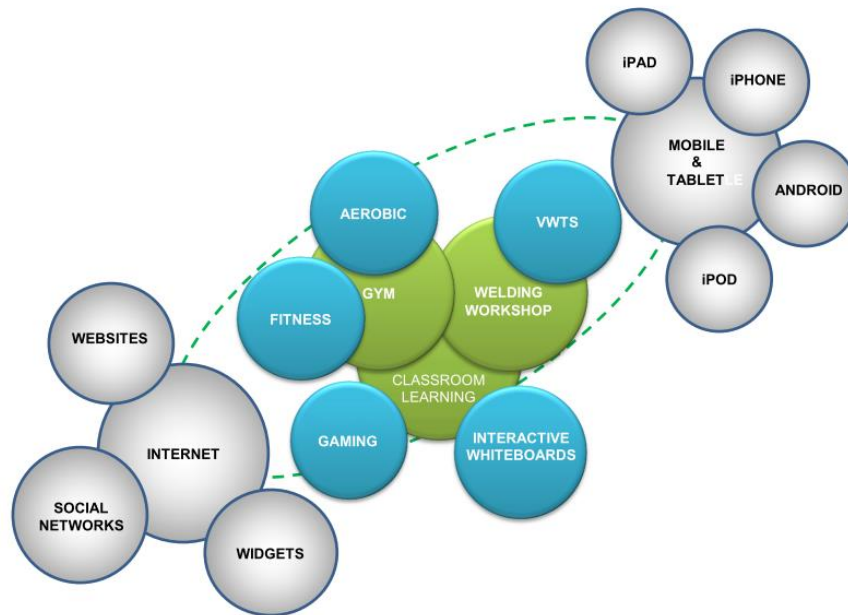


## Document



Basic elements of the S-K-S welder education system

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## INTRODUCTION

The European Commission set a goal in the production sector in 2012 to raise the BGP from 16% to 20% in the next 10 years. The economic growth is evident through a strong industrial foundation, new workplaces and investments in the sector.

A study was published in Bochum on March 20, 2013: “Macroeconomic and sectorial value added by the production and application of joining technology in Germany and Europe”- carried out at the Faculty of Bochum on behalf of the DVS – German Welding Society supported by the EWF – European Federation for Welding, Joining and Cutting.

EWF published in Lisbon on October 9, 2013 the “Study shows resilience of manufacturing and application of joining technology in Europe”.

The results of both the Bochum and Lisbon study show the extent that the manufacture and application of joining technologies represent in both added-value and jobs. Joining technologies are present in all production sectors and, according to the aforementioned study, represent 65 billion € turnover in Europe. In terms of employment by application of joining technologies, of a total of 1.2 million in EU27: 647 000 people as welders, 311 300 as welding inspectors, researchers, designers, trainers and robot operators and 165 900 in terms of joining-related personnel.

“This study highlights the relevance of this industry in Europe as a means to increase competitiveness of EU27 companies and provides further evidence to encourage its development as part of the strategy to support the reindustrialization of Europe”, (taken from the study presentation in Lisbon).

On the other hand, by monitoring the labor market it becomes evident that there is a shortage of welders in Europe.

All of the above point to the fact that there is an open space for hiring the welders. In order to fill that space it is necessary to make welding more attractive to young people, to offer modern educational programs and provide constant logistics available through mobile internet in order to ensure constant support throughout the entire working life of welders.

The S – K – S system, which is to give answers to those questions, was promoted in 2011 at the 6th International scientific-professional conference SBW 2011 “Modern technologies and processes in production of pressure equipment, welded metal constructions and products”, with the paper “Welder training – a new approach”, written by G. Adelsberger, J. Antunović and Ž. Habek from the Industrial and Trade School Slavonski Brod.

Development of the system was made more dynamic through this project.

