Employability competences through short-term intensive PBL-events in higher education

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The article presents a three-day problem based learning (PBL) event taking place as an interdisciplinary, cross-institution, and cross-sector digital learning activity in architecture, engineering, and construction (AEC). Students were given an overall realistic task by a builder to solve in interdisciplinary teams consisting of members from the involved institutions, i.e., a university college, a university, and a vocational school. Representatives from the AEC industry acted as consultants and teachers from the involved institutions acted as supervisors. Besides drawing on and enhancing students' existing disciplinary knowledge and skills, their skills in project management, collaboration, and communication were challenged during the event. Coming from a university with a PBL-model of semester-long project work, our main research interest focused on the university students' learning experience during this very short PBL learning activity. When studying the event from a work-based learning (WBL) perspective we found that the students' experiences and competences developed during the course of the event to a large extent could be interpreted as employability competences, thus placing the event as a "transitional" activity between education and a future work-place. Furthermore, we found that the gain from the event was mutual—the industry representatives learned about new digital solutions and programs used in the event. The empirical research was based on qualitative methods involving semi structured interviews (students as well as industry representatives), supplemented with informal conversations, observations, and photo documentation.

KEYWORDS

problem based learning (PBL), intensive short term PBL events, learning in higher education, employability, acquisition of competencies

Introduction

With the implementation of the international qualification framework in 2008 and matching national qualification frameworks, there is today a stronger focus on employability as a perspective that must be included in the practical curricula/education plans at higher education (HE) institutions (The European Commission, 2018).

The importance of employability is developed in the discourse of the global competitive knowledge economy, where change is an everyday reality, and generally agreed-upon by policy makers and scholars alike. Generally, there is a claim that HE institutions need to prepare students for jobs that do not yet exist, for using technologies that have not yet been invented, and for solving problems that nobody has yet thought of Bowden and Marton (2003), Kumar (2007). This claim is also seen expressed in the Lisbon and Bologna declarations referring to overall concepts such as "employability," "mobility," and "lifelong learning." The fundamental meaning of these political processes is to push for the candidates' work on their employability competences to find and keep jobs after graduation (Akkermans et al., 2013).

One approach to understanding employability is the definition outlined by Römgens et al. (2020), as an individual's perceived ability to obtain and maintain employment throughout their career. The definition identifies five employability dimensions retrieved from work place learning research: (1) human capital, (2) social capital, (3) lifelong learning and flexibility, (4) reflection on self and organization, and (5) a healthy work-life balance.

The focus on employability in HE began in the previous millennium in the US, Australia, and UK with a focus on the need for training of more general competences targeting the private sector. The discussions were based on the question of which kind of generic competences are necessary in relation to the knowledge economy and how these may be integrated in the educational curriculum (Klindt et al., 2021). Generic competences define characteristics referring to the general behavior of the person (the candidate), independently of the specific discipline related knowledge. Communication skills and analytical skills are primary examples of such generic competences.

In order to ensure development of both generic competences and employability, various short term learning approaches and environments have been developed, tested and implemented in HE institutions. Many of these attempts are in some way inspired by problem based learning (PBL) approaches and we find it important to explore this connection further by connecting short term events with experiences from HE PBL environments. In this paper we therefore focus on PBL as an educational framework for a short-term learning event case study. We aim to investigate the experiences of the different types of actors involved, in order to answer the question:

How can intensive short-term PBL events in higher education contribute to students' development of employability competences?

First, we describe the background of the chosen pedagogical framework and afterward introduce Work based learning as a framework for understanding important employability competences, as described by Eraut (2007, 2011). Afterward, the specific learning environment of the short-term PBL event case study is described. This is followed by a presentation of the results from the investigation of the case study in section "Results" and a discussion of the results with respect to the pedagogical framework in section "Discussion."

