



Design of Curriculum for Woodworking CNC Operators in Turkey

O4 FINAL REPORT

Andragogical Guide for CNC Education

by METU PRO-CNC Team



Erasmus+

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Introduction

Fourth intellectual output of the ProCNC project is the preparation of andragogical guide for CNC education. It is important to identify the profile of people who will take the mentioned education. Information on this profile can be found in the previous output reports of the project. Yet, major questions which are directly influencing the framework of the preparation of CNC education curriculum are revised in the scope of this report. Firstly, the definition curriculum is inspected in consideration with the relation of CNC education and competency/work based learning or in similar words on the job training. Secondly, the role of learning outcomes and objectives are evaluated with respect to Bloom's taxonomy followed by the essentials and key aspects of vocational training.

Considerations in Curriculum Development

Designing a curriculum in any field is a debate for which different viewpoints exist. Nevertheless it is consented that a curriculum is like a master plan to respond the needs of the disciplines and should enable learners/students to cope with future needs. A project conducted under UNESCO defines curriculum as¹

“an educational path and describes the learning process in a much more comprehensive and complex fashion than is possible with Plans of learning content or learning material”

It is difficult to find a single definition of what curriculum is; or whether a curriculum should be learner and learning process oriented, learning content oriented or competency oriented and thus there is ambiguity in the definition. Yet, a curriculum should answer questions like for whom the education is, what learning objectives and outcomes are, what should be the content, what teaching methods are to be employed and how the assessment should be. In that report, various aspects of the curriculum development discussed and some key features as a measure of success of a curriculum is put forward. These are²

“...Whether is able to attract the young generation into the occupation of the future and skills which employers need

Whether is able to deliver not only technical contents (technical skills) but also help students to learn how to cope with new challenges (coping skills) and prepare them for life long learning

Whether is able to provide people with the basic set of skills it takes to transfer from one job or area of work to another, once they have entered the workforce....”

¹ UNESCO International Project on Technical and Vocational Education UNEVOC, ED/93.C, Turin, 1993

² Ibid 26

Curriculum development is a dynamic, on-going issue. Sahlberg states that³

“...curriculum development can no longer be viewed as a project that has a start and an end. In today’s rapidly changing world, the curriculum designed today and implemented in the years to come could still be responsive and relevant in five years conceptually but specific facts may not be so. Curriculum should be viewed as a “living, organic instrument to help teachers and schools to find optimal ways to educate” students”

There are several on-going discussions on, which curriculum development model is optimal and how education should be. In addition, age profile of students determines most of the criteria for how the education should be.

Compression of Pedagogy vs. Andragogy

The following figure is a swift comparison of Pedagogic and Andragogic approaches to teaching and learning.

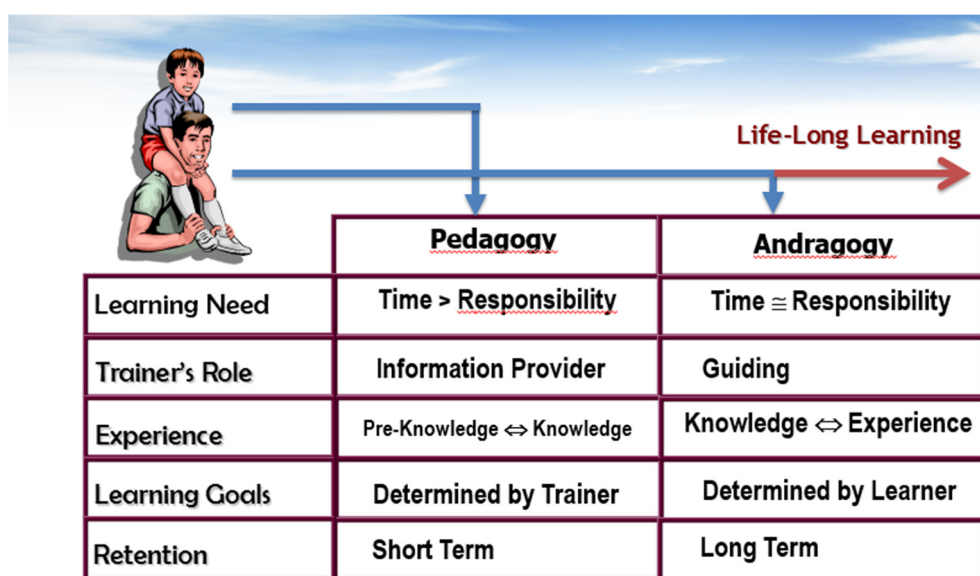


Figure 1. Comparison of Pedagogy and Andragogy

³ Sahlberg, P. (2011). Finnish lessons: What can the world learn from educational change in Finland? New York, NY: Teachers College Press.

- Adults always suffer from lack of time. Therefore the time they can commit for learning is usually short and precious. One of the keys to success in adult training is the efficient use of learning time.
- One of the key principles of adult training is guiding adults to the valid learning sources. Adults always compare new coming with their previous experience. Compared to children's previous experience, adults have a very long and in-depth previous experience.
- In adult training, new content to be taught should be linked with previous experience.
- Adults have high self-concept and self-regulation skills. Thus, learning outcomes of any training session should be determined with the contribution of trainees and these outcomes should be flexible as so can be modified based on the need of the trainees.
- It should be noted that adult training fosters longer retention since most content is associated with learners' previous experience.
- One of the most learning sources for adults is the other's experiences. So, in adult training every trainee must be an active participant and an information source of the learning environment.

