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IMPROVING TRANSNATIONAL EDUCATION IN TIMBER CONSTRUCTION BY THE USE OF PROJECT-BASED LEARNING APPROACH: AS EVALUATED BY TEACHERS AND STUDENTS

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Abstract. The atmospheric CO_2 is now at the highest level seen (400 ppm) and the construction sector is responsible for 36 % of all greenhouse gases. One way to reduce this negative impact is to use more sustainable and environmentally friendly materials such as timber in the construction. To direct the sector towards this goal, the Erasmus+ project HiTimber ("Sustainable High-Rise Buildings Designed and Constructed in Timber") was initiated in 2017. With the objective of developing an international and trans-disciplinary course in design, construction and management of sustainable high-rise timber buildings, project-based learning (PBL) was applied. The aim of the paper is to examine the effects of the PBL by examples and results from the HiTimber workshops. The presented results are the approbation of scientifically-practical results, derived from surveys conducted in 2018 and 2019 where 29 teachers and 45 students evaluated the PBL-based workshops. In general, all teachers and 85 % of students were satisfied with the PBL approach; the students were more engaged, motivated and successful in their studies. However, the transition from traditional teaching to PBL has its challenges and requires time, effort and strong commitment from both students and teachers to be effective.

***Keywords**: Education in timber construction, evaluation, improvement of learning, project-based learning (PBL)*

INTRODUCTION

The research presented in the paper is derived from the project "Sustainable High-Rise Buildings Designed and Constructed in Timber" (HiTimber). It is funded by the Erasmus+ programme of the European Union and is a strategic partnership under the key action of cooperation for innovation and the exchange of good practices. The project aims at "improving competences of students and teachers in problem solving and team work, innovative thinking, increasing their motivation, awareness of cross-professional project input and project management by using project-based learning approach (PBL)" (HiTimber, 2019). Project partners are higher education institutions from Denmark, the United Kingdom, Estonia,

Lithuania and Portugal, the Estonian Wood House Association, and the Study and Consulting Center.

The project has several objectives; the one addressed in this paper is to strengthen PBL skills through workshops facilitated by the project partners. The hypothesis is that by using PBL students can achieve better learning and improve their 21st century skills in collaboration with students from other countries and educations while increasing their knowledge in high-rise timber construction. Furthermore, it is expected that they will improve their skills of critical thinking, problem solving, group work, negotiation, reaching consensus, taking responsibility for their own learning and social participation.

Through specially designed teaching courses and workshops, the project pursued to strengthen the knowledge level, innovation and collaboration skills of the students. It corresponds to the high-rise timber construction market progress and the demand for innovative and cooperative employees within a business.

The project contains several intensive learning courses where students from partner institutions can participate in workshops on design, construction and management of high-rise timber buildings. These workshops were held in Southampton (2018), Lisbon (2019) and will continue in Tallinn (2020). They are attended by students from the partner institutions. Each workshop covers part of the building design process from the outline proposal phase, over scheme design phase to detail 1 and detail 2 phases. During each workshop, the participating students work on the assignments and end the process with a presentation. The results from the first workshop are applied to the second workshop, where new students then complete the proposal for the scheme design phase and so on. The courses are implemented according to PBL and the teachers give only few general lectures, after students in groups must use their previous knowledge and search for the new information needed in their particular project.

The workshop design in the HiTimber project and the results presented in this paper are also based on findings from two summer schools related to design and construction from wood organised by VIA University College, other summer schools and PBL-based workshops held around Europe. The summer schools and workshops were attended by more than 400 students.

In this paper, the effects of the PBL approach in transnational and interdisciplinary education in timber construction are investigated by examples and results from the HiTimber workshops and previous modules conducted by project partners at their institutions or in other projects. The study aims at determining whether students and teachers find PBL beneficial for learning, what benefits and challenges they experience and, finally, whether PBL can be implemented in similar courses or modules in the future.

1. BACKGROUND

There is a general perception in the construction sector that high-rise timber buildings will see greater advancement in the coming years due to demand for sustainable materials that can reduce the carbon footprint of the sector alongside a deeper knowledge and better skills within fire protection (Thelandersson et al.,

2004). The problem is that neither the industry, nor the education institutions and graduates are ready for this major and sweeping change in the sector. Traditionally, students are taught to design and calculate massive building structures in steel and concrete, whereas wooden structures are intended for smaller one- to two-story buildings. The HiTimber project originated from an intention to prepare students across borders for the world and development that awaits them on the other side of their education – the world where they will have to work with the sustainable wood structures and thus will be obligated to be familiar with the material, structural behaviour and the related challenges.