Pedagogical framework

The employability perspective on PBL in its general form, offers a range of possibilities in terms of allowing student development of academic identity and adaptability toward practice and the problems of society and working life. PBL in its core, therefore, holds the potential to bridge the gap between theory and practice for the development of employability. In the following we will describe key elements of working with PBL as a pedagogical setup in HE.

Problem based learning was originally designed and used to bring problems from society and professional practice into the classroom (Barrett, 2010), and has changed HE (Gijbels et al., 2005), through the work of "so called" reform universities (Kolmos, 2015), setting new standards for learning and education, by implementing what is both a learning philosophy and a pedagogical methodology.

Problem based learning emphasizes self-directed learning where students are active participants in the learning process (Savin-Baden and Major, 2004), working with a problem as the initiator of the research and project work process, providing a venue to enhance theoretical, and professional practice knowledge, and skills, develop life-long learning skills, and interpersonal abilities (Crawford and Machemer, 2008). Armitage et al. (2015) furthermore present PBL as encouraging those who take part in its processes to act both as supportive change agents as well as individuals using their creativity in finding solutions to practical as well as theoretical problems. An increase in creative capacity can, furthermore, lead to effectiveness and enjoyment as learners (Barrett, 2010).

The authors of the paper are experienced in using PBL in HE where the students' project work is semester long and entails the writing of long PBL project reports. The use of the concept "short term" in this paper highlights that the case study discussed in the following is very different and present a new type of PBL framework which has familiarities with the Camp concept (see e.g., Bager, 2011; Chounta et al., 2017 for different outlines of this connection).

One common idea—embedded in the notion of a hackathon (combining the terms "hacking" and "marathon") event—is an "invention marathon," where people interested in technology can "learn, build, and share" their creations with others (Horton et al., 2018). A hackathon can include e.g., events in which computer programmers and others involved in software development collaborate intensively over a short period of time on software projects (Briscoe and Mulligan, 2014).

Other examples of short term PBL events are short events with a particular interdisciplinary focus gathering students in real life problem scenario projects across faculties and disciplines in HE (see e.g., Wofie, 2015). Or Solution Camps with a focus on solving concrete problem scenarios for an external organization during a one day event (Solution Camp, 2022). Very often the discussed events integrate elements of PBL pedagogy and by connecting them to the HE concept of PBL we aim to develop the understanding of such events in general.

The event case study in this paper is called "The Digital Days." It has a specific focus on interdisciplinary digital problem solving and communication in the building industry (Gnaur et al., 2015). Due to a setup with participation of both students, teacher and industry representatives, an interdisciplinary nature, a PBL trained organizing group, and a short-term timespan, the Digital Days, was selected as the case-study for exploring how short-term PBL events can contribute to the development of employability competences.

In our approach to researching the level of employability competence development in students during the event, we are inspired by Eraut's work-based learning (WBL) framework (Eraut, 2007, 2011) and his understanding of learning from people in the workplace. Whilst research into WBL by e.g., Per-Erik Ellström focusses on life-long learning as well as conditions and limitations for such learning in daily work (Ellström, 2010), the scope of Eraut's framework is the transition between education and work and thereby scaffolds an approach to understand PBL events that is positioned in between an HE and an external context.