Competency Based Education

Recently, competency oriented curriculum and competence based education idea got more noticed due to its flexibility and modular type of structure.

Barman and Konwar in their study considered the need for competency-based curriculum in higher education through a very intensive survey and they pointed out the difference between competency and competence referring Armstrong's definition as *"competency is a person-related concept, competence is a work related concept"*⁴. It is also emphasized in their paper that competence- based education is a way *"to conceptualize the relation between education*

⁴ Barman, A., Konwar, J., (2011) Competency Based Curriculum in Higher Education: A Necessity Grounded by Globalization, Revista Romaneasca pentru Educatie Multidimensionala, Year 3, No. 6, April, pp : 7-15

and the world of work". They argued, *"If specific competencies are not focused in the curriculum design philosophy, the products of the higher education may not be "work-ready" and therefore not readily accepted by the industry."* Competencies can be domain-specific and generic hence identification of competencies is very crucial in developing curriculum. Another important disposition of Barman and Konwar's paper as referred to Kouwenhoven is the characteristic features of competency-based education (CBE)⁵

- *CBE is oriented to the professional practice.*
- *CBE is learner-centred and the learning process is central.*
- *CBE has a constructivist approach.*
- *In CBE the role of the teacher is that of a 'cognitive guide'.*
- *CBE has learning environments focused on the development of competencies.*
- *CBE includes the development of generic competencies.*
- *In CBE assessment focused on competencies.*
- *In CBE curriculum development is based on the elaboration of profiles and identification of competencies*

Competency-based curriculum aims students to acquire specific skills, knowledge and abilities in relation with their discipline and also skills to cope with future necessities of their discipline.

For the success of education not only a properly developed curriculum but also a proper teaching method is required. It is a very common mistake to use term pedagogy, which specifies teaching methods for children. When the higher education is concerned Knowles' term andragogy should be re-considered in developing strategies to teach adults. Knowles proposed first four key assumptions could be summarized as⁶

- Teaching should encourage learners to be self-directed
- Experience of adults is important in learning

⁵ Ibid 29

⁶ Knowles, M. S. The Modern Practice of Adult Education, Englewood Cliffs, NJ: Prentice Hall, 1980.

- Real life tasks or problems ease learning
- Education is a mean to develop increased competences

then these assumptions are extended as

- why there is a need to learn should be known
- self-esteem is important in learning

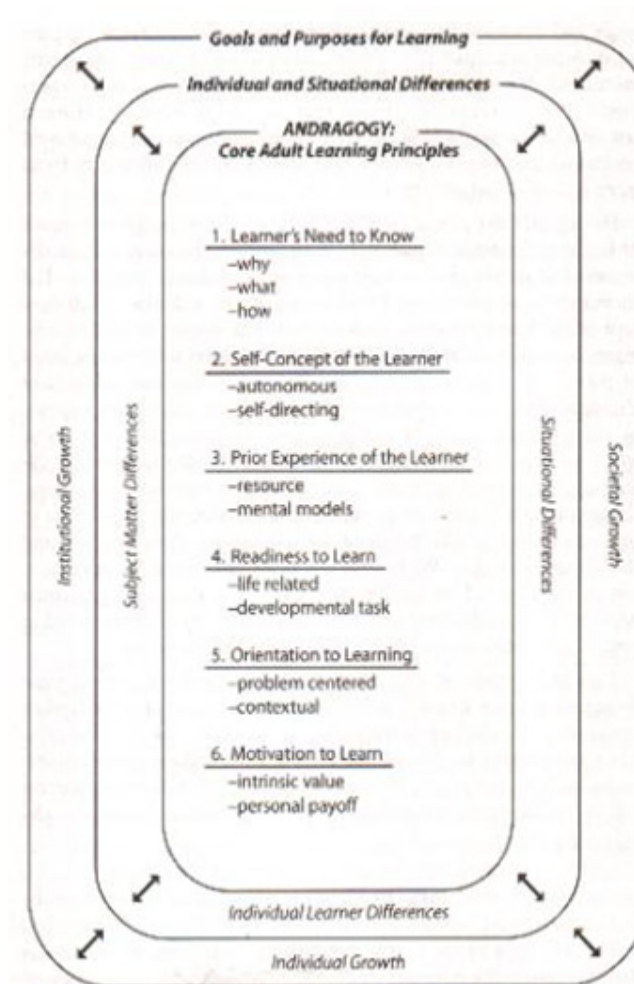


Figure 2. Andragogy in Practice⁷

⁷ Knowles, M.S.; Holton, E.F.; Swanson R.A., The Adult Learner: Definitive Classic in Adult Education and Human Resource Development

Knowles theory of andragogy is a highly debatable theory and there are several studies arguing the applicability of andragogy in education. Yet, since andragogy involves in engaged learning it is worth to re-visit in curriculum development. Ozuah in his manuscript summarized the five major learning theories; behavioral theory, cognitive theory, constructivist theory, humanistic theory and developmental theory; in order to clarify certain features of adult learning⁸. In his commentary, he pointed out the most relevant features of learning theories with adult learning as

"...Each of the learning theories has some application in adult education. For example, humanistic theory lends itself to problem-based learning and self-understanding, whereas behaviorism seems to be more relevant in the teaching of practical, specific skills. Developmental theory has been applied mostly in the areas of professionalism and moral development. Despite apparent discordances among the various learning theories, there are actually several areas of agreement including: the importance of clear goals and objectives; an emphasis on a progression of learning from simple to more complex and abstract; an insistence that the learner be active in the learning process; and an appreciation for the importance of reinforcement and feed- back. The teacher of adults should adapt and apply these theories depending on the specific circumstances and the desired outcomes ..."

