

An Innovative Guide to Work-Based Learning in the Field of Industry 4.0 [†]

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Abstract: This paper presents a practical methodology for Work-Based Learning (WBL) as a research result of the iNduce 4.0 European project consortium. A training platform has been developed for the purpose of providing enterprises with affordable and flexible training which could be best adapted and customized to their specific needs. On the training platform, there are four training modules on the subject of Industry 4.0. The courses structure is the result of a large scale survey within two target groups: manufacturing enterprises and vocational education and training stakeholders. Training begins with learning needs analysis designed to support the individual. The structure of the guide to quality WBL reveals the steps for an efficient WBL programme established by vocational education providers, which serves as a tool and requires them to commit to the quality standards and code of conduct dictated at the national level as well as to the ones stated in the European quality charter on internships and apprenticeships.

Keywords: work-based learning; industry 4.0; vocational education and training; manufacturing; smart production; training platform

1. Introduction

Work-Based Learning (WBL) is an educational strategy that provides students with real-life work experiences where they can apply academic and technical skills and develop their employability. Depending on the country and the type of agreement between the student and the company, it could be an internship, an apprenticeship, or a mentorship. Various innovative models can be used for training [1,2] and assessment [3]. WBL may take place on demand and during working hours, sometimes for a clearly defined problem [4], in various industrial fields [5,6] or services [7].

The learning materials need to be designed in order to facilitate learning by being effective and userfriendly [8], which can be on paper support or electronic [9,10]. In general, at the organizational level, the references regarding the advantages of electronic learning are superior to the disadvantages [11]. E-learning is just as effective as face-to-face training and awareness of the benefits is achieved six to eight weeks after the training [12]. A barrier to the use of electronic technologies in vocational education and training (VET) is the reluctance of some professional training institutions [13] as well as some teachers [14].

The purpose of this paper is to present an electronic training platform for WBL developed in the framework of the Erasmus project entitled Work-based training approach in the field of Industry 4.0 for competitive European Industry—iNduce 4.0 [15].

The research has started with a state-of-the-art analysis on the knowledge and skills gaps on the topic of Industry 4.0 and the requirements for WBL [16] as well as a review of the legislation framework in the field of WBL at a European level [17,18].

2. Methods

The iNduce 4.0 e-learning courses structure is the result of a large scale survey within two target groups: manufacturing small medium enterprises (SMEs) and VET providers/trainers/consultants. It was conducted in six European countries: Romania, Poland, Portugal, Germany, Bulgaria, and Cyprus. In total, 117 SMEs and 77 VET providers participated in the survey.

Based on the results of the survey, the iNduce 4.0 training course was developed on the ground of the following key points:

- The topic of Industry 4.0 is considered important but there is a low level of awareness of the subject at the company level;
- SMEs are better acquainted with the industry concept than VET providers' representatives;
- A comprehensive package of training materials is highly appreciated with focus put on "Introduction to Industry 4.0" and "Solutions for smart production environments in the manufacturing sector";
- Only one or two skills is not enough when it comes to Industry 4.0, but a set of skills is needed and is necessary to address as many skills as possible with focus on Complex Problem Solving Skills, Technical skills, and Systems skills;
- The iNduce 4.0 training course should be more practice-focused, with the option of being tailored to a different way of teaching, such as workplace training, blended learning, and online courses;
- The educational portal should have interactive evaluation tests, an option to download files, and discussion forums.

Important findings about Work-based learning that came out of the survey reveal that few of the participating VET organizations providing onsite training programmes to companies offer any training related to Industry 4.0. One reason for this might be the fact that the topic is still new and VET organizations have not yet managed to develop courses and they are not yet familiar enough with the topic. Other reasons are also linked to the lack of information resources, low demand/interest in educational services, and reluctance of employers and employees to engage with this new thematic. In comparison, SMEs pointed out two different obstacles in applying WBL programmes for new employees/students: lack of time and resources and lack of theoretical materials to combine with practical elements, such as legal regulations.

The level of awareness on the topic combined with the lack of information resources and theoretical and practical materials pointed out by SMEs and VET stakeholders as obstacles towards organizing WBL confirms the importance of the project and the need of such training materials and courses.

The training should start with learning needs to be analysed, which is a review of learning and development requirements that is designed to support the individual. It provides an opportunity to reflect on what skills/knowledge the trainee needs to succeed, what skills/knowledge the trainee already has, and what skills/knowledge the trainee needs to develop.

Skills analysis should reveal what skills the employee needs to know to carry out their role effectively and if the employee has any knowledge on the subject, which could range from having an understanding of a particular subject to more complex issues that require training, coaching etc. Expectations of the manager should reveal what is necessary for the employee to know for a better functioning of the organization and about fulfillment of organizational objectives. Identified gaps in learning, if the employee recognizes those gaps, indicate what is required in order to reach competence in that skill. Previous experience and training outlines volume of knowledge of the employee and what is required in order to reach competence in that task, the length of previous training on a particular matter and if this is still relevant and how this will be achieved, if there could be alternative ways

of learning than to send someone on a course and also how this is going to be evaluated, what processes are in place to ensure that it has been achieved, how it is going to be measured, and what the timescales are.

