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## **IDES-EDU: Comprehensive multidisciplinary education programme to accelerate the implementation of EPBD in Europe**

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**Abstract:** *This paper presents a new education and training programme on integrated energy design developed by fifteen European universities collaborating within the IDES-EDU project (2010-2013), funded by Intelligent Energy Europe. IDES-EDU aims to accelerate the implementation of the Energy Performance of Buildings Directive (EPBD) by proposing Master and Post Graduate education and training in multidisciplinary teams. To speed up transition from traditional, sub-optimised building projects with discipline-oriented, segregated budgets and operations, IDES-EDU developed comprehensive, multidisciplinary educational programmes targetting integrated project design at the interface of architecture and engineering. Taking into account local variations in climate, construction and pedagogical approaches, the programme facilitates gradual implementation towards full integration of energy efficiency in building education according to local capacity and legislation.*

*This paper summarises the evaluation process of the first implementation of the educational material in the 15 universities, by academic staff, national industry and professional organisations, and reference students from each university. Included are expected learning outcomes, level of integration in existing curricula and alignment with theory and assessment methods. Measures for improvement as well as further dissemination to other European educational facilities are proposed. In this manner, the project will contribute to make the multiple opportunities for energy efficiency a reality.*

**Key words:** *Education, integrated energy design, multidisciplinary*

### **About IDES-EDU**

In IDES-EDU 15 European universities have jointly developed education and training programmes for MSc students and professionals in Integrated Design of the Near-Zero Energy Built Environment. IDES-EDU developed 13 education packages with 98 lectures and 22 seminars and workshops and specified intended learning outcomes in terms of knowledge, skills and general competence. The courses have been further elaborated and implemented in national consortia in which educational institutes collaborate with key stakeholders such as branch organisations of the building sector (constructors, real estate developers, architects, building research institutes, utilities, suppliers and consultants) and accrediting bodies.



IDES-EDU educational packages support students' ability to create a near-zero energy built environment that satisfies aesthetic and technical requirements. The students develop knowledge and skills needed to plan, conduct and manage a building project in co-operation with a cross-disciplinary design team and stakeholders. The project website [www.ides-edu.eu](http://www.ides-edu.eu) provides more extensive insight in IDES-EDU monitoring, lecture material and other results, in particular Reports D6.1, D6.2 and D6.3 of which this paper forms an extended summary.

All 15 IDES-EDU universities implemented the educational material, adapted to local capacity and context. In doing so they contributed to education and training of future architects and engineers with expertise in interdisciplinary cooperation for construction practice and research. 1466 students were involved, among which 144 architects, 1203 engineers and 71 others. 210 students were involved in exchange programmes, and 755 students in internships. At least 3 IDES-EDU partners created new master programmes (Zuyd University, Warsaw University and University of Minho). IDES-EDU partners contributed to the creation of a new international master programme by iiSBE Europe (International Initiative for a Sustainable Built Environment) and have committed to contribute to this programme also after the IDES-EDU project finishes. 56 universities have expressed interest in using IDES-EDU material, potentially in cooperation with IDES-EDU partners. IDES-EDU material was disseminated through European umbrella organisations iiSBE Europe, REHVA, CECODHAS and ACE. Even higher numbers can be expected in the near future, as updating existing and creating new university programmes require several years to implement. Between the end of the project and 2020, 2000 engineers and 5000 architects are expected to have participated in the training. These figures are based on the estimation of the national REHVA members (110.000 engineers) and ACE members (530.000 architects).

### **Monitoring of results**

This paper includes the results of a series of reviews performed to monitor the outcomes of the development and implementation of these educational packages. The review of educational material used distinct types of surveys and feedback:

- The 5-minute feedback forms with responses from the students, teachers and external reviewers provided a large quantity of feedback on detailed slides and lectures. It was hard to link the IDES-EDU common end terms to these answers point by point.
- Course evaluations also contained an evaluation of the quality of the course organisation: was the content interesting, were the classes attractively taught, how was teachers' attitude and clarity, sufficient infrastructure for the course, and so on.
- The Reference Student Group with its discussions and workshop provided a more well-rounded and context-related response to the IDES-EDU material.

### **The 5-minute feedback form**

In addition to standard course evaluations, a low-threshold "5-minute feedback form" was developed to enable students to record reflections, thoughts and feedback during lectures – in addition to taking lecture notes, of course. It consists of 5 generic questions:



1. What is your role in the IDES-EDU project (student, teacher, external reviewer)?
2. Which lecture did you review, and what was the time and location of this lecture?
3. What, in your opinion, were the three key messages of the lecture?
4. What were the most and least useful elements?
5. Were there any unclarities or comments?

Based on tools used at NTNU Norwegian University of Science and Technology, the feedback form was adapted to fit IDES-EDU needs in cooperation with IDES-EDU partners prior to being distributed among students, teachers and professional organisations.