Eraut's work-based learning framework in general emphasizes that the "experienced challenge and value of the work" and the "quality of available feedback and support" are important *learning factors*. The "structuring of the work and surroundings," together with the "participants constellations in the group work" at the event constitute important *contextual factors* which also influence the learning factors. We consequently apply the framework, as a means of analysing, and understanding the employability value of the short term PBL-event, the Digital Days. In the following section we will describe the context of the Digital Days in some detail to help the reader understand the interactions and processes during the event.
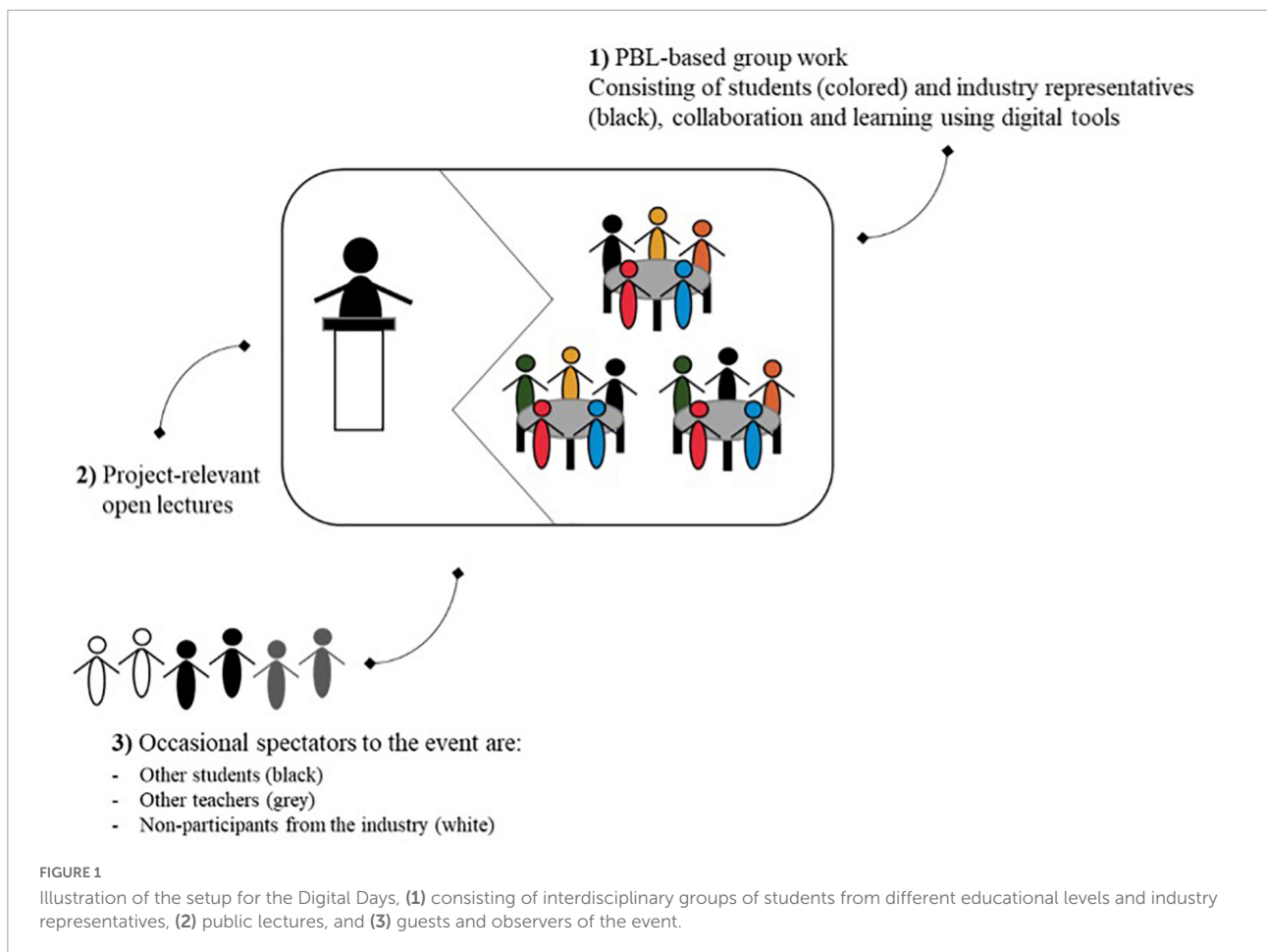
Learning environment

As stated by Ferrández-Berrueco et al. (2016) WBL must take place in real or at least well replicated work situations. This fits well with the Digital Days, as the event is held with the intention of bridging the gap between formal HEs, vocational educations, and the building industry. The intention of the event is to allow students to experience "real world" problems and work-conditions in a "safe-to-fail" environment, which should enable them to enhance their employability competences through exposure to the world of work (Hills et al., 2003).

