Literature Review on Work-Based Learning

Kristina Murtazin
Information System Group
Tallinn University of Technology
Tallinn, Estonia
kristina.murtazin@taltech.ee

Oleg Shvets
Information System Group
Tallinn University of Technology
Tallinn, Estonia
oleg.shvets@taltech.ee

Gunnar Piho
Information System Group
Tallinn University of Technology
Tallinn, Estonia
gunnar.piho@taltech.ee

Abstract — **Work-based learning is a teaching and learning method which requires students to go through practical training. In work-based learning, also employers are responsible for teaching as well as evaluation of the students. Students learn theory at the university and apply these academic and technical skills at their working place.**

This full paper aims to provide a literature review on how work-based learning is organised and implemented in engineering curricula. It also aims to find out the possible factors which are influential in work-based learning and to get information on how to provide work-based learning more effectively. We followed the guidelines for systematic literature reviews by Kitchenham and Charters [1] and asked the following research questions: RQ1: What are the problems faced by faculty and universities in conducting work-based learning? RQ2: What is the student motivation to join work-based learning programmes? RQ3: How the companies are involved and how the universities are organising the training of the company's work-based mentors? RQ4: What is the main model of work-based learning in universities? RQ5: What are the benefits (real or perceived) of work-based learning?

According to the selection criteria, 42 papers on work-based learning in engineering curricula published from 2008 to 2018, were selected for the final review and conclusions.

Keywords— education, curriculum development, work-based learning, software engineering, business information technology, motivation, methods

I. INTRODUCTION

WORK-BASED LEARNING (WBL) is a teaching and learning method which requires students to go through practical training. Students learn theory at the university and apply the acquired academic and technical knowledge at their working place. Employers are responsible for providing the students with practical skills and evaluating their capability at the working place.

In September of 2018, we started with providing WBL at the Business Information Technology study programme (2 years, MSc), Tallinn University of Technology (TalTech).

During the preparation phase, we asked the following questions: What would be the problems we might face when providing WBL? How to motivate the students to join our program? How to organise productive collaboration between the university and the companies? How to organise the teaching process? What are the benefits of WBL?

To find the answers to our questions, we conducted literature research. The main aim of this was to get familiar with the experience of other universities. Another goal was to find out what the most influential factors of conducting WBL are and how to organise WBL effectively, as part of an academic curriculum?

The rest of the paper is structured as follows. In Section II, we explain the methodology, in Section III, we discuss the results, and we conclude in Section IV.

II. METHODOLOGY

A. Planning the Review

The literature review was conducted based on the guidelines proposed by Kitchenham and Charters [1] and Kitchenham et al. [2]. The research questions we were asking were as follows:

RQ1: What are the main issues faced by the faculties and universities, in conducting WBL?

RQ2: What is the student motivation to join WBL programmes?

RQ3: How companies are involved in WBL and, how universities are organising the training of the company's work-based mentors?

RQ4: What is the primary learning model of WBL the universities are using?

RQ5: What are the benefits (real or perceived) of WBL?

B. Data Collecting and Data Analysis

We used the keywords "workplace learning", "work-based learning" and "work-integrated learning" to search the full-text articles published between 2008 and 2018.

For the search, we used the IEEE Explore Digital Library, ACM Digital library, Science Direct (www.sciencedirect.com) and Google Scholar (scholar.google.com) databases. The search returned big numbers of the records (Table 1) from which we selected only the most relevant.

TABLE I. THE SEARCH RESULTS − THE NUMBERS OF RECORDS

Keyword	IEEE Explore Digital Library	ACM Digital library	Science Direct	Google Scholar
workplace learning	394	75	748	2140
work-based learning	148	18	387	1220
work integrated learning	43	42	138	1360

C. Selection Process and Quality Assessment

Selection of papers was a three-step procedure. In the first step, based on the title and abstract, we selected papers

according to our research questions. Next, we evaluated the quality of the papers, selected in the first step. Finally, we analysed the relevance of the content of the papers according to the selection criteria.

Based on Kitchenham & Charters' guidelines [1], we defined the criteria of inclusion, exclusion, and quality. We excluded the papers if:

- The paper did not address our research questions.
- The full text was not available.
- The paper was too short, such as workshop papers.
- The same research group wrote the papers with the same data (in that case only the most recent we kept).

