Integrating Companies in a Sustainable Apprenticeship System

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Intellectual Output 4

Documentation of Professional Skills in an Operational Context[1]

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Contents

1. Background

The concept of competence, which has been established in vocational and business education for decades, experienced a renaissance over the detour of Large-Scale-Studies in general education years ago - also in an operational context for the design and evaluation of Vocational Education and Training (VET). Both, approaches, which imply an atomisation of holistic competence and thus an exact, statistically reliable measurability (psychometrics), as well as approaches, that refer to key competences, only, and thus hide the context too far, miss the core of the matter. Based on the experience that instruments that are too abstract are often misunderstood by VET practitioners, a method is proposed that is consistently oriented towards the needs and abilities of the directly involved participants and stakeholders - and that moves the reference level of competence from the dimension of formulation to the dimension of evaluation.

The ICSAS project pursues the goals of ensuring and enhancing the competence development of industrial shoe manufacturing trainees in Portugal (PT) and Romania (RO) through a learning supportive arrangement and design of company learning stations, and to create transparency about existing skills as well as to document them.

These goals are based on two questions:

1. After having passed the final examinations in the respective education system, a trainee receives a qualification proof that confirms what he is allowed to do. Alone for reasons of time or capacity, he can and must prove only a small part of his professional skills through actions and speech during the examination - the question that remains unanswered is:

   What skills does a trainee have at the end of his training?

2. The second question takes up the constant legitimacy pressure that informal learning in the process of work has to face: The supposed added value of a dual, process-oriented training compared to school-based or modular systems should be made tangible and transparent to be able to present empirical evidence in systemic discussions. This leads to the question:

   How can these competences be described and evaluated?

Another path to the development of an instrument for transparency of competence resulted in the course of the project from the concrete work in the participating companies. The resulting conclusions of the work packages (IO) that have already been completed in the first 2 years of our 3 years project are briefly described in the following:

The first short step was to identify the spheres of activity in industrial shoe manufacturing. Methodically, this was done with the help of expert interviews in the four participating countries: Germany (DE), Romania (RO), Portugal (PT) and Spain (ES), in DE in Rosenheim (Gabor) and in Pirmasens (ISC); these spheres of activity were validated during the learning station analyses (LSA).

Core spheres					
ICSAS	Cutting	Stitching	Lasting	Assembly	Finishing

Peripheral spheres				
ICSAS	Design	Technical development	Production planning	Quality assurance

Table 1: Updated spheres of activity of the Industrial Shoe Maker and Finisher profession according to the findings of ICSAS project; for the exemplary description of the sphere of activity "Cutting" cf. Annex 1

The second step was the performance of learning station analyses (for methodology and detailed results see ICSAS 2018a) at Carité (PT), Gabor (DE) and Papucei (RO). An exemplary documentation of one of these analyses can be found in Annex 2. The main result of the analyses was that due to the manufactory-similar production methods all learning stations in all three plants have high and comparable learning potentials. Thus it is important to ensure that these potentials are exploited for vocational training and education.

The aim of performing the learning station analyses was to develop an optimised, learning supportive curriculum for the company learning stations in joint workshops of the involved stakeholders in PT and RO. By focusing on the spheres of activity, a close connection between coherent learning contents was of primary importance. However, these curricula (see ICSAS 2018b and ICSAS 2018c) show only a potential way of organising the flow of the trainees through the departments. In practice, individual training plans of trainees may vary due to frame conditions/restrictions of work processes. This also means that the competences of the trainees will not develop synchronously for all trainees of a year. For example, if a company has to deal with several apprentices, one trainee could start the apprenticeship in the "Cutting" and a second one in the "Stitching" sphere. A successful formative evaluation of competences during the training course can then serve as a control instrument for the planning of the further flow through the departments of a company as the third step.

2. Dimensions of Competence Evaluation

For the evaluation of competences, a number of dimensions must be taken into account. In addition to the central aspect: **Whose** competences are to be evaluated and presented transparently, at least the following additional questions must be answered:

- **For whom** should competences become transparent?