The goal of the Digital Days is also to allow students in architecture, engineering, and construction (AEC) an opportunity for testing new technology and contemplate methods and processes in the building and construction industry. The event facilitates a forum that allows students to both discuss technology in the building industry and take part in dialogue to exchange ideas and negotiate meaning. The event managers, furthermore, design the learning conditions the participants are bound by, aiming at making them sufficiently challenging to stimulate and stretch students to develop higher levels of knowledge and skills, as it is recommended in other scientific studies (Csikszentmihalyi, 1997; Barrett, 2010). It is, however, important to notice that the students in each project group are responsible themselves for defining how they work and in which way they solve the problems they face during the Digital Days.

Hundred students in total from the three educational levels, (university college, university, and vocational school) participated in the three-day event in 2018 and were divided into four interdisciplinary groups of 25 people. They were supported by 8–10 industry representatives during the event, who fulfilled the role of sparring partners, tutors and facilitators in the PBL-setting. This ensured that the participating students had the opportunity for discussion and intervention when needed, which is important for development of disciplinary knowledge and skills, according to Barrows (1996) and Hendry et al. (1999). The students, furthermore, draw on supervisors from the involved educational institutions. In addition, the students were able to consult with a project "client," and a construction company. Both of these roles were filled by representatives from the building industry, providing a realistic simulation of real consultations with building owners and construction companies. Finally, the event had public AEC related lectures by professors, industry associations, and system developers, with the intent of widening the perspective of the students and providing them information and inspiration throughout the event days. The setup of the Digital Days is illustrated in **Figure 1**.

In this paper we focus on the university students and their development of employability competences through participating in the Digital Days. For this group

FIGURE 1
Illustration of the setup for the Digital Days, **(1)** consisting of interdisciplinary groups of students from different educational levels and industry representatives, **(2)** public lectures, and **(3)** guests and observers of the event.

of participants, the event was extracurricular, and their participation was voluntary.

The overall task for the students focused on a renovation of "Aalborg Tårnet" (Aalborg Tower) which is a 55 m high exhibition building from 1933, currently administrated by a local association, using the facility for different types of social events.

The client's requirement stated that the tower should be accessible for people with disabilities and the tower's guest capacity should be increased from 65 to 100 people. Each interdisciplinary group of students from different educational institutions and disciplines, were asked to develop the necessary product and analysis models of the building. This should allow them to detail the design of the building based on their results from various types of IT-based analysis of everything from the indoor environmental quality of the future building to planning of the construction site of the project as it would be, if it were to be built in real life. The students were required to make detailed documentation and a visual presentation of their work complying with legislation, regulation, and building owner demands. This was then discussed and evaluated by a panel of representatives from the educational institutions,

participating industry representatives and the "builder," on the final day of the event.

In order to study the learning environment and evaluate the outcome of the students' participation, seven informants were interviewed during the event using semi-structured interviews. First part consisted of interviews with four university students, three male, and one female, all in their twenties. Second part consisted of three interviews with industry representatives, all male, and in ages between 25 and 65. All semi-structured interviews were guided by an interview guide, recorded, and transcribed, as recommended by Tangaard and Brinkmann (2015). The interviews were undertaken in breaks during the event, five on the second day and two on the third and final day. The students were asked to reflect upon e.g., their overall experience of the learning situation, their collaboration with students from other disciplinary areas as well as with the industry representatives, and the challenges, disruptions, and learning processes compared to their usual PBL project work. The industry representatives were among other things asked to reflect upon their professional interest in participating in the event, their evaluation of the set-up of the event in an employability perspective, and if it was of value in relation

to their specific industry and their recruitment strategies. The interviews and transcripts were produced in Danish and later the relevant sections of the transcription were translated to English by the authors. The data were analyzed according to the dimensions of WBL by Eraut (2011).

