LEARNING LEVELS IN TECHNICAL DRAWING EDUCATION: PROPOSAL FOR AN ASSESSMENT GRID BASED ON THE EUROPEAN QUALIFICATIONS FRAMEWORK (EQF)

Riccardo Metraglia[1], Gabriele Baronio[1] and Valerio Villa[1]
(1) University of Brescia, IT

ABSTRACT
For several years the European Commission for Education and Training has been trying to build a translation device to make comparable national qualifications, aiming to promote workers and learners' mobility within EU and to facilitate their lifelong learning.
A basis to achieve this goal is to use common assessment grids to certify skills and abilities. The abilities in Technical Drawing seen as a working tool and as a language of communication, despite the existence of a certification, the ECDL CAD, for the ability to use the computer to draw, are not assessed. This paper highlights the consequences of the lack of skills certification in Technical Drawing, with particular reference to the authors' experiences in corporate and academic contexts.
Then, the paper introduces a proposal for an assessment grid for the evaluation of Technical Drawing learning levels, based on the European Qualifications Framework (EQF), with separate learning outcomes for knowledge, skills and competences. Finally, it's shown an example of Europass Certificate Supplement, with reference to the proposed grid, to certify the learning outcomes of a Technical Drawing course taught in our Faculty.

Keywords: Technical drawing, certification, lifelong learning, evaluation grid, European Qualifications Framework

1 INTRODUCTION

1.1 An overview of the situation about recognition of qualifications across the EU
One of the most important goals of the European Commission for Education and Training is the promotion of mobility and lifelong learning instruments to help make qualifications, experiences and skills better appreciated and easier to recognize throughout the European Union. The aim is to give greater access to learning or employment opportunities in different countries and encourage greater mobility for individuals, business and other organizations [1]. This goal is very hard to achieve, especially for three reasons. The first is that in Europe there is a wide variety of qualification levels and different education and training systems. The second is that in the same country, such as in Italy, there isn't often a straight connection between formal education certificates and taught skills or abilities, because education programs are different from university to university, sometimes slightly, sometimes markedly. The third reason is that, near the validation of formal education, attention must be paid also on non-formal and informal learning (and the European Commission is also working on this), and on an integration between them [2]. This complex scenario has brought European Commission to create several instruments, such as guidelines policy documents and shared assessment grids (they are currently more than eight) to get translation devices for employers and individuals to better understand qualifications from different EU countries, thus making it easier to work, study or hire staff abroad.
Moreover, the market, apart from formal education awards, requires profiles with certificated skills and abilities in specific areas of knowledge, free from "macro-certifications" covering a wide variety of competences, as degrees or diplomas. In this regard, two important lifelong learning goals are to be mentioned. The first goal is the validation of non-formal or informal learning and, later, its recognition in educational curriculums [1]. In a large number of universities where students have to pass a foreign language test, this already happens: students possessing a recognized certificate with a level equal or

higher than the one required are considered passed without attempting the test. The second goal is, vice versa, the validation and certification of specific area competences acquired by formal education, apart from the "general" degree. In analogy with the previous example, passing a foreign language test in a university gives the student a certification about a specific area of his knowledge with a shared assessment grid (e.g. Europass Language Assessment Grid), separate from formal education diploma.
There are many instruments created by the European Commission for Education and Training to make skills and qualifications clearly and easily understood in Europe. The most used are Europass Curriculum Vitae (CV) and Europass Language Passport. This is probably due to the presence of a standard model for the CV and a shared simple assessment grid for Language Passport, making easy for people to refer to. There are other Europass instruments, not so disseminated as the previous two. The most interesting is the Europass Certificate Supplement [3], built to be a passport for the validation of education and training certificates among Europe. Why this important instrument is not so disseminated? Probably due to the lack of shared simple assessment grids to refer to.