Although the number of high-rise buildings in timber is steadily increasing worldwide, the number of already implement projects, which can act as best practices for new designs, is quite small. It has yet to become a general competence to build high-rise timber buildings, as it is a case with both steel and concrete structures. However, the industry still evaluates high-rise timber construction as prestigious, expensive and exceptional one. Many uncertainties are still experienced regarding tall wooden structures, especially in relation to strength and fire safety. There is also uncertainty about the real sustainability of timber buildings versus concrete and or steel ones. On the other hand, recent research distinguishes many advantages of high-rise timber buildings. Timber has substantial environmental benefits: trees absorb CO_2 from the atmosphere, store the carbon and release O_2, as well as the processing and transportation of timber requires less energy than steel and concrete. Wood is a good insulator; therefore, less energy is required for heating and cooling wooden buildings. Finally, the number of studies has shown that timber elements have less global warming emissions than steel or concrete (Harte, 2009; Hildebrandt, Hagemann, & Thrän, 2017). For instance, Skullestad et al. (2016) have examined the sustainability of tall wooden structures and concluded on the basis of their LCA calculations that the wooden structures (especially over 12 floors) are far more climate friendly than the reinforced concrete structures.

In 2018, the HiTimber project conducted the research on best practices and knowledge gaps for the construction of high-rise timber buildings in all partner countries, namely Denmark, the United Kingdom, Estonia, Lithuania and Portugal (Hamburg et al., 2018). The study found that there was virtually no opportunity to specialise in high-rise timber construction during education in any of the partner countries and there was also a large knowledge gap in all countries within this type of construction. At the same time, there was the limited number of already built high-rise wooden buildings that could be used as best practice examples. Therefore, a need for innovative education strategies was identified (Hamburg et al., 2018).

Stock and Kohl (2018) observe that transnational and project-oriented concepts in education for young professionals in engineering need to be developed and, additionally, social and self-competences provided. This can be achieved by the PBL approach.

PBL is a problem-oriented teaching and learning approach. It was initiated in 1969 by Howard Barrows, who was an American neurology professor at McMaster University (Canada) (Li et al., 2019). Nowadays PBL is a way of training and educating students based on a tutorial process that can be adapted to different scientific and professional areas.

Based on findings by other authors, Liu et al. (2019) distinguish general characteristics of the PBL approach: 1) problems are used for starting the learning process; 2) learning is collaborative; 3) student-centred learning; 4) the supervising/mentoring role of teachers; 5) inclusion of self-studies. Moreover, such learning is inter-disciplinary and focuses on real situations; students can apply previously obtained knowledge and skills to solve new problems (De Graaff & Kolmos, 2003).

The PBL has a focus on a cross-curricular philosophy of content to be taught promoting multi-disciplinary education and training based on problem solving for acquisition of skills, the reinterpretation of knowledge and its adaptation to new and different contexts. This teaching and learning model has applicability in processes of updating skills throughout the professional life, so the advantage of PBL training at the initial phase of student education is crucial to encourage future autonomous updating procedures and initiatives.

The PBL systematises learning focus on projects as a model for teachers' activity, which considers projects as a complex mission. The PBL is based on stimulating questions or problems, which involves students in tasks such as design, problem solving and decision making, or research activities. Therefore PBL encourages active participation and "*development of flexible knowledge, effective problem-solving, critical-thinking skills, self-directed learning, effective collaboration skills, and intrinsic motivation"* (Hmelo-Silver, 2004).

By conducting PBL, real-life challenges are solved when students are working in groups to solve authentic (not simulated), profession-related open-ended problems (Thomas, 2000; Edström & Kolmos, 2014; De Graaff & Kolmos, 2003; Powell, 2004).