  Possible addressees would be, for example, the learners themselves, trainers or instructors, tutors, HR departments, national and international VET institutions (e.g. the German Federal Institute for Vocational Education and Training (BIBB), Chambers of Industry and Commerce, universities) or the national and international employment system. The answer on this question has direct consequences on the formulation of competences (level of proficiency and abstraction).

- **How** are competences **evaluated**?

  Survey instruments or procedures could be, for example: questionnaires, observation and discussion, test assignments, practical work tasks. In this regard, it is important to find a reasonable balance between the efforts of collecting and the quality of statements. Thus, if the number of cases is large (large-scale studies such as Pisa), the competence can certainly not be disaggregated and described to the same extent as in qualitative individual case studies where doubts on representativeness would be legitimate.

- **How** are skills **assessed**?

  Conceivable would be a simple positive or negative confirmation of the existence of competence, quantitative as well as qualitative/descriptive or qualitative/performance-oriented statements on competence. A pure yes / no or quantitative scale increases the clarity, but significantly reduces the informative value. The definition and interpretation of what would correspond to 100% (an expert in the sphere, a good trainee?) as well as the decision on a threshold for “yes” are hardly objective to make. Therefore, qualitative scales are more meaningful despite their (obvious) subjectivity. Two types can be distinguished: on the one hand, qualitative/descriptive scales (see, for example, Markowitsch et al., 2006), in which the degree of competence is differentiated according to the difficulty of the tasks, for example, from “simply on schedule”, “make necessary adjustments” and “take precautions” to “develop new procedures”. On the other hand, qualitative/performance-oriented levels, in which the complete, professional implementing of the complex action stands as a fixed point of reference. The description of the degree of competence acquisition is then in relation to this reference point, this means that a distinction is made as to whether a trainee “needs practical help”, “needs instructions”, “works under supervision” or “works independently” in a work activity.

- At which level of abstraction should competences be acquired?

The next subchapter is devoted to this central question.

3. Level of Competence Evaluation

Fig. 1 visualises the theoretically possible levels of competence evaluation. The y-axis represents two dimensions: both (steadily increasing) the degree of abstraction and the specificity. Whilst the top two (Vocational proficiency and Spheres of activities) as well as the bottom two (knowledge/skills and work tasks) levels are to be understood in general, the intermediate (Work-processes and Parts of work-processes (tact)) are characterised by their specificity due to work-organisation.