1.2 What about Technical Drawing?

In Italy, as in Europe, there isn't an evaluation grid to refer to in order to validate a Technical Drawing learning level certification, neither in formal education nor in informal training. The variety of curriculums, ways of teaching and learning "on the job" makes hard to define a person's technical drawing skills. All of us know each person's skills are different one from another because of education and experience, but a certification system about skills and competences easy to understand and to use by universities, companies both in national and international contexts must be developed. The lack of it, in fact, is at the root of many problems both in corporate and academic contexts the paper will discuss.
The best solution for a shared recognized certification is probably the Europass Certificate Supplement – adapted for our field – that is a kind of certification already officially approved. As said before, to use this tool in an effective way, we have to build a shared simple assessment grid everybody can refer to. In our opinion, a starting point to do this is the European Qualifications Framework (EQF) [4], that is the main instrument European Commission aims to use for mobility and lifelong learning.
This paper starts speaking about the main problems connected with the lack of Technical Drawing abilities and skills certifications both in corporate and in academic contexts. Then, it's shown a proposal for an assessment grid based on the European Qualifications Framework (EQF). Finally, with the description of the advantages this assessment grid would take, it's shown an example of Europass Certificate Supplement for a course taught in University of Brescia, referring to the proposed grid.

2 MAIN PROBLEMS RELATED TO THE LACK OF A TECHNICAL DRAWING EVALUATION GRID

2.1 Problems in corporate contexts

A clear organization chart, with clearly defined roles, tasks and competences, is very important for every modern corporation. This, moreover, is also required by ISO 9001:2000 quality certification [5] and recommended by EFQM (European Foundation for Quality Management) model [6].
In design and manufacturing companies (operating in Italy and in Europe), each company profile has to be related with specific technical drawing competences, differing from one role to another (sometimes differing a lot). Let's compare, for examples, skills and competencies of a technical commercial, a quality control officer and a technical office drawer (not a designer).
The technical commercial has to be able to read a drawing coming from technical office, and to understand it correctly to keep up with proposing and supporting an offer at a customer site or speaking with a supplier. So, his task isn't to realize the drawing, but to use it as a tool for communication. Similarly, the quality control officer has to be able to read a drawing and to understand the related information useful to perform his tasks (dimensions and profiles shape control, tolerance intervals check, …), with no regard to the rationale supporting the drawing. On the other hand, the technical office drawer must be able to develop the drawing, with full details, respecting standard regulations and understandable by other people like the previous two. Of course such skills are different also in relation with positions in organization charts: a technical office manager, or a product line manager, has to possess more competences than the details drawer or the technician whose task is to write user guides and maintenance manuals.

When a corporation wants to achieve an ISO 9001:2000 quality certification, in the organization chart it usually marks as “competences and tasks” the ones of the people currently working in the corporation in the related roles. This isn’t the best solution: because of the lack of instruments certificating the competences required for a role, the adopted solution is to “abstract” the competences from the present people (what competences? Are they all useful for that role? Do they miss something?). So, if the corporation wants to hire a person for a role, how can it understand if he or she possesses the right competences? There are currently three methods. The first is to trust in people’s education certification. The second method is to trust in a self certification about their competences in their Curriculum Vitae. The third method is to verify candidates’ abilities by a job interview.
The problem connected with the first method is that a formal education certificate is often matched with a different kind of skills and abilities, and, as we said before, this kind of certificate doesn’t define specific areas of knowledge. The second method is a risky solution: a self certification may not be a fair evaluation. The third method is an expensive solution, especially if the required competences are particular and there are many candidates to assess.
Problems don’t only concern staff input, but also the ones present in the company. Let’s suppose - it’s usual -, the corporation has to move some people among its subsidiaries or at a customer site to realize some projects. Let’s also suppose the corporation has to replace a human resource for a short-term, or it needs to add a resource with specific skills to a teamwork. How is it possible to make a quick and specific choice without an objective evaluation system? The adopted methods are similar to the previously described ones. One method is to trust in people’s self-assessment. One other is to ask their chief an opinion. A third method is to make an assessment of their projects portfolio and the other candidates’ ones. All these solutions usually involve risks and a waste of resources, even if the people are in good faith.
There is a last problem: staff training. Let’s define three of the goals of internal training, easy to find in many companies:

- To design a path for internal training;
- To define a start and a finish point in training courses to optimize the invested time;
- To choose internal candidates for training courses.

The lack of a tool to define the current level of staff skills doesn’t help to manage training programs in relation with people’s different levels of knowledge. Without a reference to a grid or a similar system, also the evaluation of the training course usefulness becomes difficult. Moreover, the start and end points of a proposed training course could not match with the technical features of learning people, were their initial knowledge assessment not reliable.
As a consequence, the simple lack of a shared common assessment grid doesn’t imply just the inability to understand what are people’s competences in Italy and in Europe, but it also concretely implies very important costs for corporations.