The 5-minute feedback form resulted in 211 answers, among which 155 from students, 33 from teachers and 23 from external professionals, and the lectures were updated accordingly. Discussions of tools, methods and procedures during lectures are highly appreciated, and mentioned frequently in “key messages” and “most useful” categories. Practical exercises with teacher support to implement tools and methods are strongly requested by respondents.

A majority of respondents emphasized the usefulness of case studies and examples to make theory more “real”, along with practical implementations such as monitoring results and processes. Some lectures were commented to have a lot of useful guidelines but lack specific examples, numbers and images which could have clarified and operationalized those guidelines; “practical important things ... rather than mathematical models”. In general group work and seminars were highly appreciated: “To put the theory in practice. Advices on how to proceed. It is not as easy as it seems to aggregate all the knowledge, pick up the relevant things and apply them. It was a great practical experience.”

Some requested more discipline-specific information in the lecture material, while others reacted to information they did not find useful for their own profession. In fact this corresponds well with the scope and goal of the IDES-EDU lecture material which can be used as a cross-disciplinary introduction for architecture and engineering students alike and supported by more detailed lectures and training by the local university when required. The variety among lecture topics and the perspectives and structures used to construct the lectures, as well as the diversity in climatic and cultural context, were mentioned as useful for reminding the audience of the holistic perspective.

Several reviewers requested a combination of summary data for the whole European context and national status quo: “If this project is meant as international platform implemented on national level as well, I can imagine presenting European data with respect to various climates as quick reference and focus on national data to be able to compare, what “my” conditions are like in comparison with other EU member states.”

### **Course evaluations**

Each university is required to perform regular course evaluations on quality of content as well as pedagogical, administrative and infrastructure frameworks. While these evaluations are not targeting IDES-EDU lectures alone, the variety of feedback provided in these documents was



checked, where available (e.g., non-confidential), and relevant input categorised and integrated into the IDES-EDU framework for further development of the material.

#### *Infrastructure, administrative services and staff resources*

Most course evaluation forms include staff resources and pedagogical competency, for example related teachers' attitudes towards students, clarity of assessment criteria, punctuality and availability of the teacher. They also include questions related to availability and quality of infrastructure, design studios, group rooms and lecture halls, as well as administrative support. Evaluations also tend to include questions related to whether students' knowledge level prior to starting the course was sufficient to support efficient learning and participation.

Several course evaluations we examined emphasise the importance of teachers with active practice in industry, cities and research. However, this active practice also requires certain flexibility in terms of course planning, as schedules and capacity may fluctuate according to project development. This type of experience provides the students with the possibility to get engaged in research and industry projects (which makes for very attractive courses).

#### *Pedagogical framework*

Most course evaluations include questions related to the appropriateness and timing of the work load per course and per semester are evaluated; both in terms of planned activity and actual implementation. In addition students were asked how they experienced the connection between learning outcomes, learning activities and evaluation activities, availability of literature, practice- and science-based material, relevance of examination content and structure and timeliness of corresponding information, and so on.

According to the respondents, IDES-EDU course content is not always fully supporting the intended learning outcomes of the corresponding course as defined at the local university. IDES-EDU lecture material of course needs to be adapted to fit the local pedagogical framework, and combined with practical student work such as exercises, seminars, laboratory work, full-scale building and other similar activities. Workshops and other student group work suggested in IDES-EDU educational packages needs support by local teaching staff throughout the semester, in particular to promote interdisciplinary student cooperation.

Theory and assessment methods are well taken care of, and are relatively easy to evaluate. However, there is a large difference in learning threshold among students when it comes to simulation and assessment tools; some require a long time to understand a tool and therefore don't have a chance to use it properly in design projects. Generally it is found difficult to create learning activities that promote critical attitude and creative use of tools to support design projects. There are large individual differences among students as well as teachers.

IDES-EDU material with description of intended learning outcomes and identified reference literature per lecture provides a useful addition to existing courses that are based on teachers'



ongoing research and projects, or their personal topic knowledge, not compendia (only recommended literature). This is also the case with practice-based exercises and design projects, as many students don't start to study or use literature as reference until just before an exam, and only then find out the theory would have been useful for their projects.

### *Geographical mobility*

Geographic mobility and exchange of students and staff is in general highly appreciated in course evaluations. Constructive cooperation among students with widely diverse cultures, educational background and expectations and between teachers from architecture and engineering, research and practice, and various cultural backgrounds, has proven to be extremely important to achieve good learning practices. However, this requires additional capacity and activities by university partners at both ends. Due to large diversity in student mass, for example, the first weeks of a semester are mainly spent on familiarising the new students with host university routines, local and national context, and with each other. Special pedagogical training is also required to deal with student groups with diverse educational, geographical and cultural background (international and interdisciplinary).

Internationalisation of the curriculum is a second main issue. Co-operation among IDES-EDU universities has shown clear differences in pedagogical cultures and expectations, in terms of student supervision, weighting of meta-cognitive skills, and integration of design practice and research. While some of the pedagogical framework is embedded in written documents, there appears to be a lot of tacit knowledge and group behaviour that only surfaces when there is a direct conflict between practices from different universities.