## THE S – K – S SYSTEM CONCEPT

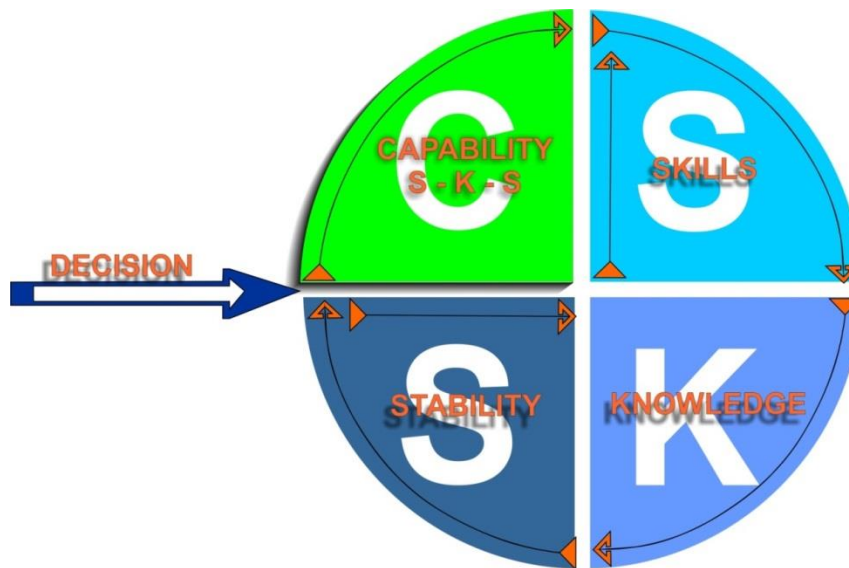


Figure 1 Outline of S-K-S system

The system is directed towards welders because they are carriers of quality in welding.

Manual welding is specific technology where following aspects become prominent:

- welder's skill in mastering the welding techniques,
- welder's knowledge expressed through guiding the welding process on the spot, and
- stability expressed through the psychophysical component visible through a disciplined guidance of the process according to the WPS, through aerobic capability and precision in execution of technical elements.

For that reason, the basic elements of the S – K – S system are: skills, knowledge and stability.

From the outline of the system depicted in Figure 1 it is visible that the concept of the system for lifelong education of welders consists of two parts:

1. Capability: S – K – S system for welding trainees, where one acquires competencies for welding in a specific process through different types of training: formal education, courses or any other formal, non-formal or informal way. After the training is completed, one obtains a Certificate on successfully completed training.
2. S-K-S system for professionals is a lifelong system of upskilling that needs to be repeated in specific time intervals in order to renew and upgrade all of the three system elements with individual welders and to harmonize them with the newest technical and technological trends.

## GLOSSARY

**Decision** – making a decision about opting for welder education

**Capability** – competence acquisition needed for becoming a welder through education in the S-K-S system

**Skills** – acquisition of skills, i.e. mastering of welding techniques

**Knowledge** - knowledge acquisition, i.e. mastering of welding technology.

**Stability** - in the welding line of work represents the capability of frequent repetition of quality welds under demanded technology using the demanded technique in the demanded period of time on one's own or under supervision

**ECVET Credit (European Credit System for Vocational Education and Training)** is a measurement for expressing the volume of the acquired competences, and it is defined as the total average time a successful learner has spent to acquire such competences.

**European Qualifications Framework – EQF** is an instrument that introduces qualification reference levels, designed to serve as a device for the recognition and readability of qualifications across national qualifications frameworks.

**Learning Outcomes** - means knowledge and skills and the associated autonomy and responsibility which a person has acquired through learning and which the person proves after the learning process is completed

**Competences** denote a set of knowledge and skills, and the associated autonomy and responsibility.

**Curriculum** - denotes a series of planned activities aimed at the acquisition of certain competences by an individual, and it includes: objectives; learning outcomes; content and methods of teaching; forms of learning, learning outcome validation, and a quality assurance system.

**Qualification** - Qualification means the formal outcome of an assessment and validation process, which is obtained when a competent institution determines that an individual has achieved learning outcomes to given standards through the issue of a certificate or diploma.

**Module** - an educational unit having a goal and contents that are defined according to demands for design of qualifications. It is shaped based on the standards of a profession and enables acquisition of competencies and qualification as a whole

**Modular curriculum** - represents an educational entity providing a specific qualification for a profession

**Education based on competencies** - educational program the contents of which are defined by analyzing the necessary competencies for performance of work assignments. The competencies the student/participant needs to acquire, the conditions in which the teaching process will be executed and the criteria according to which the student/participant will be marked/graded are regulated in advance. The evaluation criteria are regulated according to the quality standard of work assignment execution, and not according to group norms.