2.2 Problems in academic contexts

As said before, there isn’t usually a straight connection between the formal education certificates and the acquired skills. This is quite common in Italy. Management Engineering degree, for example, in Italy is placed in some universities under the “industrial area” cover, with many courses about technical drawing and engineering design, while in other universities under the “civil area” or “informatics area” or “logistic area” covers, where technical drawing and engineering design are little or none treated. Moreover, among faculties of engineering quite similar, there are exams with the same name but different programs and same program exams with different names, or partially similar, or overbalanced to the teaching of a computer aided design software or to technical drawing made by hand. Sometimes same exams have different names just for bureaucratic reasons. It also happens that same name and program exams have different final tests due to the skills they want to check – e.g. checking the ability to realize a drawing concerning all what is taught in the exam or just the ability to read and understand drawings, with less competence in realizing autonomously a drawing. Also the number of students is a defining variable: with a little number of students it’s better to make practical exercises by using 3D CAD software, while managing a large number of students usually takes the professors to teach the traditional technique “by hand”, so with pencils, rulers, compasses and so on. So it’s possible each year, in relation with the number, students passing the exam possess different skills.

One of the main effects of the lack of a competences certification in academic context is the difficulty in the reciprocal recognition of students' skills among the various universities, as we saw before.
That problem appears also in students moving around Europe with ERASMUS program [7]. They usually can't find a simple continuation of their original studies, and they have to adapt a lot their curriculums.
Another problem, in analogy with corporate contexts, is to identify people's start learning level. For students coming from high schools, for example, technical drawing knowledge levels differs a lot from a school to another. The possibility to evaluate the beginning grade of students, is a must to improve a technical drawing course design. Moreover, the same system could be used to let them do a self-evaluation of their skills on a grid or a scale. Were it possible to identify the various preparation levels of the students, it would be easier to design useful technical drawing courses, for instance dividing the classroom into sections related to the level of preparation. In the end, it's hard for students acquiring important skills and competences in Tech Drawing in formal education to make them easy to be comprehended by people outside the course or the university, without a reference evaluation grid. Vice versa, a person acquiring skills and competences in Tech Drawing outside the university by an informal training course, has many difficulties to "convert" his preparation in university credits. The recognition by a university of competences acquired outside by informal learning happens just sometimes, and with not always consistent results.

2.3 Problems related with the inconsistency with other European skills evaluation's instruments

In addition to problems in corporate and academic contexts, some benchmarks must be done about Tech Drawing's role in European Commissions' consideration. It's important, because a well shared and recognized skills certification in Europe, beyond the most one, ECDL (European Computer Driving License) – now ICDL (International), is ECDL CAD (Computer Aided Design), lately become "module 8" of ECDL [8], relating to skills and abilities about informatics tool 2D CAD's use. So, the ability in using the computer tool is already awarded. However, attention has not yet been paid to the fact that knowledge, skills and competences in Tech Drawing don't coincide with informatics tool CAD use abilities. Tech Drawing, instead, should be considered more as a language, where you have to know words' meaning and pronunciation (so, to know drawing rules and regulations), to be able to make sentences (so, to design technical drawings for specific goals), and to be able to use sentences to interact with the world around (so, to solve problems by technical drawing design). All these skills, as the skills in foreign languages, require education but also a lot of experience. However, while for foreign language education there is a well-acquainted and a shared assessment grid to refer to, as the European Assessment Grid for Language Levels is [9], there isn't a similar tool for Tech Drawing. About this point a participated reflection would be probably useful.
Moreover, the official European instrument for "translating" various National certifications, the Certificate Supplement, becomes worthless without a shared common grid, cause it reduces itself as a document reporting school training and workplace training hours as a duplicate of the original certification (for what?).
Certification's role is not just to give an "objective" opinion on a person's competences level, but also for a corporation not to waste time and resources for the evaluation of people or to pay attention to their learning path.
As an overall consequence, there is the need to build an evaluation grid to identify various knowledge and skills levels about Tech Drawing considered as a language, with different learning levels as it is for foreign languages assessment grids.