PBL is still new to many teachers and students around the world. In a few places, for example, at Aalborg University in Denmark and Twente University in the Netherlands, PBL is an integrated part of the entire educational program. Elsewhere PBL is introduced in small short modules of, e.g., a few weeks duration and other universities do not have PBL at all (Harmer, 2014). Many universities use traditional learning, where the teacher presents a theme based on the curriculum of the specific education. After that, the students must memorise this topic based on the teachers' presentation and finally they have to solve a problem designed to show how to use the knowledge. In PBL, the problem is assigned at the beginning and then students have to solve it by finding the necessary information, applying the information and presenting the results. While the first approach is fully controlled by the teacher, PBL is controlled by the students and only supported by the teacher.

Implementing PBL is challenging for both students and teachers. Many find the transition from traditional learning to problem-based learning difficult as the roles are changing, which can lead to some uncertainty for both teachers and students (Bradley-Levine et al., 2010; Sadler, 2012). Moreover, the PBL often requires collaborative work from the students who have to solve the assigned tasks in smaller groups. The group work is a new way of studying for many students (and teachers) and can cause many small or larger issues and obstacles to the students' learning and, for example, "free riders" can affect student motivation in a group (Pawson et al., 2006; Viswambaran & Shafeek, 2019). Getting used to working in groups

compared to traditional individual studies requires many efforts from students who have to make common planning, dividing tasks, trust each other's work and communicate their own findings. Teachers also have to take over the roles of mediator to succeed collaboration among the students. However, the benefits of PBL are greater than the challenges.

Viswambaran and Shafeek (2019) published their findings from a study regarding the impact of PBL as a tool to improve students' engagement and academic achievement and at the same time taking into account the curriculum of the education. All students who participated in the experimental project practically found that PBL made their studies more enjoyable and that they gained a deeper learning through their work on the assignment. Besides, their engagement increased and they were motivated to extend their learning since they had to take responsibility of their own project and could decide their personal strategy for solving the assignment. The teachers in the project observed a positive change in the students' behaviour and the way of studying and even in class attendance throughout the courses (Viswambaran & Shafeek, 2019).

Other studies revealed that the benefits of PBL include development of collaboration skills, better student engagement in the learning process (Balan et al., 2019), and increased student satisfaction with the curriculum (Czabanowska, et al. 2012).

Some of the research is focused on application of the PBL in teaching of sustainability. Wan Alwi et al. (2012) presented findings from a nine-week project aimed at increasing the awareness of sustainability for first-year engineering students at the Faculty of Chemical Engineering, Universiti Teknologi Malaysia. Cooperative PBL was used in the study. The researchers observed that a cooperative problem based learning approach had increased environmental consciousness of the students and at the same time provided engineering knowledge. Wyness and Dalton (2018) found that PBL is "an appropriate and enabling method with which to introduce sustainability".

Vasilienė-Vasiliauskienė et al. (2016) further point towards students being more attractive to companies when they are used to working problem-based and have improved these skills during their education. These competences are what companies are looking for in future employees and, moreover, a university with a PBL approach is more interesting for companies. Hence, it is expected that the PBL approach will make both students and the universities more attractive to the relevant sector and increase the likelihood of beneficial collaborations with external partners.

2. METHODS AND PROCEDURES

The HiTimber is a three year-long project, which includes research and development of a teaching module in the design, construction and management of high-rise residential timber buildings, to meet the needs of the European higher education institutions and fulfil the future challenges. The module is expected to be innovative, based on international academic and business expertise, trans-disciplinary, including PBL and "learning by doing" strategies. The module is being

developed through the way of interaction among the higher education institutions from five European countries (Denmark, the UK, Estonia, Lithuania and Portugal).

As most of partners did not have experience in PBL, the first kick-off meeting took take place in Tallinn, Estonia, in October 2017. Among the other activities, one of the aims of this meeting was to plan PBL during the project, considering the knowledge of partners. It was decided to implement PBL in the intensive learning courses for the students. As VIA University College (VIA UC) has the highest experience in PBL among the partners, the intensive training course for teachers was delivered in Horsens, Denmark, in January 2018. The training took several days because the whole teaching-learning concept had to be thought out. The aim of the training was to make project partners acquainted with PBL teaching methodology applied at VIA UC, to improve teachers' competences in teaching this methodology and to practice this concept.