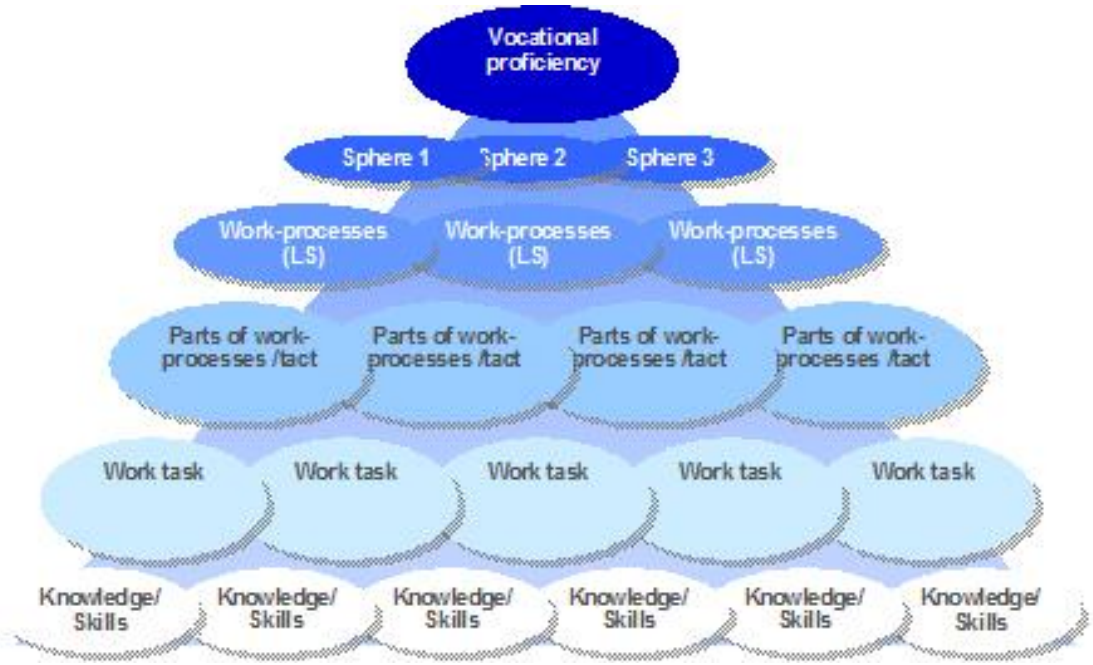

Figure 1: Possible levels of evaluation

Based on this graphic, the following principles can be set out:

1. Theoretically, all levels shown in Figure 1 could be used to assess competence (except for the lowest level, where it would be difficult to speak of competence).
2. The ellipses used for visualisation are neither to be understood as building blocks nor summative (in the sense of x working tasks result in a working process) nor linear in the sense that partial areas (modules) could be separated. The levels are to be considered as relational (not functional). The respective mastery of some of the elements of the lower level is a necessary, but not sufficient condition for the next higher level.
3. Vocational proficiency as a holistic construct cannot be evaluated in a meaningful way below a level of spheres of activity (classes of functionally identical, structurally similar tasks, see Annex 1).
4. Ideally an evaluation of competence at the level of spheres of activity would therefore be desirable; due to the abstractness and complexity of spheres of activity it can be performed only exemplarily.

5. Parts of work-processes are not suited to evaluate competences due to their specificity; for addressees who are unfamiliar with concrete, job-specific processes, they are ineffectual to create transparency.
6. Work tasks – such as preparing a workplace or preparing parts for further processing, including organisation and quality assurance – are the smallest complete actions that are not tied to specific jobs and are not differentiated in knowledge, skills and competence.

4. The Instrument

Table 2 documents the draft of our competence evaluation matrix for the sphere of activity "Cutting" (see Annex 1).

Sphere of Activity: Cutting			
Work task:	Cutting by hand, including		
Reading & understanding work ticket; Providing & preparing the material [...]; Performing the task applying safety measures and asking for support if needed; Controlling own work and identifying possible defects; Preparing products for next task; Knowledge about materials; Cooperation with colleagues; [Please continue the list if you wish to add criteria].			
Evaluation			
Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐
Place, Date	Signature		
Work task:	Clicking with cutting dies		
[Please set up the criteria in this section in line with your evaluation needs according to the example given above]			
Evaluation			
Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐
Place, Date	Signature		

Work task:	Cutting with CAD-CAM machines

[Please set up the criteria in this section in line with your evaluation needs according to the example given above]

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Work task:	Splitting

[Please set up the criteria in this section in line with your evaluation needs according to the example given above]

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Work task:	Stamping

[Please set up the criteria in this section in line with your assessment needs according to the example given above]

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Final evaluation (in this department)	
Cutting; including all work tasks above	
Evaluation	
Needs further training	Can perform all work tasks (almost) independently
☐	☐
Place, Date	Signature

Table 2: : Matrix for sphere of activity "Cutting"

For this purpose, the partners Gabor, Carité and Papucei listed all work tasks of the departments whose activities can mainly be assigned to the sphere of activity "Cutting" in the left-hand column. As a result, a list of all work tasks belonging to a sphere of activity was created. The identified work tasks are further detailed and described at the level of skills and knowledge aspects necessary for the complete action (see details below bold entries). The description at this degree of detail is disclosed in the proof of competence as an example for the work task "cutting by hand". Thus, it becomes clear that the working tasks, in contrast to their brief and activity-oriented formulation, cover each a complete action together with the necessary knowledge and the respective interdisciplinary (key) competences.