Ozuah also summarized when adults learn best⁹

- *When they want or need to learn something*
- *In a non-threatening environment*
- *When their individual learning style needs are met*
- *When their previous experience is valued and utilized*

⁸ Ozuah P., "First There was Pedagogy Then Came Andragogy", Einstein J. Biol. Med. 21:83-87 (2005).

⁹ Ibid 32

- *When there are opportunities for them to have control over the learning process*
- *When there is active cognitive and psychomotor participation in the process*
- *When sufficient time is provided for assimilation of new information*
- *When there is an opportunity to practice and apply what they have learned*
- *When there is a focus on relevant problems and practical applications of concepts*
- *When there is feedback to assess progress towards their goals.*

Another important issue in education is to define and assess the objectives and learning outcomes. Bloom's Taxonomy which was first proposed by Dr. Benjamin Bloom in 1956 is often used as a guide when designing education and learning processes¹⁰. His former students Lorin Anderson, and David Krathwohl revised bloom's Taxonomy in mid-nineties¹¹. The revised form of the taxonomy is more engaged with active thinking and with this revision a cognitive and knowledge matrix is provided.

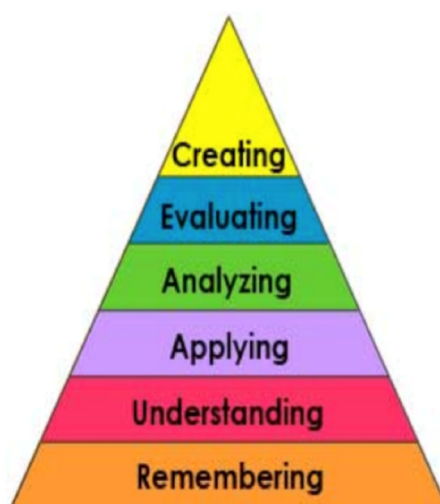


Figure 3. . Revised Bloom's Taxonomy

(<http://oie.blogs.rice.edu/strengthening-our-programs/course-level-learning-outcomes/>)

¹⁰ Bloom, B., Englehart, M. Furst, E., Hill, W., & Krathwohl, D. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain. New York, Toronto: Longmans, Green

¹¹ Anderson, L. W., & Krathwohl, D. (Eds.). (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. New York: Longman

The Revised Taxonomy's key actions can be elaborated by asking proper questions, or encouraging learners to ask these questions to themselves. Some example questions are shown in Figure 3 and Figure 4.

LEVEL 1 - REMEMBERING		LEVEL 2 - UNDERSTANDING		LEVEL 3 - APPLYING	
Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.		Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.		Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	
Key Words	Questions	Key Words	Questions	Key Words	Questions
choose	What is ...?	classify	How would you classify ...?	apply	How would you use ...?
define	Where is ...?	compare	How would you compare ...?	build	What examples can you find to ...?
find	How did ____ happen?	contrast	How would you contrast ...?	choose	How would you solve ____ using what you've learned ...?
how	Why did ...?	demonstrate	State in your own words ...?	construct	How would you organize ____ to show ...?
label	When did ...?	explain	Rephrase the meaning ...?	develop	How would you show your understanding of ...?
list	How would you show ...?	extend	What facts or ideas show ...?	experiment	What approach would you use to ...?
match	Who were the main ...?	illustrate	What is the main idea of ...?	identify	How would you apply what you learned to develop ...?
name	Which one ...?	infer	Which statements support ...?	interview	What other way would you plan to ...?
omit	How is ...?	interpret	Explain what is happening ...?	make use of	What would result if ...?
recall	When did ____ happen?	outline	What is meant ...?	model	Can you make use of the facts to ...?
relate	How would you explain ...?	relate	What can you say about ...?	organize	What elements would you choose to change ...?
select	How would you describe ...?	rephrase	Which is the best answer ...?	plan	What facts would you select to show ...?
show	Can you recall ...?	show	How would you summarize ...?	select	What questions would you ask in an interview with ...?
spell	Can you select ...?	summarize		solve	
tell	Can you list the three ...?	translate		utilize	
what	Who was ...?				
when					
where					
which					
who					
why					

Figure 4. Sample Questions for the Revised Taxonomy
(<http://goldenwestcollege.edu/wpmu/iec/files/2010/04/Questions-Using-Blooms-Taxonomy.pdf>)