Twelve teachers participated in the PBL training courses. Mentors from VIA UC provided an introduction to PBL and presented processes, including the role of the student and the teacher. Important task was planning the concept and then assignments for students. To develop a process guideline for intensive learning courses of students, a problem statement was necessary. As the topic of the HiTimber project is design, construction and management of high-rise timber buildings, it was important to get an overview into aspects and relevant subjects, also mapping the project partners' collective competences within the topic. The brainstorming method was performed on topics, keywords, etc. related to high-rise timber buildings, and then categorisation of brainstorming ideas and mapping of relevant sources, such as literature, links, research institutes, associations, etc. were conducted. To obtain the best results, the private sector was involved. Teachers of different professions (architecture, civil engineering, architectural technology, construction management) from Denmark, the UK, Estonia, Lithuania and Portugal were divided into three trans-disciplinary transnational groups (4 teachers each) and worked together on the development of the content of the new module by using divergent and convergent processes.

It was decided that the intensive learning courses (workshops) for students would take place three times each spring semester. The courses will be based on three different design stages that different groups of students have to solve each year (Figure 1). Courses will follow the phases used today in the building design and construction sector, the so-called design and building planning and management phases. In the English-speaking countries and Scandinavia, the following phases are used from design to implementation of projects on building site: Brief Phase (requirements for the project are decided by the client or client advisors and the architect), Outline Proposal Phase (preliminary small-scale drawings showing form and function of a project), Scheme Design Phase, Detail 1 Phase (drawings and documents for final local authority approval must be completed), Detail 2 Phase (working drawings). These phases were adapted in the new module.

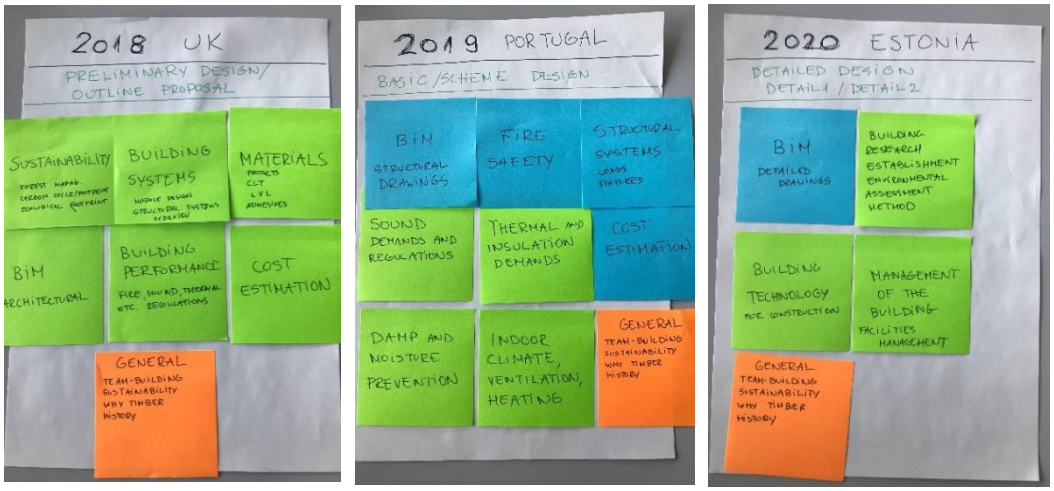


Fig. 1. Planning of workshops and lecture topics (picture by the authors).

Before the first intensive learning course students had to complete a given pre-assignment on high-rise timber structures. The aim was to obtain background knowledge necessary for the workshop.

The first intensive learning course, held in Southampton, April 2018 for 14 days, was focused on the Outline Proposal Phase. It included preliminary small-scale drawings showing form and function of project, building components, materials and form and function to be decided. The National Regional Property Group (NRPG) provided a live case study of one of the company's development project in Southampton. The case was designed by HGP Architects. The task was to convert a building to a sustainable building designed and constructed of engineered timber/wood (see Figure 2).

a) The Tower b) Ground floor plan

Fig. 2. East Street and Queens Way development (HGP Architects, 2018).

Each group of students had to choose one of the five engineered timber systems to be implemented in the Outline Proposal:

1. Solid timber panels, Cross Laminated Timber (CLT);
2. Glue-laminated timber (Glulam) panels, beams and columns;
3. Column & beam system, Laminated Veneer Lumber (LVL);
4. Module timber units, box module;

5. Column and beam hybrid (combination).

Thus, the five groups of students implementing five engineering timber systems made five different proposals.

