

Interdisciplinary skills in architectural and engineering education programs - The pedagogical challenge

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Abstract—The architectural design and engineering of construction includes many multifaceted and interdisciplinary challenges. Consequently, cooperation and communication between architects and specialised engineering professionals are of greatest importance for the successful completion of a building project. Besides, new and more integrated forms of co-operation between the various actors make the prevalent professional disciplines more ambiguous and it compels into a need for trans-professional skills among the actors.

In contrast to the requirements for interdisciplinary skills, the educational training programmes of architects and engineers are traditionally characterised by strict disciplinary boundaries. Thus, the prevailing educational system is challenged to meet the demands for trans-professional skills within industry.

The purpose of this paper is to outline some pedagogical prerequisites and requirements for reinforcement of the interdisciplinary skills within the architectural and engineering education programs as to face the challenges from industry.

The study claims that the development of interdisciplinary skills should be regarded a pedagogical issue that can be accomplished by integrative teaching activities in which the attitude between the different disciplines can be developed in a proper direction.

The paper rests upon a preliminary theoretical analysis that is supplemented with some initial interviews with students and teachers from the educational program of Architectural engineering at the Danish Technical University.

Index Terms—interdisciplinary competences, pedagogical challenges, architectural engineering

I. INTRODUCTION

THE construction industry develops and changes over time, and so does the roles of the actors involved. The recently introduced procurement systems of partnering, BOT- and PPP-projects etc., exemplifies an integrated construction delivery process that relies on a closer integration and coordination of the actors involved in construction projects. As a consequence of the new forms of collaboration, the roles

of the different disciplines in the construction industry are becoming less clear-cut and the needs for trans-professional skills grow [1].

This study constitutes a preliminary study that reflects upon the growing need for closer collaboration and understanding between the architects and the civil-engineers in the construction industry, in light of the prevailing educational structure of these two actors. The purpose of the paper is to outline some fundamental pedagogical prerequisites and requirements for reinforcement of the interdisciplinary skills within the architectural and civil- engineering education programs as to meet the challenges from industry.

The paper rests upon a literature study which has been supplemented with empirical data from interviews with teachers and students from the educational program of Architectural Engineering (Arch-Eng) at the Danish Technical University, DTU.

II. EVOLVING CHALLENGES FACING THE ARCHITECTS AND CIVIL-ENGINEERS OF THE CONSTRUCTION INDUSTRY

The central message in the Latham [2], “Constructing the Team”, was based on the simple concept that through teamwork the construction industry could delight its customers. The report implied a radical review of the construction industry in the UK and was largely brought about by a general disquiet in the industry. Partnering was pointed out as a specific method to achieve improved team work and cooperation [3].

Partnering constitutes a new form of integrated collaboration between the parties involved in a construction project. The fundamental idea is that all the actors involved are signed up to agree on mutual objectives for the project at an early stage. All actors are supposed to agree on effective decision making procedures and problems are to be resolved collaboratively by the entire team [4].

The call for new and improved forms of collaboration was reinforced in the Egan report [5], which supported the argument that partnering was vital to reach improved project performance and increased value to the client. Following the increasing sophistication in project procurement, new disciplines have been added to the traditional construction professions and the roles of the existing disciplines are becoming less distinct [1].

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Bjerregaard [6] states that the role of the engineer as an integrator between technology and the social values of society will develop further which implies an ability to apply engineering competences in the interaction with other professional disciplines.

III. THE PREVAILING EDUCATIONAL STRUCTURE OF ARCHITECTS AND ENGINEERS

In contrast to the industry's requirements for interdisciplinary skills, the educational training programmes for architects and engineers are traditionally characterised by strict disciplinary boundaries and they are often divided up in separated organisation (often at different geographical locations). These circumstances render difficulties for joint and coordinated actions to meet reciprocal demands from industry.

Each education programme requires the identification of the core elements in the skills and competences needed within the respective professions. The identification of critical cross points between the two professional competences becomes an additional requirement in education programmes aiming at interdisciplinary competences. The design of an education programme represents a balance between width and depth, i.e. generalisation and specialisation. An overloaded curriculum will have a negative impact on the interdisciplinary aspects of the education as it prevents accommodative learning and transcending into other areas of knowledge [7].