**Volume of Qualification / Learning Outcomes** denotes the total amount of acquired competences, and it is expressed in terms of ECTS or ECVET credits, or some other type of credits.

**Profile of Qualification / Learning Outcomes** - denotes the field of work and study associated with the acquired competences, and it is expressed by a name.

**Reference Level of Qualification/ Learning Outcomes** - denotes the complexity and the scope of the acquired competences, and it is described by means of a set of level indicators / descriptors.

**Quality of Qualification / Learning Outcomes** denotes the reliability of the issued official document in relation to the stated reference level, volume, and profile of the acquired competences.

**Qualification Standards** - denotes the content and the structure of a certain qualification, including all the information necessary for determining the qualification reference level, volume and profile, as well as the information necessary for the quality assurance and enhancement of the qualification standard.

**Occupational Standards** - is a list of all responsibilities of a person in a certain job and a list of the required competences.

**Vocational qualification** - formal name for a set of competencies of a certain level, volume, profile and quality, which is proven through a public document issued by an authorized institution

**Vocational curriculum** - document defining learning outcomes and conditions for execution of teaching process with the help of which the participants acquire competencies

**Vocational education** - process of competence acquisition (knowledge, skills and competencies in a restricted sense), provided the results of such process are evaluated and confirmed in a procedure conducted by vocational education institutions

**Key Competences for Lifelong Learning** denote a set of competences of an adequate reference level that are necessary for one's inclusion in the life of the community, and that form the basis for the acquisition of competences during one's lifetime to meet any personal, social and professional needs.

**VWTS** – Virtual Welding Training System

## THE S – K – S SYSTEM

### ***Capability system for trainees***

CAPABILITY is an integrated education program (learning and techniques) that precedes the S-K-S system and is of the same internal structure. It consists of the teaching material, knowledge sources (media) that enable a two-way communication, assignment system that encourages the student, and instrument activities with the help of which the program realization is evaluated. The goal is to acquire basic capabilities to work as a professional in welding.

Teaching materials lean on the document IAB-089r4-12, IIW-IAB Section: “Minimum Requirements for the Education, Examination and Qualification of International Welder”.

Knowledge sources are partly traditional, and mainly modern, associated with Internet use, web pages with e-learning materials and welding sites. Facebook was chosen as means for communication because of its wide spectrum of possibilities for communication and immense popularity within the student population, but also because all students have mobile phones, and Facebook use is free of charge. Coordination of all activities is run via mentorship.

Assignment or activity system consists of a theoretical, practical and psychophysical part.

Theoretical system of assignments is of thematic character, and it is solved by the students in cooperation with their mentor and presented to other students in the classroom or with the help of media.

Practical assignments are divided into two types: virtual (40%) and real (60%). Virtual assignments are set by the mentor by designing the curriculum and determining the minimum threshold required for going to a higher level. Real assignments are defined according to the already mentioned IIW-IAB Guidelines.

Role of the psychophysical training is to raise the welder’s efficiency in such a way to enable them to very specifically repeat certain moves many times in specific body positions, and to have a steady hand while doing that. In addition, this type of training helps the welder achieve stability – to be able to transfer the accomplishments from skills and knowledge training in interaction with conditioning to his work place, i.e. to optimize their work and achieve the results systematically, and not by chance. Evaluation instruments for program realization are: achieving of minimum goals for all types of assignments, self-control of learning results, grading of presentations based on readership rating, independent scoring on the virtual simulator and reaching of corresponding levels, as well as grading of practical assignments through methods used in evaluation of welders (e.g.. EN 287-1:2004). The other link in the evaluation system is grading of teachers by the students, and the third link is the feedback on employment of students and satisfaction of employers with their efficiency.

### ***S-K-S system for professionals***

Professional welders very rarely renew their knowledge and welding technique during their working life. While they work, they mostly live in a closed circle: work – attestation – work – attestation.... And one loses the technique without the renewal of knowledge and training. To constantly weld does not guarantee top-of-the-line welding technique.