The inclusion criteria in the first step were the following:

- The paper had to be in English and published in journals, in conference publications or as the book chapters.
- The paper is focusing on the WBL theory and practice in engineering curricula in a higher education institution.

After the first step of the selection process, all the included papers (Table 2), we analysed according to the quality criteria.

TABLE II. THE FIRST STEP RESULT – THE NUMBER OF RECORDS

IEEE Explore Digital Library	ACM Digital library	Science Direct	Google Scholar
63	21	28	22

For the field studies (qualitative and quantitative approaches), the selection criteria were as follows [1]:

- How well were the data collected?
- How well were the approach and the analysis formulated and conveyed?
- How clear were the links between data, interpretation, and conclusions?

For the theoretical papers, the criteria were the following:

- How well did the analysis address its original aims and objectives?
- How has been the knowledge or understanding extended by the research?
- How well were the diversity of perspective and the context explored?

For evaluating the compliance with the selection criteria, we assessed the papers using eight levels of classification proposed by Mary Shaw et al. [3]. These levels correspond to a certain quality as follows:

7 – anecdotes on practice;
6 – good practice example from a single course;
5 – good practice example from a curriculum;
4 – surveys with proper design and sampling;
3 – observational results reported by sound qualitative methods;
2 – quantitative empirical studies;
1 – formal or analytic results;
0 – systematic reviews with recommendations for practice.

As we were interested in facts and reliable experience, we decided to start with selecting the papers, which corresponded to the levels 0, 1 and 2: the systematic reviews, formal and analytical results and quantitative empirical studies. Later we decided to include also some papers from the qualitative research, surveys, good practice examples from a curriculum and a course (levels 3-6) into the review because we found them useful and innovative. All papers corresponding to the 7th level (the studies without validations of the results and conclusions) we excluded. As a result of the second step of selection, 54 articles were on the list of our selected papers.

In the third step, we selected the papers according to the relevance of the content — we excluded duplicated papers and the papers which did not respond to the research questions. As a result of the third step, 39 papers we selected for the final review.

Finally, all the papers in the bibliographical references of the selected papers were considered as potentially included papers and were analysed separately according to the inclusion and exclusion criteria of the selection process. As a result, we included five full-text articles; two of these are before the year 2008.

All selected papers are listed (references [4]-[46]) in the Reference section of this paper.

III. RESULTS

Each of the subsequent subsection will summarise our research findings related to the research questions we raised at the beginning of the literature research.

RQ1: What are the main issues faced by the faculties and universities, in conducting WBL?

The reported issues we found were related to the time planning, differences in university and industry expectations, students' skills and wellbeing and the resources needed in work-placed learning — look the Table 3.

TABLE III. THE ISSUES FACED BY FACULTY AND UNIVERSITIES IN CONDUCTING WORKPLACE TRAINING

Problems	Selected Papers
Time planning	[4], [5], [6], [7], [8], [9]
Differences between the university and industry expectations	[4], [5], [7], [8], [10], [11], [12]
Students' skills	[4], [5], [6], [9], [11], [7]
Students' wellbeing	[4], [6], [9], [11], [7], [13]
WBL is a resource intensive	[6], [5], [8], [11], [14]

The time planning issues, reported in papers, are the following:

1) Study courses at the university and work-based projects at the company may take place in different periods [4].
2) Students who work during the daytime at companies cannot participate in the university classes in the same (working) daytime [5].

Time planning issues are essential, and related stakeholders must solve them during the curriculum development process. Some solutions, how to address these issues, are provided in the papers [4] and [6].

The other issue with time planning is that students do not know how to plan their time and therefore, the projects which students have to conduct in a time-frame, may be poorly written and referenced [7], [8], [9].

The next issue is related to the relevance of the tasks for the employer and the academic program. Usually, the industry has different needs and success criteria than the academy.

Universities and industries must discuss and find the best possible solution for how the students are obtaining the needed theoretical knowledge and practical skills. This issue is discussed in the papers [4], [5], [7], [8], [10] and [11]. Ensuring the relevance of project topics to the employer and the academic program was stated in the paper [7].