The use of the competence evaluation matrices is characterised by the following essential elements: The persons responsible for the respective training section (i.e. the tutors in the departments) give their evaluation of the trainee's competence compared to experts` work. The selected four-level scale represents the various forms of cooperation within the community of practitioners and thus the confidence in a potential future colleague.

The information from the respective department about the evaluation of the work tasks and the confirmation date is transparent for the trainer or teacher who accompanies the trainee during the entire training course, but possibly also for a tutor in a later department. For example, it might turn out that a trainee has encountered a work task many months ago and in a department in which only simple variants of this work task occur. With this information, the upcoming department assignment, in which the same work task also occurs, can be adapted to the learning requirements of the young person.

The most important aspect of this instrument is that the evaluation and thus the responsibility for the confirmation of competence is moved to the respective community of practitioners, i.e. there are no artificial examination situations with external assessors. The respective expert-worker confirms the quality of the trainee's work with his signature.

At the end of the assignment in a department, it could be important to evaluate whether the trainee can already work independently in this department or if he still needs further support. For this purpose, the tutor can either record his evaluation of the last few weeks or

alternatively give the trainee a typical task from the department and evaluate its implementation.

The filled-in matrices should be kept by the trainee, available for the instructor / teacher - they should neither replace exams nor become part of the final assessment.

After completion of the training, these evaluation matrices can provide double added value: on the one hand, the certificates can be used in-house as proof of ability of skilled work in the respective spheres of activities - the training effort after starting to work in a department is reduced and the assignment to difficult tasks can happen earlier.

On the other hand, this instrument allows for high transparency in job applications: if a skilled worker, who was trained in one of our participating companies, applies for a job externally, his diploma is certainly a necessary precondition - but human resources managers may be less interested in how the candidate has performed, for example, in stitching in the final examination, but rather what competences he has acquired in the sphere of activity for which he is to be recruited, for example in cutting, and our instrument makes this transparent in an easily understandable manner.

5. Summary and Outlook

In Table 3, the dimensions raised in Section 2 are illustrated. Columns 2 to 4 describe possible addresses for the results of any competence evaluation – but other addressees of a competence evaluation are possible, too.

A first variant of this model (the first task of the procedure described in section 4) is highlighted in the table in light blue: A transparent presentation of the competence of trainees for those directly involved in the training (trainers / teachers, apprentices and company training staff (tutors)) in a company-internal certification model. As a level of abstraction, the work tasks were chosen, as these can be comprehensively assessed by the respective skilled workers on the one hand, and on the other hand, they do not yet have any product or process-specific characteristics. Finally, the evaluation is carried out by means of observation and supplementary discussions, which lead to a qualitative performance-oriented evaluation.

Dimension of competence evaluation	**Possible Desi**			
Addressee	Trainer / trainee	Tutor	Company	TVET institutions
Level	Sphere of activity	Process	Part of work process	Task
Data collection	Questionnaires	Observation	Test	Practical task
Evaluation	Yes / No	Quantitative	Qualitative-descriptive	Qualitative performance-oriented

Table 3: Integration of the model in the dimensions of competence evaluation

The second application variant briefly outlined in the last section is marked in medium blue: if a trainee is able to carry out the essential work tasks for a sphere of activity independently or at least under observation, he can acquire a “sphere of activity certificate” by working on a practical task, which, if necessary, can find consideration and use in another addressee group, e. g. training company / other companies of the same or related industries.

In dark blue, the matrix element “vocational training institutions” is marked – as a motivation to consider whether this approach of competence evaluation might become an element of competence evaluation when comparing the efficiency of VET systems.

6. References

ICSAS (2018a): Learning Station Analysis;

http://icsas-project.eu/wp-content/uploads/2018/05/O1_LSA_EN-version_Germany.pdf

ICSAS (2018b): National validated WBL curriculum Romania;

http://icsas-project.eu/wp-content/uploads/2019/03/IO2_Curriculum_RO_EN.pdf

ICSAS (2018c): National validated WBL curriculum Portugal;

http://icsas-project.eu/wp-content/uploads/2019/03/IO2_Curriculum_PT_EN.pdf

MARKOWITSCH Jörg et al.: Zur Problematik eines European Credit Transfer System in Vocational Education and Training (ECVET). In: Grollmann, Philipp et al. (Hrsg.): Europäisierung Beruflicher Bildung – eine Gestaltungsaufgabe. Hamburg 2006, S. 173-197.