SMEs stakeholders for training, managers, consultants, and VET providers know that they need to keep up with the latest innovations and technologies if they want to live and thrive in a competitive global market. They need to develop their own skills and knowledge in Industry 4.0 and to make sure that their current and future workforce is up-to-date to succeed.

SMEs' managers need to ask themselves these questions before even considering their employees and their own training in Industry 4.0:

- Purpose of the training: Why do I need my employees to know more about Industry 4.0?
- Measurable objectives: What measurable results are desired over time?
- Identification of the needs: What competencies are needed for succeeding now and in the future?
- Measure potential and identify gaps: What are the Opportunities/Challenges?
- Evaluate results of training: How have the defined objectives been met?

3. Results

Based on these findings, the iNduce 4.0 e-learning platform [15] has been developed with the purpose of providing SMEs with affordable and flexible training which could be best adapted and customized to their specific needs (Figure 1). The iNduce 4.0 e-learning platform can be approached in different ways, depending on the specific needs of the user. Furthermore, it allows both SMEs' managers and employees to adapt the new disruptive tools and methodologies provided by e-learning to their best advantage, or any other kind of learning experience involving learning providers and companies.



Figure 1. iNduce 4.0 e-learning platforms.

The iNduce 4.0 e-learning platform allows one to create new accounts and after registration, the user may choose a training course to enroll and then start studying. First, the user may select one of the languages: English, Romanian, Bulgarian, German, Greek, or Portuguese. There are four modules: Module 1—Introduction to industry 4.0; Module 2—Solutions for smart production environments in the manufacturing sector; Module 3—Smart robotics; Module 4—Applications of Cyber physical production systems/Internet of things across the process chain. Each of the four Modules include: Description and Outcomes; Subsections; Conclusion; The material in the pdf for download; Quiz (Figure 2).

The course facilities comprise: Dashboard: showing the courses that the user is enrolled in; Profile: settings of the profile; Messages: for exchange of messages with other participants and teachers; Preferences: change password, preferred language, etc.

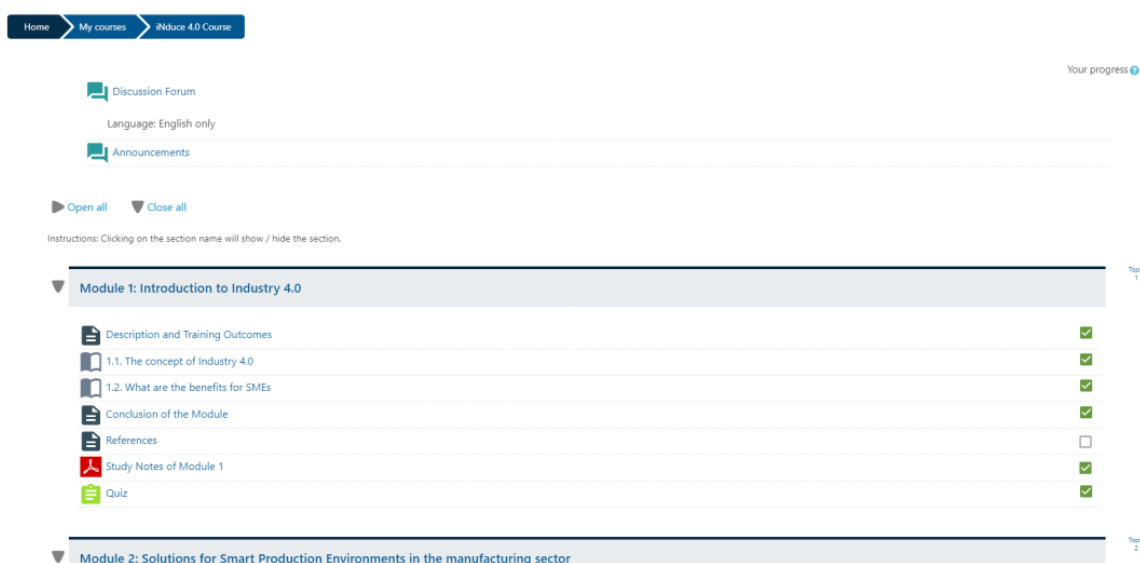


Figure 2. Structure of training modules.

4. Discussion

An efficient WBL programme established by SMEs’ Managers and VET providers with the support of the iNduce 4.0 e-learning platform requires them to commit to the quality standards and code of conduct dictated at a national level as well as to the ones stated in the European Quality Charter on Internships and Apprenticeships [19]. A comprehensive apprenticeship programme based on the INDUCE 4.0 course serves as a tool.

The structure of the Guide to quality WBL is presented in Figure 3. In the assessment phase, different departments of the company must be consulted to identify specific areas of work to which an intern could contribute.

The relations phase consists of approaching educational institutes like universities, technical schools, training centers, and other educational facilities that can equip the worker with the skills needed. This can create a solid bridge of skills between the company and the educational institutes.