3. A STARTING POINT AND GOALS TO ACHIEVE

3.1 A starting point for an assessment grid: the European Qualifications Framework

The European Qualifications Framework (EQF) is the main instrument promoted by European Commission as a translation device to make national education qualifications and lifelong learning's certificates more readable across Europe [4]. It was assumed as a starting point.
The EQF aims to relate different countries' national qualifications systems to a common European reference framework. In the vision, individuals and employers will be able to use the EQF to better

understand and compare the qualifications levels of different countries and different education and training systems.
Agreed upon by the European institutions in 2008, the EQF is being put in practice across Europe. It wants to encourage countries to relate their national qualifications systems to the EQF so that all new qualifications issued from 2012 carry a reference to an appropriate EQF level. An EQF national coordination point has been designated for this purpose in each country.
The core of the EQF concerns eight reference levels describing what a learner knows, understands and is able to do – 'learning outcomes'. The main reference level descriptors are:

- Knowledge (what a learner knows), described as “theoretical and factual”;
- Skills (what a learner understands), described as “cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments);
- Competences (what a learner is able to do), described in terms of “responsibility and autonomy”.

The EQF wants to place levels of national qualifications at one of the central reference levels, ranging from basic (Level 1) to advanced (Level 8). The aim is to enable a much easier comparison between national qualifications and should also mean that people do not have to repeat their learning if they move to another country. The EQF applies to all types of education, training and qualifications, from school education to academic, professional and vocational. This approach shifts the focus from the traditional system which emphasizes 'learning inputs', such as the length of a learning experience, or type of institution. It also encourages lifelong learning by promoting the validation of non-formal and informal learning.
The EQF was born to certify education qualifications, and not specific areas of knowledge (that is more common in informal education). The European Commission, however, encourages potential new evaluation instruments to be easy to integrate with the EQF. This seems a good reason to choose EQF system as a starting point to make the Technical Drawing Evaluation Grid.

3.2 Main goals of the Technical Drawing Evaluation Grid

As said before, in this evaluation grid Tech Drawing was considered as a language. So, while the EQF was considered the inspirational format, the philosophy was inspired by the Common European Framework of Reference for Languages, that constitutes the reference grid for the European Language Passport.
In analogy with that grid, the main goals of Technical Drawing Evaluation Grid (TDEG) are:

- To be a reference framework for Tech Drawing education both in national and international contexts;
- To be a reference framework for Tech Drawing education both in formal education and in non-formal or informal learning;
- To constitute a guideline for learning paths design;
- To be a useful tool to recognize skills and abilities in corporate contexts;
- To be a common self-assessment tool;
- To represent a reference point for engineers curriculums design;
- To constitute, in analogy with foreign language evaluation tools, a tool to assess skills and abilities both in comprehension and in production.

Moreover, in regard to the current situation about certifications recognized in Europe, other goals are:

- To be the main reference grid for the Europass Certificate Supplements related to Tech Drawing courses;
- To constitute an instrument which can be integrated with the EQF officially used to certify education qualifications;
- To constitute an instrument useful for certifications connected with ECDL CAD.

4. THE TECHNICAL DRAWING EVALUATION GRID

In following chapters the Technical Drawing Evaluation Grid we are proposing will be referred to as TDEG. TDEG for learning levels is reported in Table 1 and Table 2. Some considerations are needed to make them clear.
As a first point, the original eight EQF reference levels have been split into two. Two different kinds of skill and competence are defined for each level, even if the considered theoretical knowledge is the

same for both. This was made in analogy with the “comprehension” and “production” used in foreign language assessment grids. The first type, defined “A” (*A level* from now), is related with technical drawing used as a pure communication language, with special reference to technical drawing understanding capability. The second type, defined “B” (*B level* from now), is related with the capability to produce correct technical drawings aimed to design synthesis.

As a consequence, it is mandatory that a B certification implies the A certification on the same level (as to say that before showing abilities in speaking a language, abilities in understanding it must be shown). So, the certification of a B level (e.g. 3-B) requires the certification of the corresponding A level (e.g. 3-A), while the certification of an A level doesn’t require any certification of B levels.

Of course each level requires knowledge, skills and competences of the previous levels qualification. So, to certificate an A level – e.g. 3-A – implies that the learning outcomes of the previous A levels have already been acquired – e.g. 1-A, 2-A. To certificate a B level – e.g. 4-B – implies that the learning outcomes of the previous B levels have already been acquired – e.g. 1-B, 2-B, 3-B – and of course that the learning outcomes of the corresponding A level and of the previous A levels are acquired too – e.g. 1-A, 2-A, 3-A, 4-A.