7. Annex

7.1. Annex 1:

Cutting and Clicking of Materials for Upper Manufacturing ("Cutting")

The task of the cutting department staff is to cut the shoe parts from upper, lining, interlining and reinforcement materials (leather, synthetic leather, natural or synthetic textiles) in the required geometries.

The following cutting techniques are used:

- Hand cutting with knife and pattern stencils: Mainly used for sample and small series production.
- Clicking machines and cutting dies (swing arm cutting presses for cutting upper and lining leather, travelling head and beam cutting presses for natural and synthetic textile materials): typically used for serial production.
- Dieless cutting on automated CAM cutting tables (oscillating blade / punching / roughing tool, water jet or laser): mainly used for prototyping and small series production, but also for serial production. The cutting geometries are provided by the CAD system.

Material, colour, number of pairs and special requirements can be found in the accompanying specifications that come with each work batch.

Prior to cutting, the leather hides and skins must be checked in terms of differences in thickness and colour, quality zones and eventual defects. Crucial in leather cutting – whether manual, machine cutting or computer-aided – is the compliance with the cutting rules (quality rule, pairing rule, stretch direction) because they influence the quality of the final product. Skill and experience in creating a cutting layout on a hide or skin are also imperative to minimise waste, because the upper leather represents by far the largest single cost item in shoe production.

Further operations in the cutting room are splitting of the cut parts (to reduce them to the required even thickness) and stamping of the parts (article number etc.). The quality control of the cuts is carried out directly in the department.

7.2. Annex 2:

Gabor Cutting_Jan_2018

Description	**Learning Station** **Date**	Cutting / Prototype production January 2018
Location / Site	**Vocation**	Industrial Shoe Maker and Finisher
Allocation	**Time frame / Occupational profile (vocational position n°)**	A 2. Cutting and clicking of materials for upper manufacturing (§ 4 paragraph 2 number 2), 18 weeks A 1. Assessment and use of materials and auxiliary materials for upper manufacturing (§ 4, paragraph 2 number 1), 14 weeks A 3. Preparation of upper parts (§ 4, paragraph 2, number 3), 10 weeks
Process environment	Products	Cut upper parts (outer upper, interlining, lining)
	Type of product / service	Semi-finished products
	(Internal) supplier	Leather / materials warehouse
	Order- / material acceptance	Batch box with work order and cardboard patterns
	Direct user of product / service	Stitching (at Gabor Rosenheim this is also where quality control of the upper parts prepared to be stitched takes place)
	“End” user of product / service	Final inspection / shipment to customer
	Production steps already performed	Design, pattern making (including digital object data for automated cutting tables), cardboard patterns (from the grading room), production planning (creating work orders for production including all production steps / stating all materials and components), preparation of materials to be cut (for serial production, the material is being prepared for the cutters, but for prototype production the cutters fetch the material they need from the warehouse themselves)
	Interfaces with other process steps	-

	Particularities	At the Rosenheim site, Gabor produces exclusively prototypes. In consequence, there is no piecework rate. The reason for this is that the workers do not only need to concentrate on the correct execution of all work steps for the new patterns (no routine work), but they also need to verify that all information in the work order is coherent and complete. This could not be done under time pressure. Sometimes the workers need to make own decisions. As concerns prototype production, the cutters are responsible to choose the needed materials (upper, interlining, lining) in the warehouse (whereas for serial production, the cutters will receive the prepared batch boxes with all materials at their work place).
Process steps Detailed description	The cutter receives the first draft for a new prototype from the designer. The work sheet contains information on: • who created the design (name) • date • article name • pair or piece • upper material, lining, seam colour, elastics • sometimes only the outer upper material is defined and interlining and lining are determined only later • patterns If **cutting** is done by hand, the cutter cuts interlining and lining, whereas the upper leather is cut on the automated cutting table (oscillating knife). All pattern stencils carry designations: O or OB = outer upper leather, V = interlining, F = lining. The marking pattern stencils are of particular importance for the stitching department (to provide guidance to the stitchers on how to join the upper pieces). Sometimes prototypes are produced without a final decision on interlining and lining. The final decision is taken when design and marketing will discuss the article. Only after this meeting all materials are defined. Cutting of upper leather is done on the cutting table: All upper leather parts are cut from leather hides or skins (no need for pattern stencils as the CAD system communicates the geometry data to the cutting table). The work starts on the nesting table to define the cutting layout. First,	