The companies are not always keen to pay a salary for the students. They are also not keen to prepare the needed tutorials and educate the WBL coordinators. Therefore, a clear pattern, which satisfies the expectations of educational institutions, industries and students must be fixed before starting the collaboration for WBL. This issue is discussed in the paper [12].

Problems might also occur when *students skills* and previous experience does not meet the industry's needs, as reported in the papers [4], [5], [6], [7], [9] and [11]. The situation, when students have not enough programming skills to join and work with the teams at the industry, can make the students feel bad and the studying motivation can go down.

In companies, the students start comparing themselves with the full-time engineering staff, and if they do not have enough professional skills, they have worse working conditions and lower salaries. This *wellbeing* issue of students may also arise psychological problems of students as reported in [4], [6], [7], [9] and [11].

The work-based learning is a resource-intensive activity for the universities. As reported in papers [5], [6], [8], [11] and [14], these additional activities, that need resources, are the management of the contacts between the companies; searching for the new industrial partners; and the designing of the new courses.

RQ2: What is the student motivation to join WBL programmes?

Many studies analyse students' motivation to join WBL programmes. One of the motivation factors is that the WBL program can provide real-life experiences, cases and industry practices. They also help students to develop the practical skills which *help them in the future work* and provide them with the working experience already during their studies, and therefore help them to meet the demands of the labour market — in Table 4, we summarised the results of the RQ2.

WBL is *highly personalised* and can provide students with the industry and real-life experiences that can help them in the future ([10], [15], [16], [17] and [18]).

Other motivating factors that make students join the WBL programmes and in turn, force universities to make changes in the curriculum are as follows ([5], [16], [19]) :

- students want and need to *study near home;*
- more students want to go *back into higher education after a break;*
- the growing demand of industry for educated workers with degree education forces employees to go back to school to obtain the skills and the degree;
- students need income, WBL is an excellent possibility to learn and work at the same time ([5], [18]), in the chosen specialisation.

WBL is a possibility for students to have a full-time job and at the same time to study to obtain a degree. That is very important for the students, who want to be economically independent; are from the families with the lower-income; and for students who already have families. The authors of [20] found that traditionally the participants of WBL are mainly those who have working experience and who are already working in the industry and they choose the WBL programmes to be able to learn without quitting their workplace.

TABLE IV. STUDENT MOTIVATION TO JOIN WBL PROGRAMMES

Motivation	Selected Papers
Helps students in the future	[10], [13], [15], [16], [17], [18], [21], [22], [23], [24]
Students can save time by combining work and learning	[5], [11], [13], [16], [18], [19], [20]
Students skills	[4], [5], [7], [8], [10], [11], [12]
Workplace learning is valued	[4], [5], [7], [8], [10], [11], [12], [21]

Also, the flexibility of the WBL program, that can provide an option for a part-time study, classes in evenings or weekends and financial support from employers can be motivating for some students ([18], [20]). For adult students, WBL programs are more suitable, because they can study for a degree at the same time they work for the industry.

WBL is adaptable for different students, starting from the employees with lower positions, and ending with high-responsibility position [19]. A strong motivation for many students is entering or re-entering into the industry and starting or continuing their career during academic studies [11]. WBL also provides students with an opportunity to present their skills and competences to the employers [7].

RQ3: How companies are involved in WBL and, how universities are organising the training of the company's work-based mentors?

Involvement of the industries in the university study programmes is necessary mainly because companies often

perceive academic education as somewhat distant from the industry —Table 5 summarises the results of the RQ3.

The following key questions can be distinguished. How to organise the role of the company in the WBL? Moreover, how to attract and persuade the company to participate in WBL curriculum as it usually also requires company resources.

Students need to have supervision and support of the industry, in addition to the education staff, during the WBL studies. The company needs to propose their supervisor for the students, whose role is crucial, as the student's practical skills and wellbeing during the study process depend largely on the WBL supervisor. Also, an educational institution needs to consult and give instructions to the WBL supervisors to get constructive feedback from the students. These WBL supervisors need to be fixed and not changing. Sometimes it is necessary to organise special training for the WBL supervisors ([4], [10], [11], [12], [16], [25]).