LEVEL 4 - ANALYZING		LEVEL 5 - EVALUATING		LEVEL 6 - CREATING	
Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.		Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.		Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.	
Key Words	Questions	Key Words	Questions	Key Words	Questions
analyze assume categorize classify compare conclusion contrast discover dissect distinguish divide examine function inference inspect list motive relationships simplify survey take part in test for theme	What are the parts of ...? How is ___ related to ...? Why do you think ...? What is the theme ...? What motive is there ...? Can you list the parts ...? What inference can you make ...? What conclusions can you draw? How would you classify...? How would you categorize...? Can you identify ...? What evidence can you find ...? What is the relationship ...? Can you distinguish between ...? What is the function of ...? What ideas justify ...?	agree appraise assess award choose compare conclude criteria criticize decide deduct defend determine disprove dispute estimate evaluate explain importance influence interpret judge justify measure opinion perceive prioritize prove rate recommend select support value	Do you agree with the actions...? with the outcome...? What is your opinion of ...? How would you prove/disprove ? Assess the value /importance of? Would it be better if ...? Why did they (the character) choose ...? What would you recommend...? How would you rate the ...? What would you cite to defend the actions ...? How could you determine...? What choices ...? How would you prioritize ...? What judgment can you make ..? Based on what you know, how would you explain ...? What information would you use to support the view...? How would you justify ...? What data was used to make the conclusion...? What was it better that ...? How would you compare the ideas ...? people ...?	adapt build change choose combine compile compose construct create design develop discuss elaborate estimate formulate happen imagine improve invent make up maximize minimize modify original originate plan predict propose solution solve suppose test theory	What changes would you make to solve ...? How would you improve ...? What would happen if ...? Can you elaborate on the reason ...? Can you propose an alternative...? Can you invent ...? How would you adapt ___ to create a different ...? How could you change (modify) the plot (plan) ...? What could be done to minimize/max ..? What way would you design ...? What could be combined to improve (change) ...? Suppose you could__what would you do ...? How would you test ...? Can you formulate a theory for ...? Can you predict the outcome if ...? How would you estimate the results for ...? What facts can you compile ...? Construct a model that would change ...? Think of an original way for the ...?

Figure 5. Sample Questions for the Revised Taxonomy

(<http://goldenwestcollege.edu/wpmu/iec/files/2010/04/Questions-Using-Blooms-Taxonomy.pdf>)

The bottom to top part of the pyramid, thinking skills changes from low to high. The matrix shown in Figure 4., where knowledge and cognitive dimensions are shown, complements this pyramid. Each discipline should fill this matrix with proper actions specific to the subject matter

		COGNITIVE PROCESS DIMENSION					
KNOWLEDGE DIMENSION		Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	Terminology Elements & Components	Label map List names	Interpret paragraph Summarize book	Use math algorithm	Categorize words	Critique article	Create short story
Conceptual Knowledge	Categories Principles Theories	Define levels of cognitive taxonomy	Describe taxonomy in own words	Write objectives using taxonomy	Differentiate levels of cognitive taxonomy	Critique written objectives	Create new classification system
Procedural Knowledge	Specific Skills & Techniques Criteria for Use	List steps in problem solving	Paraphrase problem solving process in own words	Use problem solving process for assigned task	Compare convergent and divergent techniques	Critique appropriateness of techniques used in case analysis	Develop original approach to problem solving
Meta-Cognitive Knowledge	General Knowledge Self Knowledge	List elements of personal learning style	Describe implications of learning style	Develop study skills appropriate to learning style	Compare elements of dimensions in learning style	Critique appropriateness of particular learning style theory to own learning	Create an original learning style theory

Figure 6. A Sample of Matrix Showing Knowledge and Cognitive Dimensions
http://www.principals.org/tabid/3788/default.aspx?topic=Technology_Integration_Will_We_Know_It_When_We_See_It_A_New_Taxonomy)

Both Revised Taxonomy and the Cognitive Process and Knowledge Dimension matrix are useful instruments to develop curriculum and to describe the learning objectives in any level of education. Iowa State University Center for Excellence in Learning and Teaching propose a model for learning objectives and detailed the knowledge dimensions and cognitive process as shown in Figure 5 and Figure 6.

concrete knowledge			abstract knowledge
factual	conceptual	procedural	metacognitive*
knowledge of terminology knowledge of specific details and elements	knowledge of classifications and categories knowledge of principles and generalizations knowledge of theories, models, and structures	knowledge of subject-specific skills and algorithms knowledge of subject-specific techniques and methods knowledge of criteria for determining when to use appropriate procedures	strategic knowledge knowledge about cognitive tasks, including appropriate contextual and conditional knowledge self-knowledge

(Table 1 adapted from Anderson and Krathwohl, 2001, p. 46.)

Figure 7. The Knowledge Dimension

(<http://www.celt.iastate.edu/pdfs-docs/teaching/RevisedBloomsHandout.pdf>)

lower order thinking skills			higher order thinking skills		
remember	understand	apply	analyze	evaluate	create
recognizing • identifying recalling • retrieving	interpreting • clarifying • paraphrasing • representing • translating exemplifying • illustrating • instantiating classifying • categorizing • subsuming summarizing • abstracting • generalizing inferring • concluding • extrapolating • interpolating • predicting comparing • contrasting • mapping • matching explaining • constructing models	executing • carrying out implementing • using	differentiating • discriminating • distinguishing • focusing • selecting organizing • finding coherence • integrating • outlining • parsing • structuring attributing • deconstructing	checking • coordinating • detecting • monitoring • testing critiquing • judging	generating • hypothesizing planning • designing producing • constructing

(Table 2 adapted from Anderson and Krathwohl, 2001, pp. 67–68.)