The structured programme is a clearly defined programme which ensures that an apprenticeship/internship in the company is valuable and will help attract young talent. The programme should ensure that the intern: has clear written learning goals to be achieved; is given the opportunity to see different areas in the company; has planned and structured training using iNduce 4.0 onsite: an optimal “abstract/concrete” learning balance; is given a range of tasks to ensure the development of different skills foreseen in the programme; is given the opportunity to learn from other employees; has regular meetings with a supervisor to monitor progress.

The efficient recruitment increases the chances of getting the right person in the company. It should be based on: creation of a clear job description, including skills and competencies the company needs; stating in the job description that there is in-house training on Industry 4.0 will entice motivated people who are eager to improve their skills; ensure length of the apprenticeship/internship and the remuneration/reimbursements details are clearly stated; always give feedback to the interviewed people so they can improve their interview skills. This has the potential to create a positive image surrounding the company for young talent.

The introduction checklist is crucial for the intern to have a positive experience in the company. An example of a checklist for the first days in the company consists of: a good introduction to the company, its values, and missions, as well as to all the staff; a tour of the facilities; providing him with relevant health and safety information; giving him a copy of the working rules and the Code of Conduct; making him aware of available complaints channels; going through his desired learning

objectives, as well as tasks and duties stated in the job description; planning of training during his time with the company.

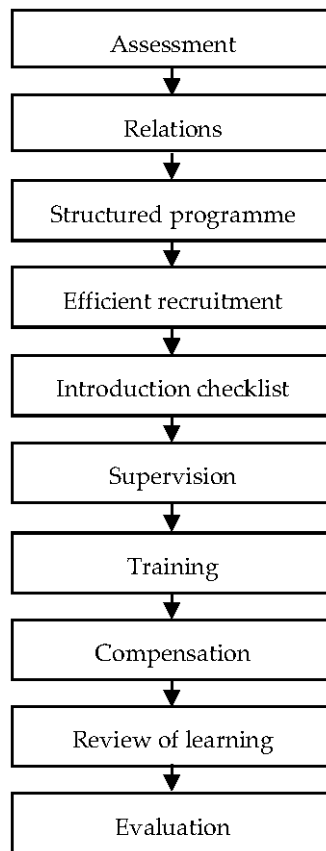


Figure 3. The Guide to quality Work-Based Learning (WBL).

The supervision is important for the intern in order to have supervisors who are trained in their responsibilities. This ensures that the intern feels supported and is part of a concrete learning process while the company is making the most of his skills and time. This could involve establishing monthly assessments to review progress and satisfaction and establishing a midterm review to assess progress against the written learning objectives.

Training gives interns the possibility to receive in-house training, which could enhance their professional skills. Training in Industry 4.0 is not only essential for the future of their career, but also for the company: it is important to go through iNduce 4.0 to select relevant modules for the intern as well as for the company. Good training must be well balanced between learning “abstracts” and applying them on-site and having a professional trainer is of course ideal but can be expensive. The alternative would be having an in-house trainer (e.g., the intern supervisor) who possesses pedagogical skills.

Compensation for interns means: no discrimination toward young people; incentive for motivation and commitment at work; making them part of the staff of the company, not just as cheap/free workforces.

Review of learning may consist of end-of-internship/apprenticeship presentation for the intern: what they have done; what they have learnt.

Evaluation of the internship/apprenticeship should include: How well the learning objectives are met? What projects have been completed or contributed to?; What knowledge and skills make the intern more prepared for the labor market?; What areas of improvement regarding the WBL process have been identified?

5. Conclusions

All levels of SMEs are going to benefit from the iNduce 4.0 training course. SME managers need to know about new technologies that can be applied to their companies in order to survive and develop in a competitive market. Acquiring skills and knowledge in Industry 4.0 can be key to the success of a business. This can be achieved in many efficient ways, including work-based learning by means of the e-learning platform iNduce 4.0.

Benefits and opportunities after upgrading to Industry 4.0 comprise: Increased productivity; Improved risk management; Real-time tracking, monitoring, and automation; Enhanced predictability of insights and actions; Optimized technology through the convergence of Information Technology and Operational Technology; Remote and predictive maintenance of machines; Optimized machine operations; Energy and environment monitoring and remote management; Self-sustained operations—machine learning-based robotic process automation of machines.

Benefits of the training using the iNduce 4.0 e-learning platform include benefits for the learner and benefits for the employer.

Benefits for the learner comprise: development of work-based learning and work-related skills simultaneously; exploiting the workplace as a learning resource; using existing knowledge activated as a foundation for new knowledge.

Benefits for the employer comprise: flexible, tailored to their needs; can lead to improved workforce performance and productivity; increases employee motivation—higher staff retention; meets skills shortages; work-based learning—little time off the job, minimal disruption.

iNduce 4.0 can be employed to best advantage its users thanks to its flexibility, which allows a customized adaptation of its learning tools to the specific needs of each user.

It is important to point out that even though e-learning presents many advantages, it is not exempt from some drawbacks. The most effective way to minimize the latter is to recur to blended learning: getting the most of an e-platform such as iNduce 4.0 by mixing online and face-to-face training [20].

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