TABLE V. INVOLVEMENT OF THE COMPANY AND TRAINING OF THE COMPANY'S SUPERVISORS

Factors	Selected Papers
The role of the WBL supervisor	[4], [10], [11], [12], [16], [25]
Relationship between the company and university	[16], [17], [25], [26], [27]

Employers often refuse to invest in higher education programmes. Unfortunately, universities do not always know how to clearly articulate the economic benefits of investing in the development of labour and providing opportunities for organisations and their employees. In order to make higher education offers more attractive for the companies, it is necessary that accreditation and evaluation are flexible and that education programmes are relevant to the businesses. It is also important to provide the marketing materials which help industries to assess, that university programs are to educate and develop future employees. It is also important to involve companies in the curriculum development ([16], [17], [25], [26]).

The study, reported in the [27], explains, how the concept of competences can help with industry engagement. To improve this situation, and to move forward the employer engagement, this study proposes that the key to closer education/employer relations lays on competencies. By cross-matching competencies (typology, applications and exemplars) with the simplified outcomes of workforce development (mainly, skilling, up-skilling and re-skilling) and education in general (teaching/learning, quality assurance, and fitness for purpose), a productive resonance with employers' engagement emerges.

RQ4: What is the primary learning model of WBL the universities are using?

Various publications have highlighted a variety of WBL models. Table 6 summarises the RQ4.

The European Commission identifies three work-based models [28]: learning apprenticeships, learning on-the-job training periods in companies, and integrated training.

In the apprenticeship system, the companies are the training providers. In these programmes, learners spend significant time on training in companies ([28], [29], [30], [31]). On-the-job training typically covers an internship at workplaces as a compulsory or optional element of study programmes, leading to formal qualifications. Such on-the-job training is typically around 25-30% of academic study and has no or little integration to ordinal studies at university ([28], [31]). In the integrated WBL, the university and the company are working closely together to educate the students.

It is possible to distinguish another WBL, called a school-based programme. Here the "real life" skills of students are acquainted through on-site university labs, workshops, kitchens, restaurants, junior or practice firms, simulations or real business/industry project assignments [28].

TABLE VI. THE LEARNING MODEL OF WBL IN UNIVERSITIES

The learning model of WBL in universities	Selected Papers
Apprenticeship	[7], [14], [22], [23], [28], [29], [30], [31], [32]
Dual model	[23], [33], [34]
The UK universities models: individual, distance, in-house, integrated, and co-delivery	[13], [32], [33], [35], [36], [37]
Curriculum-aligned model	[4], [11], [15], [22], [25], [26], [29], [31], [34], [38], [39]
3Ps	[25], [34], [40], [41]
On-the-job training periods in companies	[11], [14], [20], [22], [26], [28], [29], [30], [31], [34], [38], [41]
Integrated training	[11], [22], [28], [33], [34], [39], [40], [42], [43], [44]

The study, reported in [33], analysed the work-based models of higher education in German and British universities. In Germany, the model called "dual", as universities work in partnerships with the industries. The students are learning both at universities and their workplaces. At universities, students obtain theoretical knowledge, and the industry provides practical knowledge and skills.

There are five models used in the UK universities, described in [32], [36] and [35]: the individual, distance, in-house, integrated and co-delivery WBL models.

In the *individual model,* the curriculum is assembled individually, according to each student's previous experience and skills, and adapted to the industry needs. Usually, the student lives not far from the university, to be able to attend the classes at the university, and each student is advised by the personal mentor who keeps tracking the curriculum and student's performance.

In the distance model, students do not need to attend the classes physically and can take part in the classes from all over the world, via electronic channels.

The in-house model requires students to be physically present in the classes. The in-house model is very similar to the individual model, but in that case, the collaboration between the university and industry is closer. The learning facilitator is provided by the university who works off-site within the industry, as part of the learning development team.

The learning programme might be adapted individually, according to the students' and industry needs, and must be conducted by the university, as in some cases the employers can request the learning modules that are related to the business needs. Through this model, the WBL centre takes "*the university into the workplace and, in so doing, helps to break down the barriers between higher education and industry and helps to change the perceptions of individuals as to what the university study entails*" [35].

The *integrated model* is used, as a long-term arrangement between the industry and the university, after analysing the benefits, risks and costs. The facilitator provided by the university works as part of an in-house employee development team. As a result, a new programme, providing academic credit or not, might be worked out [35].

