Applying case studies to teaching architectural investment

Michał Kwasek & Rafał Janowicz

Gdańsk University of Technology
Gdańsk, Poland

ABSTRACT: Case studies enable students to encounter practical issues during their education. Experiments conducted in class employing this method often feature simplified models of real-world situations. However, they still enable students to encounter actual problems, to which theoretical knowledge is applied. In architectural education, students carrying out semester projects usually rely on data provided by the teacher, without wondering where the data came from. The case study method described here was implemented by means of a graph and in accordance with the principles of *turquoise* teaching. It has been implemented and used for several years in classes, where architecture students are taught how to manage their company and how to organise the investment process. The teaching covers essential guidelines that determine how the architect-manager works. Discussed in this article are the advantages of the method, the impact of it on the effectiveness of education and its application.

INTRODUCTION

Competence is Required

Architects have a special role in the modern world and should have general knowledge in many fields of science. Italian philosopher Umberto Eco opined that in contemporary society, dominated by specialisation, an architect seems to be the last humanist [1]. It creates a difficult situation from the point of view of teaching. It requires that during their education, students are given a wide range of material which, though disparate, is closely related to their future profession.

An architect, in addition to the ability to shape new objects and surrounding spaces, should acquire competence in management. Such competence is required by the architect's obligation to co-ordinate the investment process, as well as from the contractual liability to meet the quality requirements and deadlines for design and works.

In this context, it is important for students to be able to modify investment strategies resulting from changed circumstances; for example, resulting from changes in investor assumptions or legal regulations. This should be included in university programmes to best prepare students for future employment [2].

Project management is a skill employed in various disparate projects to achieve goals on time, with an agreed quality and price. This requires a control of all processes related to the project and the product [3]. Management specialists develop project management methodologies, which various institutions try to standardise.

Organisations, such as the Project Management Institute have branches around the world and recommend various methods; for example, projects in controlled environments (PRINCE2), Kanban, rapid application development (RAD), and Six Sigma, with a variety of programs, such as MS Project [4]. Effective cost and time management play an important role in the success of a project [5].

> (...) *The schedule is not only a tool for managing time. By assigning resources and the time they are used, it affects the ability to estimate costs, and by optimizing the schedule to optimize costs* [3].

Teaching architecture usually does not allow for extensive and in-depth discussion of project management. At the same time, this is an extremely important issue in future professional practice. Therefore, it is necessary to familiarise the student with the basic tools of management and show them ways to expand knowledge and skills in this area.

CASE STUDY METHOD BASED ON A NETWORK OF RELATIONSHIPS IN TEACHING INVESTMENT

Better Connections between Exercises and Courses

The course, *Investment Process Organisation*, (seventh semester of first-degree engineering studies) was investigated to determine the impact of changing the teaching methods on teaching effectiveness. The course consists of a series of lectures and practical exercises during which students are taught key aspects of the investment process. The course covers legal provisions, implementation of various types of project, and the rights and obligations of participants in the investment process.

Students assess the attractiveness of lectures as relatively low because of the large amount of knowledge transferred, as well as its legal and formal nature; the content of the lectures is seemingly distant from architecture and is perceived as of little use. In addition, for course exercises it was assumed students were familiar with Gantt charts, which, in a limited way, portray the relationship between events. Course participants' evaluation largely was negative.

As part of changes to the course, it was proposed, in practical work, to use a network of connections to build the schedule and apply elements resulting from project documentation. This could better connect the exercises with the lectures and other architectural courses. To compare the effectiveness of changing the teaching method and determining its impact on the effectiveness of knowledge acquisition two studies were conducted, in the middle of the course and at the end.

Conducting Classes by Applying Case Studies

The students numbered about 160 and were divided into 60 training groups. Topics were allocated from a diverse pool that reflected the putative investment and project tasks from private or public investors. Real cases engage students and increase the effectiveness of the teaching.

The design tasks related to architectural projects in the vicinity of the university campus, from changing the use of part of a building, through the expansion of existing buildings, to completely new projects; that is, small single-family houses, multi-family housing, service and public utilities. The tasks were to be financed from public or private funds; those that may have a greater or lesser impact on the natural environment; historic buildings; those built in the vicinity of an archaeologically protected area.

The specific locations forced students to refer to local laws, also known as the task-based/project-based method [6-8]. Students were presented with a set of 50 putative designs. Each group analysed the legal situation of the project and proposed a way to implement the project. They then visualised it in the form of a network of connections, based on critical analysis of the documents.

Despite the fact that project management is supported by various software, characterised by various ergonomics and functionality [9], such as MS Project this was abandoned in favour of a manually edited network of links. This limited the need to master new software given the limited number of teaching hours. Techniques included sticky notes that can be easily changed (Figure 1 and Figure 2), which facilitated updating the study.