As each educational program has a limited scope of schooling, introduction of new subjects (e.g. trans-professional training) must be done at the expense of established subjects and training-courses [8]. Thus, this paper argues that the call for interdisciplinary training in the educational programmes of A and E should be done without replacing established subject fields of the respective programmes. Instead, interdisciplinary training should be regarded as a matter of how to teach, rather than what to teach, i.e. it is a matter of pedagogics.

IV. TEACHING INTERDISCIPLINARY COMPETENCES

Interdisciplinary competences, as well as competences in general, contain the three interacting dimensions of knowledge, skills and attitudes. Knowledge primarily refers to the respective fields of knowledge that characterises each profile. The specific knowledge that is gained through an educational programme constitutes the foundation of the respective professional roles. Yet, interdisciplinary competences also require an overall awareness of the knowledge fields represented by other, closely related, disciplines.

The skills of specific importance in an interdisciplinary curriculum are represented by the ability to interact with people from different professional disciplines, e.g. the ability to communicate, coordinate, mediate, compromise, convince, to convey your own knowledge and to assess input from other professionals.

The competence dimension of attitude implies the willingness for the students (and the professionals) to

transcend from their own professional field over to another. Thus, knowledge and skills represents the dimension of competence that constitutes the basic role of a profession, while attitude is closer related to the interdisciplinary competence. As knowledge and skills gradually develop during an educational program, so does the attitude.

Wilkinson and Scofield [9] present an example of integrated teaching of A and E from the University of Auckland. They report that the first semester of integrated courses went well, i.e. the students showed a positive attitude. However, during the second semester the students became more reluctant to the interaction between the two disciplines [9]. This reaction can be explained by the psychological involvement of a personal identity in the respective fields of knowledge. As the professional role grows stronger, by increased knowledge and skills in a specific field, the distance to the opposite role also increases, which influences the attitude towards each other [10]. Another implication that acts on the growing dissociation of the two disciplines as the education programmes proceed could be the different pedagogical layout that the two education programmes of architects and engineers represents. Bjerregaard, teacher at the Architectural and Engineering programme at DTU, describes education of architects as typically implicit teaching, while she described education of engineers in terms of explicit teaching. Implicit teaching is characterised by the individual development of each student while explicit teaching is characterised by an impersonal approach to the technical problem and its solution. Typically, architectural students primarily work and are assessed on individual assignments while engineering students work together with the same problem in groups. The implicit and explicit approaches to teaching, as described by Bjerregaard, most likely influence the professional roles of architects and engineers. Bjerregaard's observations correspond with Wenger [11] who claims that personal identity is shaped by the teaching community and culture of practice that the students affiliate with.

Thorough knowledge and skills within an educational programme are two central parts of interdisciplinary competences, as it constitutes a basis for development of an individual identity and sense of affiliation to a professional role. It is argued in this paper, however, that the competence dimensions of knowledge and skills also must be supported with a proper attitude. Thus, the question of attitude constitutes the principal pedagogical challenge in the answer to the industry's demand for integrative competences.

Bjerregaard [6] and others (e.g. [8]) state that integrative competencies are gained by integrated teaching methods such as projects or similar kinds of teamwork where students from different disciplines get the opportunity to interact. When using projects in teaching it is possible to formulate the project assignments so that the knowledge and skills of all the disciplines represented by the project group are needed to reach an optimum solution [12]. The formulation of learning objectives in courses with interdisciplinary emphasis shall explicitly stress the aim of attitude to be attained. Also the

assessment procedures are of importance, following the arguments of Constructive Alignment. Besides knowledge and skills, the assessment should also consider the ability to act and integrate with people from other educational disciplines [13].

V. CONCLUSION

The need for interdisciplinary competences, as requested by the construction industry, challenges the prevailing architectural and engineering systems of education that traditionally are characterised by strict disciplinary boundaries.

It is argued in this paper that interdisciplinary training could be introduced in the existing educational programmes without replacing established courses. Programme-specific knowledge and skills constitute the basis for the individual identity and sense of affiliation to a professional role, and these are important parts of the interdisciplinary competence. However, it is within the development of a proper attitude towards the opposite discipline that the principal challenge of interdisciplinary competences relies. Thus, interdisciplinary training is to be regarded a pedagogical issue that could be impelled by integrative teaching activities. By establishing educational situations in which architects and engineers interact, and by using assignments that promotes and utilizes the combined skills from architects and engineers, mutual respect and understanding for the other discipline will be a possible outcome.

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