Figure 8. The Cognitive Process Dimension

(<http://www.celt.iastate.edu/pdfs docs/teaching/RevisedBloomsHandout.pdf>)

This section aims to call attention to curriculum development process for which the role or support of educationalists are essential. It is also intended to highlight that curriculum development is beyond to decide on the content only. It should also be admitted that, educationalists might recommend different curriculum models in fulfilling the goal of the present project.

Vocational training

Education, training and learning

Education requires certain sets of activities, which trigger and alter individual's particular behaviors, which leads to learning. By definition, education is an activity that is initiated to change knowledge, skill and attitudes of individuals and communities, and learning is the process by which the change in knowledge skill and attitudes are occurred (Knowles, III, & Swanson, 2014). However, the concept of education and learning has evolved with regards to the needs. In that regard, training leads as an educational approach for skill development in order to produce expected output. Rothwell¹² explained that training pushes the knowledge, skills and attitudes that are significant to succeed the expected work performance, and it alters behaviors of individuals so that they may improve their work as fast as possible. Thus, it can be considered work related approach in education.

Vocational training constitutes a sub-group of the training, which embraces less academic and more job-oriented approach and mostly given to the adults. The focus and content of vocational training make the application to set in different course in comparison to common trainings. Here, the main group of interest is the adult learners, and the training approaches should be developed accordingly.

The concept of adult learners

In the literature, there are number of studies focusing on adult training and education. In the very basics, it is known that different types of learning require different types of instruction¹³. In that regard, Gagne's five major categories of learning provide an overview of different learning types, which are verbal information, intellectual skills, cognitive strategies, motor skills and attitudes. In addition to that, learning design (formal, informal and incidental learning), taxonomies of learning and theories of learning are important in terms of determining training strategies¹⁴. As in other learning processes, adult learning is affected by

¹² Rothwell, W. (2008). *Adult learning basics*. Virginia: ASTD Press. Retrieved from <https://www.google.com/books?hl=en&lr=&id=AOuigkauF9kC&oi=fnd&pg=PR1&dq=adult+learning+basics+rothwell&ots=DuyAX3p7lv&sig=j1h60ygeP3Mh8czx8r5W5F5nwlk>

¹³ Ibid.

¹⁴ Gagne, R. (1985). *The conditions of learning* (4th ed.). NY: Holt, Rinehart and Winston. Retrieved from <http://psycnet.apa.org/psycinfo/1970-19966-000>

motivational differences (such as, social networks, helping others and career expectations), intelligence types (such as verbal, musical, logical or interpersonal), age related hearing, seeing, memory and learning differences and chemistry and psychology differences¹⁵. It should be also noted here that generation differences, and so, differences in expectations and cultural differences are also important factors effecting learning. Similarly, Knowles et. al.¹⁶ outlined the key assumptions about adult learners. These are as the followings:

1. Adults are motivated to learn by need and interests that learning will satisfy
2. Adults' orientation to learning is life-centered
3. Experience is the richest source for adults' learning
4. Adults have a deep need to be self-directing
5. Individual differences among people increase with age

Similar to Gagne and Rothwell's statements, the key assumptions of Knowles about adult learners provided that focusing on motivation, experience, self-direction and life-centered approaches would be effective in training adults. As in others, vocational training can be assessed by the same assumptions, and here, the motivation to learn stands out as the one of the most prominent factors. The motivation can depend on various elements¹⁷:

1. Success – adults want to be successful learners
2. Volition – adults want to feel a sense of choice in their learning
3. Value – adults want to learn something they value
4. Enjoyment – adults want to experience the learning as pleasurable

On the other side, experience and life-centered learning can be nurtured with repetition and imitation of common tasks, especially in vocational training due to its job-oriented nature. Gage and Berliner¹⁸ stated that learning through imitation is appropriate for the tasks, which

¹⁵ Rothwell, W. (2008). *Adult learning basics*. Virginia: ASTD Press. Retrieved from <https://www.google.com/books?hl=en&lr=&id=AOuigkauF9kC&oi=fnd&pg=PR1&dq=adult+learning+basics+rothwell&ots=DuyAX3p7lv&sig=j1h60ygeP3Mh8czx8r5W5F5nwlk>

¹⁶ Knowles, M., III, E. H., & Swanson, R. (2014). *The adult learner: The definitive classic in adult education and human resource development*. Routledge. Retrieved from https://www.google.com/books?hl=en&lr=&id=1We2BQAAQBAJ&oi=fnd&pg=PP1&dq=The+adult+learner,+Knowles+definitive&ots=C7HY_tNtmS&sig=dzVZsA_Wv3RDdScNsh6mJxTrgqc

¹⁷ Wlodkowski, R. J. (1993). *Enhancing Adult Motivation to Learn*. Proquest/Csa Journal Division. Retrieved from <https://books.google.com/books?id=PKN6AAAACAAJ&pgis=1>

¹⁸ Gage, N. L., & Berliner, D. C. (1998). *Educational Psychology*. Houston: Houghton Mifflin. Retrieved from https://books.google.com.tr/books/about/Educational_Psychology.html?id=iYVpAAAAMAAJ&pgis=1

have little cognitive structure. In this matter, motivation and experience can be categorized as prior concerns in vocational training process.