Working in inter-disciplinary and cross-national project groups, the students had to produce a professional technical report on the implementation of their chosen timber system. At the end of the first workshop, students presented their proposals to their peers and experts from the industry. The audience and judging panel were invited to ask questions about each proposal and an award from the Timber Research and Development Association (TRADA) was given to the team that presented an overall concept the best.

The project and research topics and new outline proposal handed at the end of the workshop was at the prescribed level, so they could be passed on to the other groups of students, attending the second workshop. The second workshop held in Lisbon, April 2019, focused on the explicit detailing of the project at the main design stage. The last workshop, which will take place in Tallinn, April 2020, will focus on the tendering phase and planning of the construction on site.

Each intensive learning course consists of three main parts: theoretical (25 % of all hours), practical – preparation of the projects (50 % of all hours) and independent work of students (25 % of all hours). There is predominance of class teaching, project work, research task, analytic group work and preparation of digital presentation. International group of teachers (HiTimber project participants trained in Horsens before) and professionals from the private sector teach students according to their best expertise in a particular area of high-rise timber building design, construction and management. Moreover, they act as mentors, guiding students in preparation of the projects.

Five incoming students from each university and ten students from hosting university participate in the intensive teaching course each time. They form five international groups, consisting of architecture, civil engineering, construction management, architectural technology and real estate management students, who work together and learn the new course by the use of PBL.

Each year intensive learning courses mostly involved new groups of students from each university, but one or two students from previous year participated as well. Each student received a certificate proving participation in the project and ECTS credits. At the end of the intensive learning courses, teachers and company representatives provided their feedback.

3. RESULTS

After each intensive learning course, feedback from teachers was collected by means of questionnaire surveys and additional interviews. In total, 29 teachers participated in the survey.

Survey results revealed that all teachers were satisfied with the workshops in Southampton and Lisbon, and they would recommend this experience to their colleagues. Majority of the teachers strongly agree that they have learned from good practices abroad and had an opportunity to share their own knowledge and skills. Moreover, teachers have experimented and developed new, innovative learning

practices and teaching methods (PBL), as well as enhanced their curriculum design skills. Workshops have also contributed to development of joint courses or modules, academic networks and joint research. Teachers have reinforced or extended their professional networks or built up new contacts, improved social, linguistic and/or cultural competences (see Figure 3).