### **Reference students and workshop**

In order to get an in-depth impression of the students' experience in the IDES-EDU partner universities, a Student Reference Group was established consisting of 1-2 Reference Students at each university. Applicants were selected based on their experiences with energy in buildings related courses and interest in multidisciplinary project work, integrated energy design, and educational aspects. The Reference Group students came from a wide range of disciplines and academic traditions, and with diverse professional experiences. Most students had a background from established (generic) programs in architecture, environmental physics and building engineering on Bachelor and Master level, while some were currently taking part in relatively new MSc programs more articulated on energy in buildings related topics.

Many of the students had previously been engaged in sustainability projects and had some experience in multi-disciplinary problem solving and teamwork. During their education many had acquired experience from several institutions and university exchange programs (ERASMUS, summer school etc.), and expressed such opportunities as positive experiences that helped broaden their view, critical abilities and self-reflection. This was also mentioned as a motivation and possible outcome of being part of the work in the joint reference group.



The Reference Group was responsible for good dialogue with IDES-EDU teachers and evaluation team throughout the semester and for encouraging fellow students to participate in the Five-Minute Feedback Form and other forms of feedback. They reviewed lecture slides and courses, based on their background, field of work, and to some extent their common interests. The students were asked to assess and discuss a range of questions, amongst others:

- Are the intended learning outcomes for the course accessible and understandable?
- Do the intended learning outcomes feel relevant and achievable?
- Do the students have the necessary prerequisite knowledge?
- How do students work on the subject? Do you have any suggestions for improvement?
- Do the lecture elements and structure support the learning process?
- Are any of the elements particularly challenging?
- Is the lecture relevant for becoming an expert on energy in buildings?
- Does the lecture meet your expectations? What can be improved?
- Do you have any comments to particular slides?

The work of the reference student group culminated in a workshop in Maastricht 23-27 June 2013, arranged in coordination with the final meeting of the IDES-EDU project at the same location and time. During the workshop the students had time to develop their own group work as well as discussion, presentation and interaction with the IDES-EDU partners.

The outcome of the Reference Group was a series of key messages and priorities as well as a joint introduction of expectations, goals and visions for courses on energy in buildings:

- Overviews of tools, methods and procedures, and their application in diverse contexts; Provide students with the tools and skills to balance specialist/holistic approaches;
- Case studies and examples; Education that provides continuous capacity to deal with the demands of construction sector and society at large – so that students gain “up-to-date” and relevant competence from building professions;
- Creating a framework for cross-disciplinary co-operation with group work and seminars; Integration to deal with increasing complexity and specialization;
- Architectural and engineering students gaining insight in “the other side”: each others’ professional language, educational topics and pedagogical methods, getting to know each other and discussing priorities from different professional perspectives;
- Design should be made for people;
- Including social norms and “nudging” as core elements in energy in buildings education. For example, is it easier to sell a ZEB house if “several neighbours already had purchased a similar house” rather than convincing them of technical principles?

### **Conclusions and outreach**

IDES-EDU students, teachers and external experts have throughout the project emphasized and strengthened cooperation on integrated design of near-zero energy built environment. In



addition to developing lectures and courses worth 120 ECTS, they have built a long-term co-operation model based on dialogue, reflection and interaction. The co-operation platform has not only been planned, but also implemented with regular quality insurance and updates through specific responsibilities. Above all, the importance of interdisciplinary co-operation and integrated design was highlighted by students, teachers and external professionals alike.

The main aim of the interdisciplinary courses is to help the students learn how to solve challenges related to integrated design of near-zero energy built environment. In order to achieve this co-operation among the students is a highly useful and effective didactic method. Experiences from IDES-EDU show that the students and teachers found the co-operation between architecture and engineering on the one hand, and between IDES-EDU partners on the other hand, to be very fruitful and innovative, and, above all, relevant for future practice. Therefore we recommend to continue the courses' implementation at IDES-EDU partner universities, including cooperation between architecture and engineering students, and to extend and intensify the cooperation.

Comprehensive co-operation, however, does not become successful without effort. Students, teachers and external experts have pointed out deficiencies and challenges in the current set-up. They request more extensive, in-depth co-operation between students across universities, and better organisation of the co-operation between architecture and engineering students, particularly with relation to work load, responsibility and credits. The students and teachers also request more consistent co-ordination of the different departments that allows for meaningful co-operation between the students of different learning environments. This type of co-ordination among departments requires considerable human and financial resources.

The most important step, however, was taken several years ago: to establish cooperation and initiate interdisciplinary and international education in integrated design of near-zero energy built environment. An initiative students as well as teachers and external experts appreciate considerably. What now remains to be done is an adjustment of the particular content, timing and extent of co-operation so as to continue to ensure a meaningful learning experience within the financial and administrative framework of all participating universities.

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