Developing the vocational training

As stated in the previous paragraphs, education and training may require different approaches regarding to the learner and the content. The literature provided number of categories in learning. In that regard, there are three kinds of learning (natural/formal/personal), three aspects of aspect of learning (reason/emotion/action) and three domains of learning (technical /social/ developmental). In addition to that, there is the learning cycle (Kolb's), which has four distinct learning styles that is shaped according to the content¹⁹:

1. Concrete experience
2. Observations and reflection
3. Formation of abstract concepts and generalizations
4. Testing implications of new concepts in new situations

Considering vocational training needs, it can be concluded that a formal, action-based technical learning skills may required with testing implications of new concepts. In this context, Levinson's life task development model suggest that for the age group of 17 and 22 (as in CNC training program), developmental period is at the early adult transition and the task could be to explore possibilities and make tentative commitments²⁰. In other words, the model suggests that vocational training for early adult transition can be more of an exploratory stage.

Basics of vocational training methods

In the literature, the training methods may vary by the content and requirements of the job. However, the basics of instructional system design (ISD) can be employed to develop the overall framework of the training. The ISD provides a set of tasks or processes including analysis (performance assessment), design (task analysis, defining outline and learning objectives), development of instructional materials, piloting and revision, implementation and evaluation. In this context, content performance matrix can be suggested as instructional

¹⁹ Knowles, M., III, E. H., & Swanson, R. (2014). The adult learner: The definitive classic in adult education and human resource development. Routledge. Retrieved from https://www.google.com/books?hl=en&lr=&id=1We2BQAAQBAJ&oi=fnd&pg=PP1&dq=The+adult+learner,+Knowles+definitive&ots=C7HY_tNtmS&sig=dzVZsA_Wv3RDdScNsh6mJxTrgqc

²⁰ Levinson, D. (1986). A conception of adult development. American Psychologist. Retrieved from <http://psycnet.apa.org/journals/amp/41/1/3/>

design material, which provides ability to assess the training in two different levels: remember level and application level. ISD for Vocational training can be beneficial to test and retest training methods for effective approaches at state of application level.

In addition to that, vocational training needs a technical design to provide an effective approach for the training program. Wakefield²¹ outlined characteristics of technical training as the following, and expected one or more characteristics presented in the training:

- A distinct vocabulary is used.
- Existing information and resources are scarce or solely experience based. f It takes years to learn the intricacies of the topic.
- Available information is often proprietary.
- The product in question is in a state of development.
- Because it deals with complex and complicated topics, the technical training takes longer to develop.

Approaches and materials

As well as the methods, different approaches and materials are available for technical training and learning process. Rothwell (Rothwell, 2008) suggested a schematic approach for workplace learning process and its application as given in the Figure. The author outlines the needs in workplace learning and indications of training, which can be also adapted in vocational training.

²¹ Wakefield, S. (2011). Technical Training Basics. Virginia: American Society for Training and Development. Retrieved from https://books.google.com.tr/books/about/Technical_Training_Basics.html?id=6TC8WSBLEUKC&pgis=1

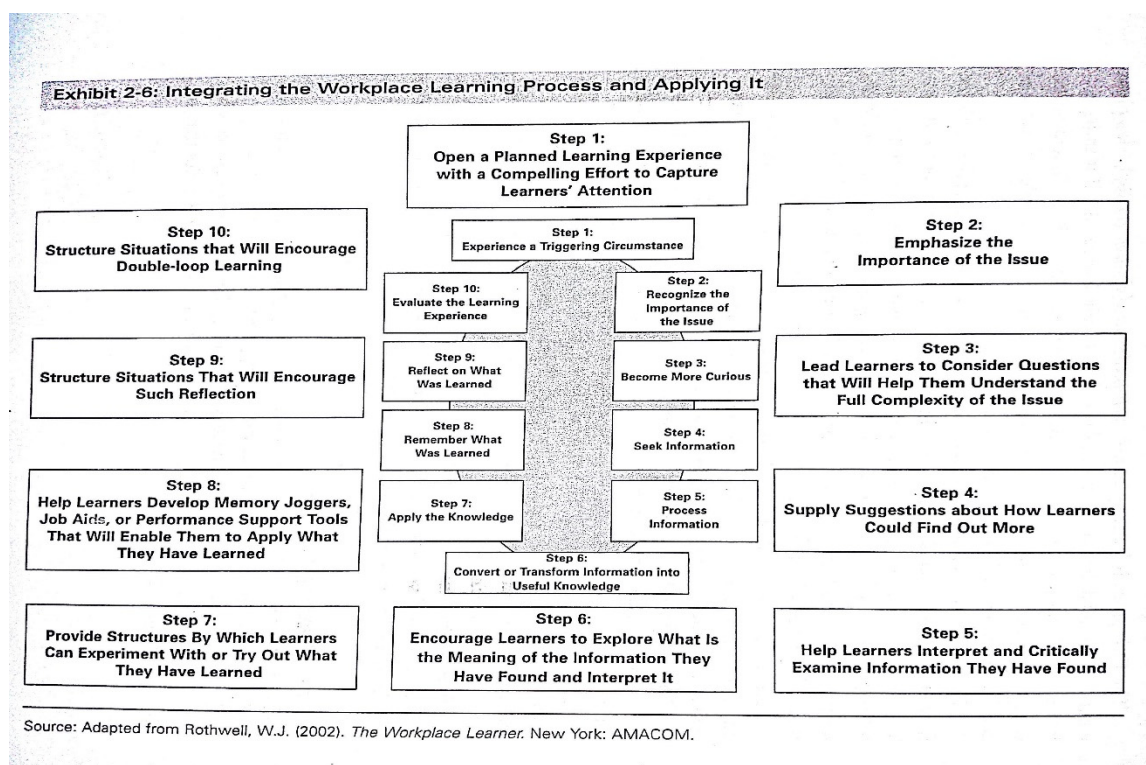


Figure 9. Integrating the Workplace Learning Process and Applying It

In vocational training, procedures, processes and contents were more likely to be taught instead of concepts. Thus, the following points provided by Clark (Clark, 2011) about training approaches based on the contents would be helpful.