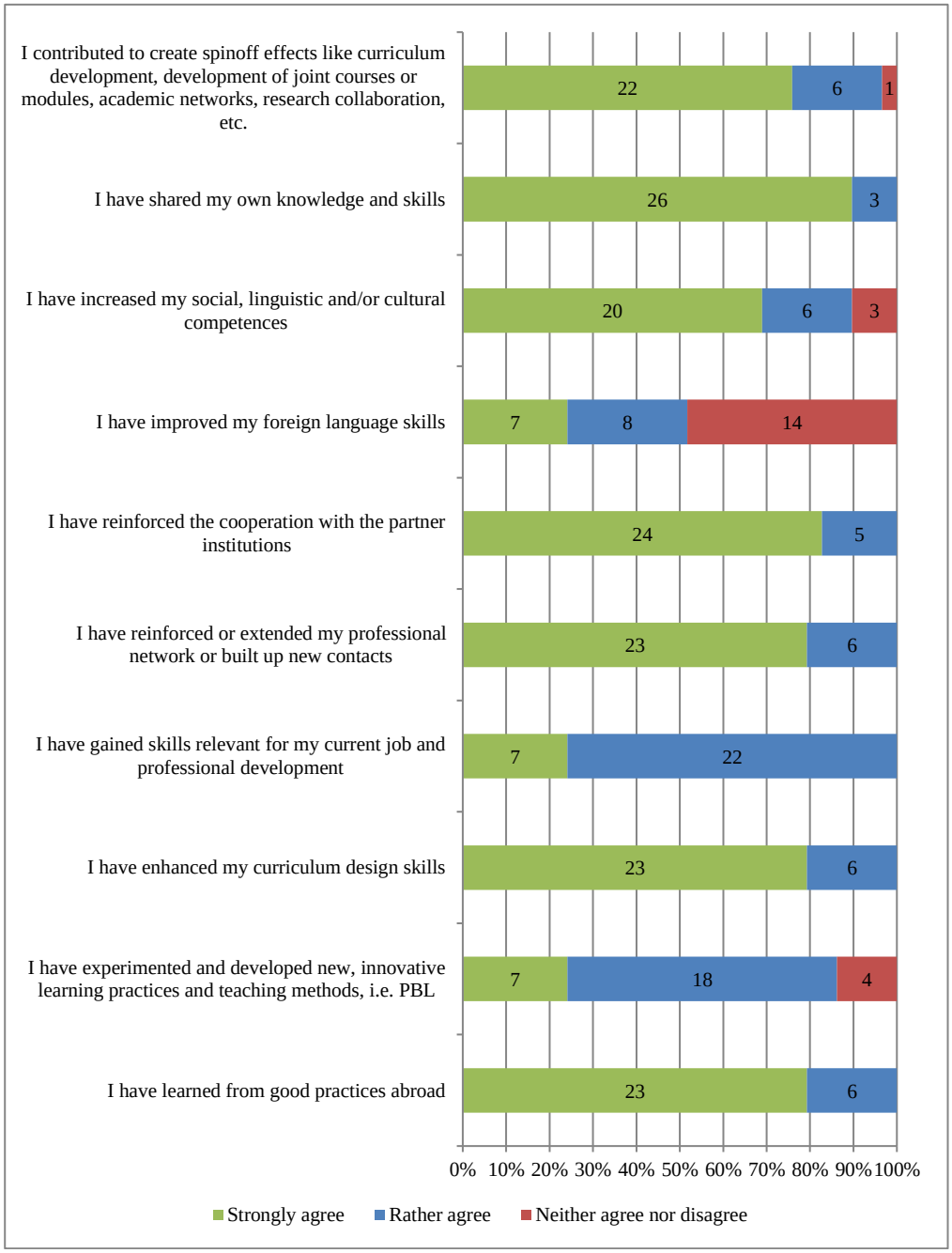


Fig. 3. Personal and professional achievements of teachers (developed by the authors, based on survey results).

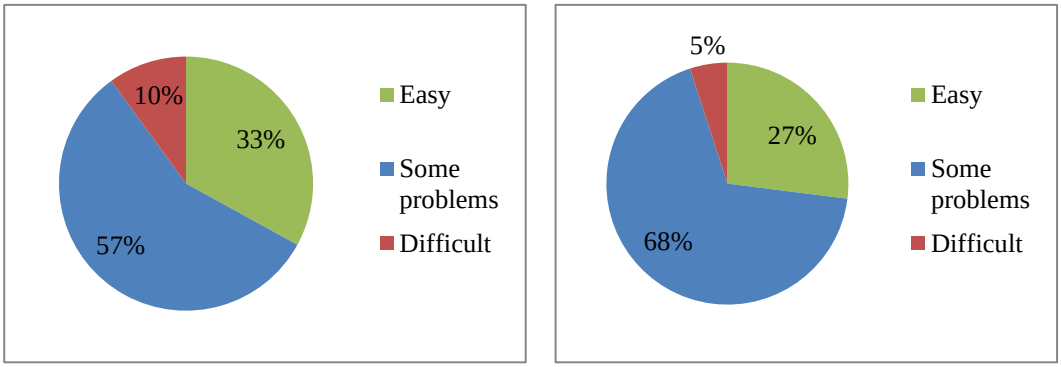
Teachers have found PBL not very difficult and agreed that it has a potential in

education of future engineers. On the other hand, interviews with teachers revealed some problems. Teachers experienced that some of the groups were not functioning well. Attitudes to teaching and learning had to be changed from the teacher-centred to student-centred approach. PBL required students to implemented active learning strategies and to apply critical thinking, not all students were active all the time. Some teachers also faced difficulties in provision of necessary information (theoretical lectures were short) and changing of their role to supervisors (coaching, management of group work).

Feedback from students was collected by means of surveys. In total, 45 students participated in the survey, 21 from workshop in Southampton and 23 from workshop in Lisbon.

Most of the students found working with the proposed development interesting (62 % in case of Southampton, 59 % in case of Lisbon), the remaining students found some parts interesting. In the case of Southampton, 67 % of students and 73 % of students in case of Lisbon liked to work on the completely new outline proposal.