	the barcode on the work order is scanned to identify the shoe model and call up the geometry data from the CAD system. Then the cutter places the leather hide/skin on the layout table and decides on the nesting of the parts (which are projected on the leather). Next, the hide/skin is put on the cutting table (which is positioned in a right angle next to the layout table) and the cutting process starts. A positioning cross serves as reference to make sure that the position of the hide/skin for both layout and cutting will match. On the cutting table, the leather is kept it in the exact position by vacuum suction. To improve the suction effect, a plastic sheet is placed on the hide/skin (leather is air permeable which reduces the suction effect if no plastic sheet is used). **Stamping:** All cut parts are stamped on their back with gold foil (article number, size, pictogram etc.). The stamping specifications must be respected (notice next to stamping machine). The stamping machine must be set up correctly and the appropriate stamping foil must be chosen. **Splitting:** Thickness homogenisation of cut parts (e.g. leather heel cover must be split down to 0.45 mm). **Clicking of sock liners:** At clicking press with bi-manual release. The cutter needs to go fetch clicking dies (the reference number of the die is given on the work sheet, e.g. 9602) from a shelf, where the cutting dies are stored according to size in dedicated compartments, and the material to be cut (for example pigskin colour caramel). The cutter needs to adjust the clicking press (i.e. clicking stroke height, clicking force). With a second die, the cutter will cut a sheet foam material (the exact type is also defined on the work sheet). The foam sock liner paddings are slightly smaller than the leather sock liners. The leather sock liners and the foam parts are bonded (with glue). The effect when the foot enters into the shoe is a sensation of comfort and cushioning. Insoles are not cut in the cutting department; they are purchased as ready-made components.	
Workplace	Shop floor	Prototype production
	Lighting conditions / environment	-
	Posture	-
	Specifics	-
Organisation	Group work?	No
	Employees at workplace per shift	1
	Employees in department	6
	Hierarchy	Fore(wo)man, workers, apprentice(s)

	Work places in department	5 hand cutting work places, 2 tables which make up the computer optical system (COS) = 1 for nesting, 1 for cutting, 2 swing beam clicking presses, 1 stamping machine, 1 splitting machine
	Shifts	1
	Similar work stations	-
	Specifics	-
Interfaces	… to other vocational positions?	B 6 handling of tools, machineries, and devices (8)
	… to other learning places?	Stitching Work preparation
	Separate trainee workshops / theoretical knowledge?	LF 2 Cutting leather LF 3 Cutting textile LF 4 Preparing upper parts
	Other	
Vocational training	Vocational year / duration	2 x 3 months within the first half of the apprenticeship
	Preconditions / previous stations	Theoretical knowledge about leather and materials as well as about footwear parts and components (vocation school and also in-company tutoring; the basics of work safety (pictograms) are imparted at vocational school and are being recalled in each department at each new machine.
	What should they learn?	All specific work steps in the cutting department
	Specifics of training (individualisation, duration, timing)	-
	Experience with trainees & young skilled workers	Very positive
	Assistance / working tasks	All tasks in the department
	Number of trainers	2
	Maximum number of apprentices	1-2

	Other		Specifics at Gabor: About 1/3 of all skilled workers are officially qualified to train apprentices	
	Is the existing learning potential used?		Yes	
	Possibilities for improvement		Nope	
Highest level of autonomy that can be attained	Support	With instruction and guidance x	Under surveillance	Independently (cutting table) x

8. List of tables