A notice about the norms (STANDARDS) column: to know by heart the norms doesn’t mean to know them by memory. Some standards must be throughout known, for some others it may be enough to be able to find them out, or to know their title. This has not yet clearly pointed out in the grid, and the authors are discussing the way to put in this information.

Table 1.Technical Drawing Evaluation Grid: Levels 1-4

	Knowledge (STANDARDS)	Skills (to ...)	Competence (to be able to ...)	
Level 1	General principles of representation (UNI EN ISO 3098-0/2, UNI EN ISO 128-20/24, UNI EN ISO 5455, UNI EN ISO 5457, UNI 8187, UNI 938); Projection methods, representations and orthographic views (UNI EN ISO 5456-2, ISO 128-30/34); Cuts and sections (ISO 128-40/44/50, UNI 3972)	Carry out a "Wizard" (following indications provided by thirds parties) representation in views and sections of a part by following these basic rules: - Lines of text and characters, dimensional scales, sizes and folding of sheets, specification box; - Orthographic views and representations in sections and cuts in industrial and mechanical design.	Interpret the morphology of a part through its representation in views and sections	1-A
		Know by heart how to select appropriate views and sections needed to represent a part, autonomously applying relating standards	Independently carry out the representation in views and sections of a part	1-B
Level 2	Dimensioning (UNI 3973, UNI 3974, UNI 3975, UNI 4820, UNI ISO 3040, UNI 8822-1/2); Draw of parts and assembly (UNI EN ISO 128-22, ISO 7573, UNI EN ISO 6433); Notes on machining	Enter any single dimension of a part according to the dimensioning standards; Interpret the information contained in an assembly draw (specification box, parts list, identification of the single parts).	Interpret the dimensioned drawing of a part and / or the main elements of an assembly drawing	2-A
		Organically enter, by independently applying the related standards, all dimension of a part, taking into account the possible machining; Enter the information about the specification box and part list of an assembly drawing; Add dimensions regarding encumbrance and mechanical interfaces to an assembly drawing.	Realize the dimensioned drawing of a single part and know by heart how to extract the parts from an assembly drawing	2-B
Level 3	Threads (UNI 4535, and similar, UNI 2709, UNI ISO 228 and similar...); Threaded connections	Represent a threaded feature referring to threads standards; Recognize a threaded connection (screws, nuts, ...) its characteristics, methods of representation and designation.	Recognize the threaded parts represented in a drawing and interpret the thread designation	3-A
		Be able to choose the type and characteristics of a threaded element according to its use in accordance with the regulations	Realize the dimensioned drawing of a part containing threaded parts and to complete with thread designation	3-B
Level 4	Tolerances (UNI EN 20286-1/2, EN 22768-1, UNI 3976); Roughness and surfaces finishing (UNI EN ISO 1302)	Enter a single dimension with dimensional tolerance or a single indication of surface finishing respecting the related standards	Interpret a complete picture of dimensional tolerances and surface finishes	4-A
		Enter dimension with dimensional tolerance and surfaces finishing once you know the type of coupling and / or functionality of the part	Realize the dimensioned drawing of a part complete of dimensional tolerances and surfaces finishing	4-B