Students assessed a PBL approach (Fig. 4). Results revealed that most of the students had some problems with PBL: 57 % in case of Southampton and 68 % in case of Lisbon; however, for some students PBL was easy: 33 % in case of Southampton and 27 % in case of Lisbon. PBL was easy for the students who previously used this approach in their daily learning practices (i.e., students from Denmark and the UK) and more difficult for the students who never used this approach (i.e., students from Lithuania and Estonia).

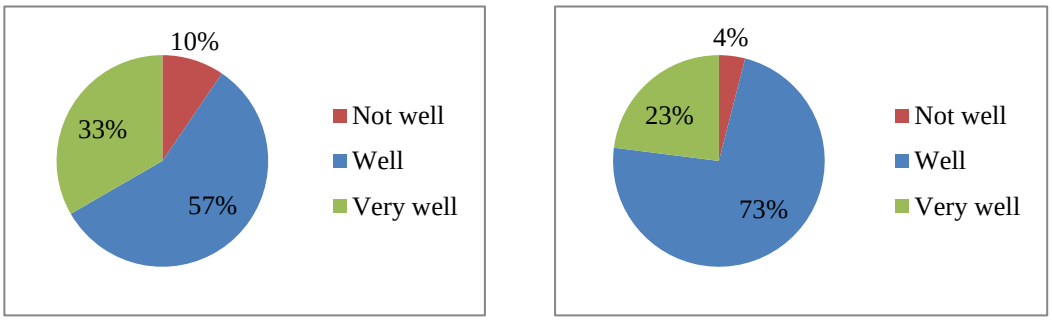


a) b)

Fig. 4. Assessment of PBL by students: a) workshop in Southampton; b) workshop in Lisbon (developed by the authors, based on survey results).

Success of PBL implementation is highly related to the efficiency of students' group work. Students were asked if their group work functioned well (Fig. 5). In case of Southampton, 10 % answered that group functioned not well, 55 % that it functioned well, and 33 % that it functioned very well. 62 % of students had small problems working together, 29 % had difficulties, and 9 % had large problems. In case of Lisbon, 4 % of students answered that group functioned not well, 73 % that it functioned well and 23 % that it functioned very well. Out of students, 73 % had

small problems working together, 27 % had difficulties, but no one had considerable problems.



a) b)

Fig. 5. Functioning of group as evaluated by students: a) workshop in Southampton; b) workshop in Lisbon (developed by the authors, based on survey results).

It can be observed that group work was better assessed in case of Lisbon. This is because more attention was paid to improvement of the group work by HiTimber project team. Moreover, some of the students who took part in Southampton workshop also participated as mentors in Lisbon workshop; they were already familiar how to make group work more efficient and guided other students.

Students had to choose their team roles. In case of Southampton, 57 % of students felt that their team role which they chose at the start fitted well in their group, 33 % would make some changes, and 10 % thought that they did not fit well in their group. In case of Lisbon, the results were better: 64 % of students felt that their team role which they chose at the start fitted well in their group, and 36 % would make some changes.

Based on PBL theory, working in group allows developing other team role qualities. That was proven in both cases. In case of Southampton, 92 % of students and in case of Lisbon 89 % agreed that they developed other team role qualities. PBL also helped learn more not only about their profession but about other professionals' input in the project: agreed by 81% of students in case of Southampton and 77 % of students in case of Lisbon.

Lectures were an important component in PBL as students needed new information to solve their assignments. In case of Southampton, 95 % of students found that they had received adequate information and lectures, 5 % answered that they did not receive adequate information, while in case of Lisbon 77 % of students answered that they received adequate information and lectures, and 23 % replied that adequate information was not received. Therefore, it can be assumed that lectures were more informative in Southampton.

Both workshops in Southampton and Lisbon had positive outcomes (Table 1). Majority of the students agreed that high-rise timber building design and construction would be relevant in the future work and they would think more about the environment, e.g., carbon and ecological footprints after workshop, sustainable timber would have positive effect on reducing the greenhouse effect and carbon

emissions in the future. For the HiTimber project it is important that 100 % of the surveyed students from Southampton workshop and 91 % from Lisbon workshop would like to follow the project, and more than 80 % of students would recommend a similar workshop to fellow students.