The second part of the empirical data collection was based on observation, which was done by members of the research group who spent a full day observing activities as well as engaging in informal conversations with the participants, documented through field notes and photos. The observation data and field notes served as background information for understanding and description of the set-up and the learning environment (see **Figure 1**).

Results

In this section the results from the semi-structured interviews, are presented, guided by the four dimensions of WBL in Eraut (2011): (1) The challenge and value of the work, (2) feedback and support, (3) allocation and structuring of work, and (4) encounters and relationships with people at work. Both student and industry representative informants provided feedback on these four dimensions of the WBL framework, as shown in **Figure 2**.

With respect to the "challenge and value of the work," the student informants, primarily focused on how the Digital Days introduced them to the AEC-industry, and the real-world processes, which are not typically observable for the students during ordinary education. Some informants furthermore highlighted the possibility of experiencing stressful situations and "fire extinguishing" as a positive trait of the event. One of the students e.g., noted, "*you learn how to keep calm in stressful situations*" whilst another student explained that, working in a stressful setting: "*makes it important to coordinate across expertise in the project group compared to the process during ordinary education*," further adding, "*this is what I think you get out of the event the most.*"

On the topic of "feedback and support," the student informants explained that working side by side with industry representatives allows for continuous feedback for the students, and the possibility to get new tools from them, which according to one of the informants, "*might provide some employability,*" as the representatives "*can tell you when you are barking up the wrong tree, compared to how things are done in the real world.*"

Both students and industry representatives, additionally, agreed that they could inspire each other with respect to new solutions and aid each other in getting to know new tools and methodologies.

"Allocation and structuring of work" at the Digital Days is a task for the student participants to handle, which according to the informants, help them to identify and understand the distribution of power and responsibilities of a project.

Combined with the inputs given by the industry representatives, the informants noted that a better understanding of the AEC-industry was facilitated, and that the hierarchy of the workplace was introduced to them.

According to one of the industry representatives, "*there are off course aspects obstructing the event being a hundred per cent realistic, but that is because there is no boss saying* "*time is money*" *and such. . . the event will never completely be like the real world, because that will make us focus too much on the product, and not the process of developing.*" This highlights that the allocation of work must represent realism of the AEC-industry, however, not to a degree where learning is limited by students being afraid of trying new things or making mistakes.

With respect to the final aspect of WBL, which is "the encounters and relationships with people at work," the student informants stressed that the collaboration facilitated at the Digital Days, both through the realistic setup and the interdisciplinary nature of the event, was one of the primary learning outcomes, combined with learning better communication, as previously mentioned. This is in line with the needs in the industry, according to one of the industry representatives, who noted "*it is not the expertise we worry about the most, it is mostly the people. People need to be able to communicate with others. Communication is a major part of the building industry.*" According to another industry representative, "*the event is not about technology, it is about people*", which highlights the ability to collaborate as one of the most important learning outcomes the students experience at the Digital Days, through their encounters and relationships.

Another factor mentioned by both students and industry representatives, is the ability the event provides regarding internships and getting a job after graduation. One industry representative explained, "*it is a very good way for us to* "*get*" *the right people. I get a chance to speak with them and attain a good insight into how they are as persons and how they will fit into our or one of our branches. This makes the recruiting process short as we get a chance to work together for a little while during the event.*"

The results of the semi-structured interviews showed the Digital Days as a realistic platform for developing employability competences through the lens of a WBL-framework. The short-term PBL event allowed the students to try out new and/or other things than they do during ordinary education, in addition to allow the students a realistic introduction to the AEC-industry, in a "safe-to-fail" environment.