Papers [11], [26] and [38] provide an overview of WBL practice in Australian universities, where, in some areas of education (including engineering education), WBL is a fundamental part of the curricula.

In the Murdoch University, an equivalence, a focussed learning, educational supervision, and academic control are the critical factors in conducting a WBL. Mentioned above means that:

a) learning standards and outcomes of a WBL are equivalent to modules offered in a not-WBL way;

b) the learning context in the WBL is determined by objectives and outcomes;

c) an educational supervision guides the processes of setting learning goals and assessing students concerning learning outcomes;

d) university has the academic control in ensuring academic standards in supervision and assessment.

The WBL programs, developed by Victoria University [11], includes all the stakeholders (learner, university and partner organisation) and is an integral part of the curriculum. Learning outcomes are clearly defined; learning from experiences in the workplace is an integral part of the learning activity; assessment tasks reflect learning outcomes, and; assessment criteria are clearly defined. All parties are prepared adequately for the learning activities, and learners are supported in the workplace by the company WBL supervisor. The learning activities are improved continuously by an adequate quality assurance system, and all the activities have appropriate resources, provided both by companies and universities.

The paper [15] analyses five different WPL models. All these highlighted WBL models need the involvement of students, educational institutions and industrial employers.

The paper [20] reviews 43 WBL related articles and summarises the main characteristics of WBL. These primary characteristics are: (a) diversity of participants and facilitators; (b) practice-based learning; (c) flexibility of learning time; (d) systematic instruction at the workplace; and (e) active engagement and motivation of learners.

The model in [25] presents WBL as a triadic learning endeavour in which student, work-based facilitator and university tutor are engaged in a learning process as equal participants. The authors also claim that WBL moves the learning process from 'academy-based' (where theory invariably precedes practice) model to 'academy-aligned' model where theory can be learned in parallel or even after obtaining practical skills.

The study [4] describes the experience of the cooperative education - an academic-industry partnership that takes work-integrated learning "*further by deliberately aligning workplace experience to the academic curriculum*".

Paper [7] describes the experience of Aston University, an action research exploratory study, to analyse how work-based industrial project improves learners' skills and value for their employer.

Paper [14] explains the work-based learning program, designed by University Teknologi PETRONAS (UTP, Malaysia), to produce "work-ready" graduates. The program, called Student Industrial Internship Program (SIIP), is designed to provide WBL experience for the students. There are two courses: Student Industrial Training (SIT) and Student Industrial Project (SIP). The outcome of the program indicates that the selected batch of students was performing well. They were able to adapt to the real working environment and develop all the necessary skills needed for the "work-ready" graduates.

The aim of the paper [34] was to build a new in-depth framework for identifying the essential factors of best practices in WBL programmes. The framework was designed based on case studies of best practices from 14 WBL programmes where learning is a central goal of the programme.

In all the cases, university and industry worked together in close partnership. Despite many contextual differences (e.g. tradition, regulations, flexibility) of the partnerships, the study found some partnership elements in the curriculum design, delivery and evaluation of these WBL programmes. These elements were the '3 Ps': *Participating organisations*, *People involved*, and *Programme structure*. Mentioned elements seem to hold at least on a European scale, no matter what kind of higher education system is in use ([25], [34], [40], [41]).

RQ5: What are the benefits (real or perceived) of WBL?

The study, reported in [29], summarises the following pros and cons for WBL. The main pros of integrated internships are as follows: a) for a majority of students the inductive pedagogy (from practice to theory) is more efficient than the deductive

pedagogy; b) academia and industry understand better their mutual objectives; and c) curricula are better prepared to the needs of employers and society.

The main cons of integrated internships are the following: a) employers may consider apprentices as mere employees and underestimate the educational part; b) companies are focussed of ready-to-use engineers and not in preparing young people for a long-term professional career.

Almost all studies found that WBL is beneficial to their academic and professional development. For students, the following positive benefits were reported ([14], [15], [21], [22] [38], [45] and [46]): (1) WBL develops students' learning autonomy and entrepreneurial skills; students are becoming more aware of their learning processes; students are more capable of managing their academic and professional performance, and; students become more familiar with the learning objectives and outcomes. (2) WBL motivates students to use their own learning experiences. (3) WBL develops students' creativity and analytical thinking, making them more sensitive to customers' needs and more aware of the real world of work; develops work-readiness and increases job offers, career progression and salaries. (4) WBL develops students' communication and interpersonal skills; is building their self-confidence and decision-making ability; increases their teamwork ability, leadership and negotiation skills.