Table 2. Technical Drawing Evaluation Grid: Levels 5-8

	Knowledge (STANDARDS)	Skills (to ...)	Competence (to be able to ...)	
Level 5	Removable unthreaded connection: - Keys and keyways (UNI 6604, UNI 6607, and similar) - Pins & Plugs (UNI EN 22340, UNI EN ISO 2238 and similar) - Spline profiles (UNI EN ISO 6413 and similar) - Rings (UNI 7435 and similar)	Be able to represent a removable unthreaded connection within a drawing; Recognize the designation of a removable unthreaded connection.	Recognize the housing of a removable unthreaded connection in a part drawing or its presence within an assembly drawing, and interpret their designation	5-A
		Be able to choose type and characteristics of a removable unthreaded connection according to its use and in accordance with standards	Perform a part drawing complete with indication for housing of removable unthreaded connections	5-B
Level 6	Machine component representation: - Powertrain (UNI EN ISO 2203 and similar) - Bearings (UNI EN ISO 8826 and similar) - Seals (UNI EN ISO 9222 and similar) - Springs (UNI EN ISO 2162 and similar)	Be able to represent the main machine components within a drawing	Recognize the representation of a machine component within an assembly drawing	6-A
		Be aware about the implication of the presence of a machine component in a part and be able to insert the appropriate tolerances for housings of machine components	Perform a part drawing complete with housings for machine components	6-B
Level 7	Permanent connection: - Welding (UNI EN 22553 and similar) - Rivet - ...	Be able to represent a permanent connection within a drawing; Recognize the designation of a permanent connection.	Recognize the work of preparing a permanent link in the design of a particular; Recognize the presence of a permanent connection within an assembly, and interpret their designation.	7-A
		Be able to choose the type and characteristics of a permanent connection as a function of its use in accordance with the regulations	Perform the drawing of a complete piece of information for chambers of permanent links	7-B
Level 8	Geometric Dimensioning and Tolerancing (GD&T) (UNI 7226 / ISO 1101 and similar, ASME Y 14.5-2009)	Recognize the indication of a geometric tolerance	Interpret a drawing complete of geometric tolerances	8-A
		Be able to enter geometric tolerances according to standard	Perform a part drawing complete of geometric tolerances	8-B

5. A WINDOW ON THE POSSIBILE ADVANTEGES GOT FROM THE PROPOSED GRID IMPLEMENTATION

5.1 An example of advantages in corporate contexts

In paragraph 2.1, with special reference to manufacturing companies, the advantages coming from the availability of a Tech Drawing competence chart were pointed out. The proposed grid would help solving problems related to hiring new human resources, internal staff mobility, corporate certifications at customer sites, internal formation and so on. In Table 3 the three examples of people employed in different roles shown in the paragraph 2.1 are reported, and their required knowledge, skills and competences - referring to the Technical Drawing Evaluation Grid - are defined. It's easy to assume the described corporate contexts would gain improvement from the proposed grid implementation.

Table 3. Examples of corporate profiles' TDEG evaluation

Profile	Role and/or needed skills and competences	TDEG Level required
Technical commercial	To propose and support offers at a customer site; To be the intermediary with suppliers; Ability to read and understand a drawing coming from technical office; …	6-A
Quality control officer	To understand and use drawings' information to make quality controls (dimensions, tolerances, …) on parts and items; Ability to read and understand advanced drawings and specific details and to sketch out drawings as a verification tool; …	8-A/2-B
Technical office drawer (not a designer)	To realize autonomously assembly parts drawings; …	8-B

5.2 An example of advantages in academic contexts

Specific knowledge areas certification is probably the only reliable certification system beyond formal education certifications. To meet market requirements, Italian and European universities are developing more and more complex and articulated curriculums. But, in addition to specialization, market requires flexible profiles. Instruments are needed to better define each person skills certifications beyond the formal education(s) one(s).The Europass Certificate Supplement, proposed by the European Commission for Education and Training, could be a useful instrument. In Figure 1 and Figure 2 a sample of a possible Europass Certificate Supplement is reported, with reference to the "Industrial Technical Drawing" course taught in the Faculty of Engineering, University of Brescia. The release of such a certification at the end of each course would help students to make their skills understandable both in academic and in corporate contexts, both in Europe and in international contexts.

In Figure 2 some reference figures are quoted, whose meaning is hereby explained.

(1) As body awarding is indicated the specific Department responsible of the course, but it should officially be the University (when this certification system was approved).

(2) Here it's reported the certificated learning level referring to the Technical Drawing Evaluation Grid (TDEG): Level 6-A and Level 4-B.

(3) We remind you that to acquire a B level certification it has to possess the corresponding A level certification (at least). Level 6-A provide access to the corresponding B level (6-B) and to the previous not certificated ones (5-B) and to the following A levels (7-A and 8-A).

(4) All these data are currently inapplicable because this certificate is just a proposal, so without an official endorsement.

Finally, some certificate format's final lines were omitted because in a simulation like this it would have been with no meaning. The implementation of the proposed grid would most probably have a relevant impact on the academic contexts.

Europass certificate supplement (*)

Italy

1. Title of the certificate (1)
DISEGNATORE TECNICO DI BASE
(*) In the original language

2. Translated title of the certificate (1)
BASIC TECHNICAL DRAWER
(*) If applicable. This translation has no legal status.

