables about VET in Italy

Table 6: General Subjects for All Professional Profiles

Subjects	First Year (hrs)	Second Year (hrs)	Third Year (hrs)
Italian Language	145	50	35
English Language	60	25	20
Logical -Mathematical Thinking	120	35	25
Scientific Thought	60	15	10
Informatics	65	25	20
History, Geography, Society	60	20	10
Civic Culture	25	20	5
Economic system and Employment Law	25	10	5
Work World	20	12	12
Personal skills	20	12	12
Duration of General Subjects	600	224	154

Table 7 : Courses for CNC Operators

Subjects	First Year (hrs)	Second Year (hrs)	Third Year (hrs)
Gainful employment in the form employee or self-employed	20	12	12
The professional activity of officer qualified to machine tools	24	12	12
Measurements and tolerances	28	36	36
Interpretation of technical drawings and specific production	-	76	84
Machining with conventional machines and CNC	-	100	122
Preparation of the machines for the working	-	56	76
Machining of adjustment	-	76	96
Group, position, role, climate organization	-	24	24
Care and maintenance of the station job	-	36	36
Safety in workplace	28	32	32
Assessing the quality of a process and production of their work	-	16	16
Duration of CNC Related Courses	100	476	546
Duration in Total	700	700	700