For employers, the positive characteristics are the following: (1) Improving the skills-base and flexibility of the workforce at all levels, is leading to increases in productivity. (2) The organisation that values the theoretical knowledge of employees, alongside the practical skills enables each member of staff to contribute according to their ability. (3) Recognising, rewarding and incentivising a staff through measures, that link to a national educational framework, is encouraging for employees and leads to progress. (4) WBL supports employee recruitment via non-traditional measures.

The study [15] found that businesses that collaborate with universities in research and learning gained competitive advantages and business benefits. These benefits include access to new ideas, international networks of academics, and the latest research and cutting-edge technology. Employers also benefit from a chance to spot and recruit the brightest young talent; and access to specialised consultancy and continuing professional development for staff and management.

The study conducted by the Royal Society got similar results. The employers may benefit from the appropriate skills, knowledge and experience at the right time according to business need. Also, the means of ensuring a stream of prospective employees through the pool of potential student candidates is beneficial for employers. At the same time, being able to bring together skills or expertise from more than one university and establishing broader strategic alliances with specific universities may open possibilities for further beneficial collaborations in all fields [16], [15].

According to [30], the benefits of WBL include improvement in the range of a person's skills and competencies. WBL also increases persons learning activity and acceptance of the need for ongoing learning.

WBL models generally have two other attributes that improve their prospects for success [15]. These attributes are

low government costs and benefits for private-sector employers. The government costs are low, mainly because employers pay for the work and work-based training of participants. Students, who possess these value-added features of WBL, are highly demanded by industry because the industry needs competent workers who are valuable assets to the company. An education system with WBL is beneficial for all involved parties, namely, for the student, for educational institutions and the industry.

IV. CONCLUSION

Learning, in a fast-changing world, requires new learning models. Learning, in higher educational institutes, has been evolved into a learner-centred, including competency-based and constructivism-based learning models. These learning concepts will have to be applied to professional learners too. In parallel, we see the evolution from e-learning to blended learning [18].

This full paper aimed to conduct a literature review on how work-based learning is organised and implemented in higher education study programmes. We conducted our research according to the guidelines for systematic literature reviews presented by Kitchenham and Charters [1]. According to the selection criteria, described in Section II, 42 papers published from 2008 to 2018, were selected for the final review and conclusions. Besides, we included two earlier papers, because these selected papers cited them commonly.

We had the following questions: RQ1 - What are the main issues faced by the faculties and universities, in conducting WBL? RQ2 - What is the student motivation to join WBL programmes? RQ3 - How companies are involved in WBL and, how universities are organising the training of the company's work-based mentors? RQ4 - What is the primary learning model of WBL the universities are using? RQ5 – What are the benefits (real or perceived) of WBL?

The issues, related to the RQ1, were time planning, differences between the university and industry expectations, students' skills and wellbeing and resources. All these issues can be avoided in WBL by partner-based communication, accurate programme design and planning.

Related to the RQ2, probably the biggest motivator for the WBL students is to obtain an academic degree and contribute to its professional development in combination with the everyday work and economic independence.

It is highly essential (RQ3) to organise WBL so that companies are involved, and companies' supervisors are trained in WBL related activities starting from the design and development of study programmes and ending with students' support, planning of students' learning paths and organising assessments and evaluations of students.

It looks like the most appreciated WBL model (RQ4) is a close partnership of all involved parties (student, university, industry) together with clearly identified learning outcomes and individual study paths, where are counted the needs of different parties (students personal and professional development goals, industry business needs, and academic requirements for a degree).

It looks, that when appropriately organised, and in close partnership, the WBL is beneficial (RQ5) for all the involved parties. Students are obtaining an academic degree, being during the studies economically more independent, and in an inductive

learning environment, that is more suitable for most students. Universities are better understanding the aims of industry and society, and therefore are offering better and more relevant education. The industry is building close relationships with universities, and in addition to better-prepared engineers, they involve in planning research directions of universities to get relevant solutions for business and technical issues.

For further research, we plan to expand the list of research questions and databases (e.g. Scopus and the Web of Science).

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