3. Profile of skills and competences

To be awarded this certificate the holder will have demonstrated formally through a process of assessment, to be able to:

- extract the part drawing, in views and section, from an assembly drawing;
- realize a part drawing complete of threaded features, dimensions, thread designation, dimension tolerances, surface finishing and specification box;
- add dimensions regarding encumbrance and mechanical interfaces to an assembly drawing;
- recognize designation and representation of machine components, removable unthreaded components and their housing.

4. Range of occupations accessible to the holder of the certificate (1)
Engineering Industry (Technical Employee, Quality Control)
(*) If applicable

(*) **Explanatory note**
This document is designed to provide additional information about the specified certificate and does not have any legal status in itself. The format of the description is based on the following texts: Council Resolution 93/C 49/01 of 3 December 1992 on the transparency of qualifications, Council Resolution 96/C 224/04 of 15 July 1996 on the transparency of vocational training certificates, and Recommendation 2001/613/EC of the European Parliament and of the Council of 10 July 2001 on mobility within the Community for students, persons undergoing training, volunteers, teachers and trainers.
More information available at: http://europass.cedefop.europa.eu

Figure 1. Example of Europass Certificate Supplement – First page

5. Official basis of the certificate

Name and status of the body awarding the certificate	**Name and status of the national/regional authority providing accreditation/recognition of the certificate**
Department of Mechanical and Industrial Engineering **(1)** University of Brescia – Faculty of Engineering Via Branze, 38 – Brescia Tel. +39-030.3175.559 Fax. +39-030.37.02.448	CURRENTLY INAPPLICABLE **(4)**
Level of the certificate (national or international) *Level TDEG:* 6-A – 4-B **(2)**	**Grading scale / Pass requirements** A **Pass Grade** is awarded if all the skill and knowledge assessments were passed. A **Merit Grade** is awarded if the pass standard is exceeded. A minimum score of 75% is required to pass knowledge assessments. All essential criteria must be demonstrated to pass skills assessments.
Access to next level of education/training This Certificate may provide access to other awards at TDEG at level 7-A, 8-A, 5-B, 6-B. **(3)**	**International agreements** CURRENTY INAPPLICABLE **(4)**
Legal basis CURRENTY INAPPLICABLE **(4)**	

6. Officially recognised ways of acquiring the certificate

Description of vocational education and training received	**Percentage of total programme (%)**	**Duration (hours/weeks/months/years)**
School-/training centre-based	50	75 hours
Workplace-based	50	75 hours
Accredited prior learning		
Total duration of the education/ training leading to the certificate		150 hours

Entry requirements
(Upper) Secondary education, Level ISCED '97 3A

...

Figure 2. Example of Europass Certificate Supplement – Second Page

6. CONCLUDING REMARKS

A shared technical drawing assessment grid is expected to be a useful tool to solve consistent corporate and academic problems. It would be a useful mobility and lifelong learning instrument. Were it adopted in industry context, the proposed grid would be useful in many ways. For instance, with reference to paragraph 2.1, a company applying to ISO 9001:2000 could identify its staff's skills and competences by using the grid, and put this information into the Quality Manual, with the TDEG attached. Moreover, this information would be useful also for "process management" (it would be possible to define the required skills about Tech Drawing for each resource in the processes). The TDEG could also be used as a self-assessment grid by the staff, and to design internal learning paths.

It's to underline in many companies many people have excellent abilities by "learning on the job", thanking the buildup of experience and not formally taught skills. Again, the situation is in analogy with foreign language skills, with people "learning on the job" – i.e. living in a foreign country – and people learning by training courses. This makes the assessment grid a more powerful and needed tool, so to bring different learning paths to a common benchmark.

Also in academic contexts, some applications would become easier to do. If universities used TDEG as a reference point for the evaluation of the abilities at the end of a Tech Drawing field course, these could be recognized by every other universities or training bodies using TDEG as a reference too. Engineers curriculums could be designed following TDEG and the choice to achieve a certified specific knowledge level by formal education or informal learning (or both) should be inconsistent, as it is for foreign language qualification – just the test is the key to achieve the certification.

Starting from the next academic year, the TDEG will be the main instrument to refer to for teaching in the Design Group of the Department of Mechanical and Industrial Engineering at the University of Brescia. The Design Group is also evaluating the hypothesis to extend this grid reference to training courses for individuals and corporate staffs outside the university.