Table 1. Impact of Workshops as Evaluated by Students (developed by the authors, based on survey results)

	Southampton			Lisbon		
	Yes	Partly	No	Yes	Partly	No
High-rise timber buildings design and construction will be relevant in the future work	76 %	19 %	5 %	59 %	36 %	5 %
Will think more about the environment, e.g., carbon and ecological footprints after workshop	81 %	10 %	9 %	73 %	23 %	4 %
Agree that use of sustainable timber will have a positive effect on reducing the greenhouse effect and carbon emissions in the future	81 %	10 %	9 %	100 %	0 %	0 %
Would like to follow HiTimber project in the future	100 %	0 %	0 %	91 %	0 %	9 %
Would enrol in the same module if it was offered	90 %	10 %	0 %	86 %	0 %	14 %
Would recommend a workshop to fellow students	81 %	19 %	0 %	82 %	14 %	4 %

In general, 90 % of students from Southampton workshop and 86% of students from Lisbon workshop think that HiTimber project fulfilled their expectations.

CONCLUSION

As concluded in previous research (Bradley-Levine et al., 2010), working with PBL for the first time is challenging for teachers. Throughout the HiTimber project, different challenges of implementing PBL were discussed several times among the teachers. Some teachers in the project had worked with PBL for several years, while it was new to others. It became clear that it took some time getting used to PBL, to put aside ones previous blackboard-oriented teaching methods in favour of new and more guidance-oriented methods. A challenge that was taken by all new PBL teachers in the project was solved under the supervision of other more PBL experienced colleagues. The teachers in the project benefited greatly from this collaboration, but in addition it was understood that a broad general knowledge of the teaching topics was required as well as skills in teamwork supervision. It is therefore recommended to envisage trainings of teachers in PBL before actual implementation starts.

It should be noted that the change between traditional teaching and PBL is difficult for the teachers and requires time, effort and adaptation. One of the main challenges in introducing PBL is the requirement of a new mind-set from both students and teachers since they have to adapt and accept it. Students have to be

more involved and active and the teacher in most situations has to undertake the role of supervisor. Students have to adjust to group work, self-study and supervision instead of lectures.

In many universities, PBL is not implemented yet or implemented to small extent (Harmer, 2014). The authors' experience points to the fact that the most successful implementation of PBL requires accustomisation, practice and preferably continuity in the form of PBL projects (of shorter or longer duration) each semester. It can be assumed that adaption to PBL and its acceptance can be achieved easier in this way.

As in the study by Viswambaran and Shafeek (2019), where students increased their study engagement when working according to PBL, a great deal of commitment from the students in the HiTimber workshops was experienced and the majority of the students would like to enrol in similar courses again. The authors believe that increased engagement and motivation was partly caused by much higher degree of autonomy and the need for independence in the learning process. The students were simply forced to be more active and outreach in the PBL projects to achieve success. Furthermore, an increased extent and depth were experienced in the personal reflections of the students, regarding their own learning, the collaboration in the team and the academic content.

A well-functioning group interaction determines whether and to what extent PBL as an approach to learning can succeed and therefore the authors recommend to focus on the group work and the collaboration among students and to assist the students in situations when the team experiences difficulties in cooperation. If the team does not function well, the students will spend their energy on these challenges instead of utilising the differences among team members to go further in the study topic. This indicates that guidance may not only be on the study subject, but also on collaboration, communication and study techniques.

Collaborative learning (Biggs & Tang, 2011) is a well-known term in much PBL literature and it has become clear in the HiTimber project and other projects, conducted by the authors, that the collaboration among students increases their individual learning. In the group work, it is necessary to be able to disseminate one's own knowledge in a professional manner, also it becomes clear that all members of a group have different knowledge that can be divided in the group and utilised in the project. Students gain deeper learning through discussions, active learning, shared inspiration and the application of their former experiences.

Based on the findings by the authors from the HiTimber project, previous experience with PBL and other research within this topic, the recommendation is to increase the use of PBL in teaching as much as possible. Especially it is recommended in construction and engineering programs where this approach can prepare the students for their future carrier, increase their motivation and engagement in their studies and make them more attractive to future employers. It can be a challenge to make the transition to PBL, but in the end, as the HiTimber project proves, it is worth it.

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