- Teaching “procedures” requires (1) a clear statement (directive), (2) a demonstration and (3) hands on practice with explanatory feedback.
- Teaching facts (such as concrete objects, unique data and associations in statements) are based on memory. Facts can only be memorized and thus remember-level objectives are possible. Here use of diagrams and tables for factual data are suggested.
- Teaching processes are unlike procedures, they are descriptive. Using tables or flow diagrams are suggested. The process can have a remember or application level objectives.

In that regard, Clark²² also suggested a number of training contents. These can be listed as: Applying zoom principle (zoom-out parts of processes in the illustrations), spiral principle

²² Clark, R. (2011). *Developing technical training: A structured approach for developing classroom and computer-based instructional materials*. John Wiley & Sons. Retrieved from https://www.google.com/books?hl=en&lr=&id=Ji_zLZJarzYC&oi=fnd&pg=PR11&dq=Developing+technical+training,+clark&ots=vnzWech3RR&sig=BVNc5ZxoE4_z4pX-pvpUtdNQbR4

(building up skills from basics to advance), job centered sequences (group knowledge according to how they used in the job), problem based learning (solving cases from simple to advance).

On the job training²³

On the Job Training (OJT) stands as a variation of vocational training, and it can be handled in more of a professional environment. On-the-job training is training that takes place while employees are actually working. It means that skills can be gained while trainees are carrying out their jobs. This benefits both employees and the business. Employees learn in the real work environment and gain experience dealing with the tasks and challenges that they will meet during a normal working day. The business benefits by ensuring that the training is specific to the job. It also does not have to meet the additional costs of providing off-the-job training or losing working time.

There are several methods of providing on-the-job training. Four frequently used methods are briefly described here:

- Coaching – an experienced member of staff will help trainees learn skills and processes through providing instructions or demonstrations (or both).
- Mentoring – each trainee is allocated to an established member of staff who acts as a guide and helper. A mentor usually offers more personal support than a coach, although the terms 'mentor' and 'coach' are often used interchangeably.
- Job rotation – this is where members of staff rotate roles or tasks so that they gain experience of a full range of jobs.
- 'Sitting next to Nellie' – this describes the process of working alongside a colleague to observe and learn the skills needed for a particular process. This can be a faster and more useful way of learning a job role than studying a written manual. The colleague is always on hand to answer any questions or deal with any unexpected problems.

²³ <http://businesscasestudies.co.uk/aldi/business-expansion-through-training-and-development/on-the-job-training.html>

Conclusion

This phase of the Project is focused on “what a curriculum is” and “how the vocational training should be” in order to provide a concrete base and clear understanding of the curriculum to be proposed in the last phase of the present study. Based on the concepts, competency and competence, and what they connote in the realm of curriculum preparation is discussed. In relation with this discussion competency based curriculum aiming at specific skills, knowledge and abilities as well as skills to cope with future necessities of the discipline of interest is the prominent approach for formal and informal training of wood-working operators. As it is defined clearly curriculum is not equivalent to content development; curriculum is the roadmap of the education/training for whom that education is to be designed, what teaching method should be used and how the learning activities should be assessed and how the content should be conveyed to the learners. In this context, andragogical principles defining the principles of adult learning and related principles of curriculum development are highlighted. When the adults are considered (16 years old and above), education should encourage self-learning and enable learners to gain meta-cognition in order to cope with life-long learning process.

Learning is a controlled activity and thus assessment plays an important role in reaching the objectives. Revised Bloom’s Taxonomy which is widely accepted assessment method among teachers, also can be used as concrete guidelines in curriculum development as a whole or development of any related module as well as determining the learning objectives and outcomes. Knowledge dimension and cognitive process dimension and related subjects are summarized in Figure 2 to Figure 7 as a part of this assessment process are to be employed in developing/revising the curriculum. The curriculum development procedure is also discussed in the realm of vocational training and the essential features of VET are provided aiming to broaden up the considerations regarding formal and informal training.

In concluding the present report, as it is discussed deeply in the previous outputs of the project, when the curriculum for CNC operators are concerned only content-wise both in EU and in Turkey, they are very similar. Contents are in close relation with EQAVET, ECVET and MYK but how the curriculum should be conveyed, assessed, and structured show variations. The findings presented in this report are to be employed as the framework in the output 5.

Appendices

Appendix 1:
Main Principles Of Layout Design For
Education And Presentation Documents

CHAPTER TITLE

MAIN TITLE

TITLE

- Maximum 8-9 points should be written on a page. Sentences should not be longer than 2-3 lines at once.
- Rather than a literary language, the text should be written preferably in bullets, in a readable and easily catchable simple way; containing keywords.
- The *keywords* or important parts should be written in bold character or in another color.
- For a better legibility, especially in long texts or paragraphs, typefaces with serif should be preferred over the sans serif ones:

A large, dark brown serif capital letter 'E' with a classic, slightly flared design.