It's to be underlined that the proposed grid refers to drawer's skills and role, and not to designer's ones. Tech Drawing, we remind, is an instrument (and this instrument use abilities we want to evaluate and certificate) as a language is, and to know how to draw doesn't imply to know how to design, as to know a language doesn't imply to be a writer. To evaluate higher level skills, the authors are working on a similar assessment grid to identify, for instance, competences levels in Machine Design area. However, this is a next stage. The main goal of the proposed work is to promote a shared evaluation and certification system for Tech Drawing knowledge similar to an already known and shared system for Tech Drawing software knowledge as ECDL CAD is. In the vision, the two certifications will be mutually recognized and integrated, to contribute to an easier profile skills identification both in academic and in corporate contexts.

The authors know that the validation of a common certification system must be the result from a largely shared work of several universities and other organizations both national and international. The proposed system is surely fit to further improvements, a largely participated thinking about this topic being a main purpose of this paper. Even the use of the EQF system as a model may be susceptible to improvements (also the assessment grid for foreign language knowledge was considered as a model). An hypothesis worthy thinking is to put all competences shown in the proposed grid in a reduced number of levels, and to create various branches relating to the various technical drawing and design specializations, like Machine Design, Mould Design or Product Design, the same way it's already done for some foreign language knowledge qualifications (business' purpose, legal's, academic's, …).

The proposed approach could probably also be used for other skills in engineering education. Established that an engineer should know by heart the basis of engineering education, skills and abilities interesting for industry are almost defined. However, just few assessment grids and referring certificates are delivered, the most related to informatics tools use. Engineering skills are much more than this. An analytic instrument fit to describe in detail the real competences of an engineer is still far from being developed, and maybe it will never be. The authors are working to focus the engineer "identity", which is a quite challenging task (it's still a complex and many-sided profile to describe). Finally, it's to underline the proposed framework and vision don't aim to make state-based education and degrees worthless, but, in reverse, to strengthen them by solid and common instruments. We think TDEG could be one of them.

REFERENCES

[1] *European Commission for Education and Training web site, Mobility and lifelong training page,* http://ec.europa.eu/education/lifelong-learning-policy/doc40_en.htm

[2] *Ibid., Validation of non-formal and informal learning page,* http://ec.europa.eu/education/lifelong-learning-policy/doc52_en.htm

[3] *Europass web site, Europass Certificate Supplement page,* http://europass.cedefop.europa.eu/europass/home/vernav/InformationOn/EuropassCertificateSupplement.csp

[4] *European Commission for Education and Training web site, The European Qualifications Framework page,* http://ec.europa.eu/education/lifelong-learning-policy/doc44_en.htm

[5] ISO 9001:2008,*Quality management systems – Requirements,* www.iso.org

[6] *European Foundation for Quality Management web site,* http://www.efqm.org/en/

[7] *European Commission for Education and Training web site, The ERASMUS Programme page* http://ec.europa.eu/education/lifelong-learning-programme/doc80_en.htm

[8] *ECDL web site, Module 8 – 2D Computer design page,* http://www.ecdl.org/programmes/index.jsp?p=108&n=110

[9] *Europass web site, The Europass Language levels – Self Assessment Grid* http://europass.cedefop.europa.eu/europass/home/hornav/Downloads/CEF/LanguageSelfAssessmentGrid.csp?loc=en_GB

Contact: Riccardo Metraglia
University of Brescia
Department of Mechanical and Industrial Engineering
Brescia, IT
Tel: Int +39 030.37.15.508
Fax: Int +39 030.37.02.448
Email: riccardo.metraglia@ing.unibs.it

Riccardo Metraglia is PhD Student in Applied Mechanics in the Department of Mechanical and Industrial Engineering at the University of Brescia. He researches in technical communication and in user-centered design. He is interested in many aspects of design and communication, in particular how the aesthetics of a product can influence users' opinion and in usability in information design and technical communication.

Gabriele Baronio is Assistant Professor of Engineering Design in the Department of Mechanical and Industrial Engineering at the University of Brescia. He teaches in technical drawing and computer-aided design. Currently, his research activity is mainly focused on the design and development of biomedical devices and aids for the disabled people.

Valerio Villa is Assistant Professor of Mechanical Drawing in the Department of Mechanical and Industrial Engineering at the University of Brescia. He teaches mechanical design and technical communication. His experience covers mainly the design of special machines for industrial production and for scientific experiments.