Mistakes in welding usually come from the badly chosen welding technology or the badly chosen welding technique. If the technology is left to the welding specialists (IWE; IWS or IWT), the poor performance (technique) is then left to the welders.

The research has shown that welders regain their technique through training, which automatically reduces the percentage of mistakes.

The S-K-S system for professionals is based on:

- Training of welders on virtual simulator (100%) at least once a year, regardless of attestation,
- Renewal of knowledge from the field of welding technology once a year,
- Constant care of psychophysical condition of welders by introducing the conditioning and psychological preparation through organized professional or recreational programs.

## **PEDAGOGICS, METHODICS AND COMMUNICATION OF THE S-K-S SYSTEM**

When any type of education is discussed, be it formal, non-formal, informal or e-education, it is important to know that in its core is **interaction**.

The S-K-S system is deeply involved in EQF that represents the instrument for recognition of levels of acquired competencies based on measurable learning outcomes, mutual trust and quality assurance and management system.

The S-K-S system is doubly integrated. On the one hand, it integrates knowledge, skills and psychophysical stability. On the other hand, it integrates traditional and modern teaching methods based on mobile technologies and Internet/Web consumerism.

No matter if it is teaching in elementary school, secondary school, at an institution of higher education or part of lifelong/permanent education, the educational process is always more successful if one respects and applies the appropriate pedagogical, didactic and methodical principles.

The S-K-S system promotes modern teaching, where one strictly takes care of the fact that the usage of appropriate pedagogical models and principles, as well as adequate means of communication with the teacher/mentor/instructor and among participants themselves is essential.

Pedagogically speaking, the S-K-S system leans on the curriculum pedagogy, an important interdisciplinary area that is methodologically, structurally and in terms of contents defined (designed) in relation to practical expectations. Here, one has to keep in mind that the curriculum is not the same as the syllabus, knowledge catalogues or educational standards. Its starting point is the general established strategy of social development, singularities of modern educational policies and verified pedagogical standards and competency expectations. It includes formal, non-formal, informal and e-learning, as well as media inculturation and socialization process. It is enacted based on the optimal, rational and interdisciplinary consensus. Here it is essential to set a clear upbringing goal and educational assignments as a curricular starting point. All this goes to prove that the chosen pedagogy is satisfactory at both European and national levels.

By analyzing the welding population, one has come to a conclusion that, no matter if one deals with trainees or professionals, it is necessary to apply teaching methods directed towards the participants' needs to the greatest extent possible.

Structured and modular model was chosen as a teaching process model, primarily because gathering, processing, filtering and the choice of goals is left to the experts. They define educational content and form the modules. During further course of module designing, the initiative is taken over by teachers – practitioners, because they are more familiar with their surroundings and their participants' abilities. Having participants' individual characteristics in mind, possible implementation scenarios are defined: methods and work forms, social organization, as well as teaching materials and aids to be used. Control points for evaluation, connections with other modules and correlation with other subjects are also defined.

### ***Why methodics?***

Because it is obvious that just placing the contents of a subject or a course on the Internet/Web, without using the corresponding pedagogical models and principles, as well as without sufficient representation of appropriate means of communication of participants with their teacher/instructor and among other participants is not enough to fulfill educational goals in case of less independent participants.

### ***Why communication?***

Learning process is not just connected to individual efforts in acquiring the knowledge and skills, but is also based on the social interaction between the participant and the teacher/instructor, as well as among the participants themselves.

This is why it is not enough that the participants of a teaching process or an on-line course simply obtain information from available literature and electronic resources for an educational process to be successful, but rather get help and assistance in mastering the contents through communication with their teacher/instructor, as well as the feedback on their results and work mode.

Taking part in a group educational process is a chance for participants to make informal contacts and fulfill different social needs. The social aspect in group education is especially important because communication has an impact on participants' motivation, but is also important for the greater sense of confidence and pleasure when participating in group forms of teaching and thus acquiring knowledge and skills.

In distance learning, there is a trend of intensifying the social interaction with stress on the so called "we-learning" systems, which are also recommended in the S-K-S system.