Serif

A large, dark brown sans-serif capital letter 'E' with a clean, modern, and straight design.

Sans Serif

MAIN TITLE

TITLE

- The choice of typeface should continue in consistency in the entire document. Different forms of a same typeface family could be used (ex: times new roman in **bold**, regular and *italic* forms)
- To achieve memorability, a unity and accordance in use of color should be well considered. For the background, sharp and neon colors that usually disturbs the eye -such as yellow and red- should be avoided.
- Softer colors like white, light grey is better for use to keep the attention on the content and not on the background. Use of color gives better results when used in texts or caution marks.
- Titles should be bigger and in a different color than the main text.

TITLE

- Negative space (blank space) (approx. 20% of a page) should be spared.
- The content (text, image etc.) should not be very close to the ends, margins should be around 1-2 cm at least. Images only could expand until the edges.
- To make following up easier, texts and images should be –as much as they can– aligned in reference to each other:

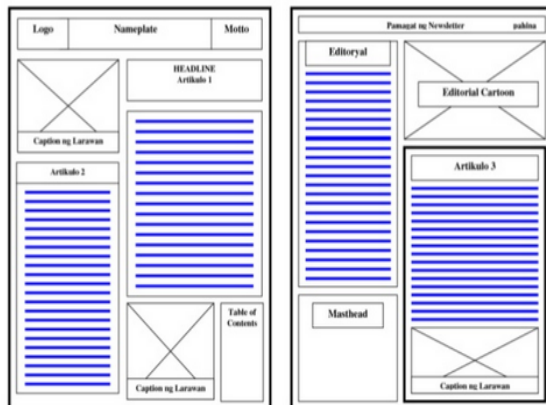
- Chapter titles, main titles and titles should be arranged in a way to be differed; but in unity at the same time.

Example:

Chapter title: Times New Roman-navy-24 pt

Main title: Times New Roman-blue-22 pt

Title: Times New Roman-grey-18 pt



- Chapter titles, main titles and titles should be arranged in a way to be differed; but in unity at the same time.

Example:

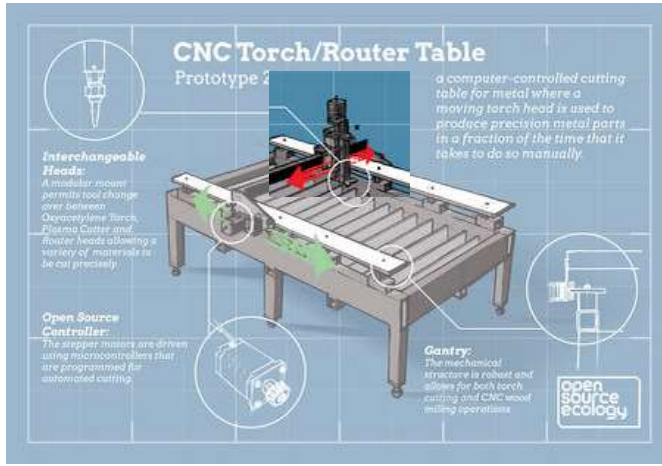


Chapter title: Times New Roman-navy-24 pt

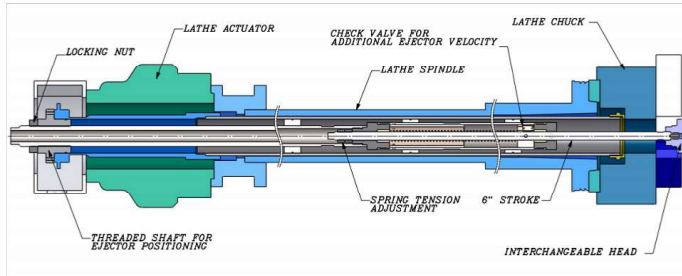
Main title: Times New Roman-
blue-22 pt

Title: Times New Roman-
grey-18 pt

Fener Mili



CNC frezelerde kesicinin dönme hareketini sağlayan parçasına fener mili denir.



Fener mili üzerinde; hareket iletim sistemleri, soğutucu üniteleri ve elektrik motoru bulunur. Tezgâh fener mili çok önemli tasarım özelliği taşır

Nasıl Çalışır:

Tezgâh millerine hareket veren motorlar AC (alternatif akım) ve DC (doğru akım) şeklinde tahrik edilir. Günümüzdeki tezgâhların çoğunda DC motorlar kullanılmaktadır. Bunun nedeni devir kontrolünün voltaj girişinin değiştirilerek ayarlanabilmesi ve sabit bir kesme hızı sağlanabilmesidir.



Yapılması gerekenler:

1. fener mili çok iyi yataklanmalı
2. titreşimi absorbe edecek (kaybedecek) özellikte dizayn edilip montajı yapılmalıdır



<http://www.phase3cnc.co.uk/spindle-care/>



Yeterli olmayan destek yalnızca boyutsal hatalara değil, aynı zamanda kötü yüzey kalitesi ve titreşimlere neden olur



Fener milinin eğilme ve burulmaya karşı dayanıklı olması ve eksen boyunca etki eden tüm eksenel kuvvetlere dayanacak sağlamlıkta olması gerekir