Discussion

Through the use of the four dimensions of WBL by Eraut (2011) as a measure for the development of employability competencies in short-term PBL events the previous section highlighted how aspects of employability is

Mentioned by:	Students	Industry Representatives
The challenge and value of work		
Introduction to the AEC industry	+	
Introduction to Real World Processes	+	
Undergoing stressfull situations	+	
Problemsovling and "fire extinguishing"	+	
Learning better communication	+	+
Feedback and support		
Leaning through side-by-side collaboration with industrial representatives	+	
Inspiration to new solutions	+	+
Introduction to new tools and methodologies	+	+
Allocation and structuring of work		
Understanding the distribution of power and responsibilities in the AEC industry	+	
Understanding the hierachy of the workplace	+	
Encounters and relationships with people at work		
Understanding the need for interdiciplinary collaboration	+	
Finding internships and jobs	+	+

FIGURE 2
Themes arising from the semi-structured interviews, categorized using the four WBL-dimensions described by Eraut (2011).

practiced and developed through the Digital Days. In the following discussion we will focus on how the pedagogical PBL framework functioned and in some aspects was changed in this employability oriented short-term setting.

As mentioned by the student informants, the Digital Days provide the students a unique insight into how the industry they are about to enter works. It allows them to undergo stressful situations and do problem-solving on a higher level, than what they usually experience in a traditional educational PBL setting. The event therefore has a potential of a deep exploration of "what is possible" as it provides a more realistic environment. As described by the informants, one of the primary benefits of participating was the inspiration gained through collaboration with people from the AEC-industry.

In this sense, this type of short-term PBL events provides an educational setting that is markedly different from many HE PBL projects where students most of the time work on a distance from their context of exploration. The short-term PBL event has more resemblances to e.g., internships also used in HE but here in a shorter period of time and in a more intensive environment where students and industry representatives negotiate the meaning of approaches, solutions etc.

A trademark of PBL is the principle of self-directed learning in teams of students. The value of the work a participant can experience at an event, like the Digital Days, is dependent on the participants' own ability to define the knowledge and skills they require to solve their assignment. According to

Halliwell (2008) this is also what will keep the participant engaged in participating. This corresponds well with the findings of Lam (2004) who describes self-directed learning, placing the student as the one assuming the primary learning responsibility. Combining the findings of both Halliwell and Lam, shows that in order for a student to be challenged and attain value from participating in a short-term PBL event, students must engage themselves in a project, through taking responsibility of their own learning needs, as well as defining what is required in order to solve the problems which are faced, themselves. A process resembling self-directed learning, as described by Savin-Baden and Major (2004). In this respect PBL in short-term settings very much resemble the semester long version of PBL by bringing students in a position to develop their own learning goals and find their own approach and methods to developing solutions to a given problem.

In addition to working from a self-directed problem based approach the students also had to organize and structure the teams overall work. According to the interviews, this called for an understanding of how to distribute power and responsibility in the project team, as well as understanding the hierarchy of the workplace in the industry environment. The way the students worked, was inspired by the industry representatives participating, as also noted by some of the informants.

The nature of the event, in which the students had to structure their own work without direct support from a teacher and had to allocate the "right" amount and type of

resources in order to finish the project, a process resembling WBL, additionally resulted in development of employability competences, which will not necessarily be developed through traditional PBL education. The heterogeneity of the interdisciplinary student groups as well as the influence of the industry representatives clearly provide an organizational setup to the PBL framework that is far more complex than what the more normal homogenous PBL groups of students will experience through their project work. Experiencing this level of complexity in backgrounds and disciplines contributed to a lot of reflection on the students' own skills and expertise as opposed to the skills of other team members.

This type of short-term PBL events seems to hold the potential for being a format that can be used to build employability competencies. Among other aspects these events bring industry and HE closer by establishing a framework for working together on joint challenges, and by creating extremely heterogeneous teams that highlights the need for organization in a complex workplace context. More studies are needed to explore how much control and structure is beneficial from the organizer side in events like the Digital Days. Studies that explore the educational setup in terms of time frame, the impact of lectures during the event etc. is also needed to help our understanding of how an effective PBL based educational platform can be created for the development of employability competences.

Data availability statement

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent was given by all participants in the research process.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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