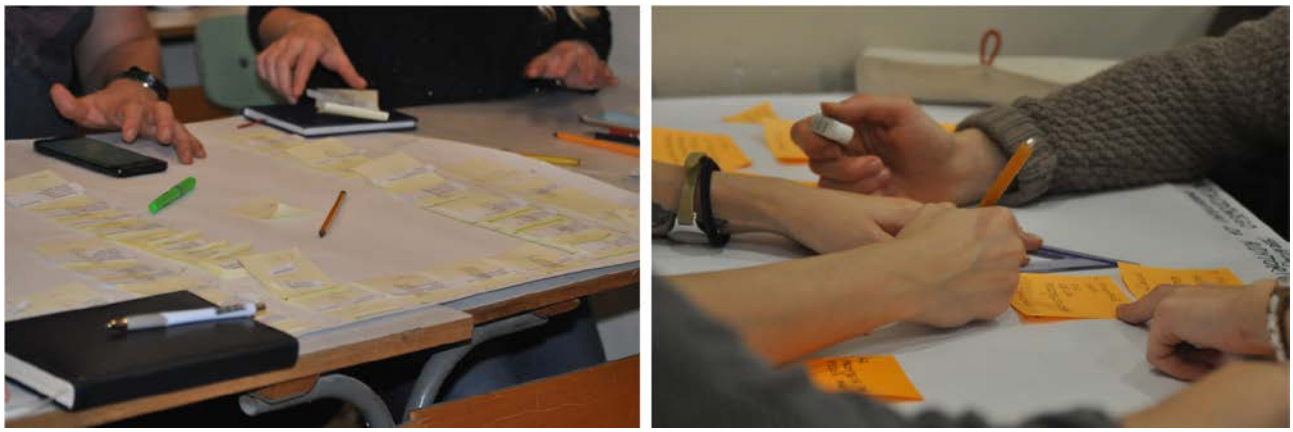

Figure 1: Students creating networks.

The networks created enabled determination of the critical path, and finally, the developing of a Gantt chart. This was a significant positive change compared to existing methods since it forces large interaction between students, which improves the teaching [6][7].

This also puts great emphasis on the independent work of course participants, while the teacher serves as a co-ordinator of the students. Thus, the teacher becomes a partner who considers possible solutions; the awareness of the goal and

the manner of its implementation is decentralised. This is compatible with turquoise models of education and management, which are considered to increase work efficiency [10].

The classes end with public defence of the solutions worked out by the groups. During the defence, students can review the solutions of other groups, and hence observe differences resulting from the varied investments, the location or legal status, as well as to discuss legitimacy of the solutions.

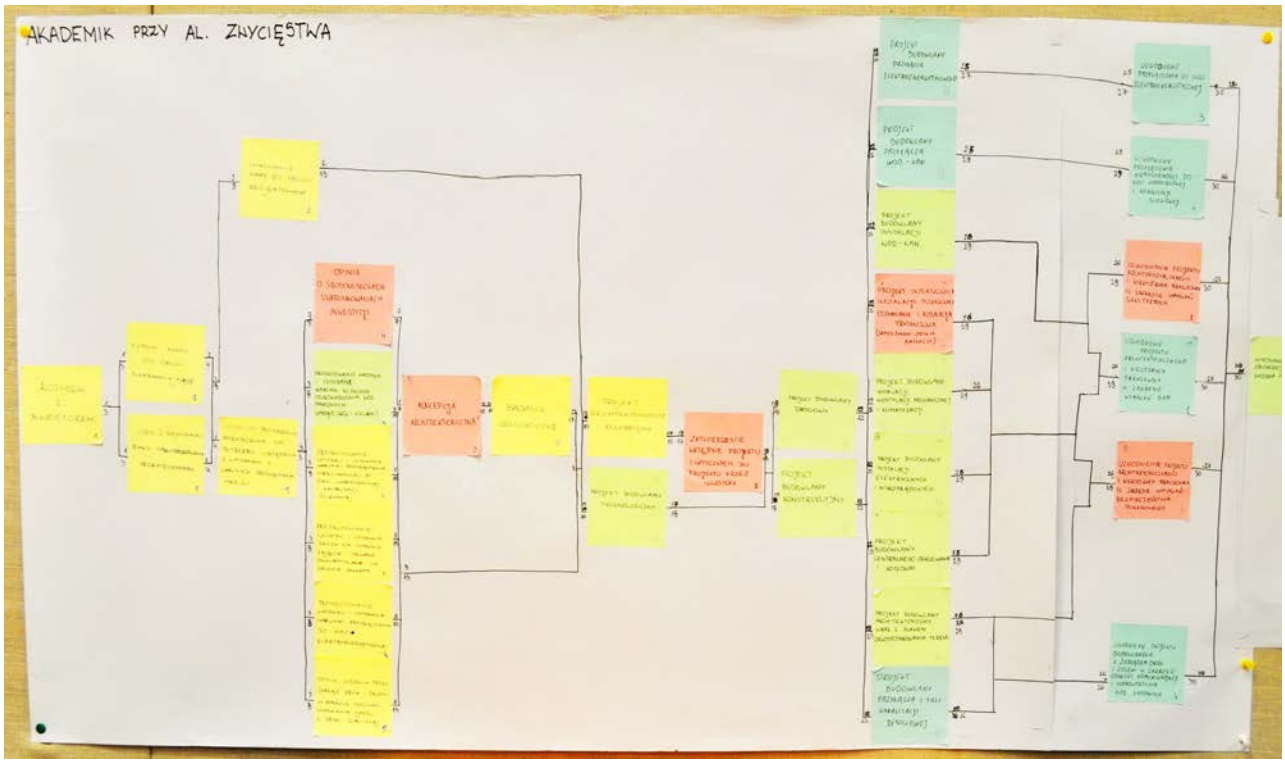

Figure 2: Fragment of a sample network of connections.

The network diagrams, although a simplified model, allow graphical representation of legal and administrative processes that elucidate the material in classes, assisted by real-word examples [11][12]. The possibility of identifying different solutions for the same task is of great importance for the students' learning. Decisions as to when an activity occurs, and how it links to other elements, is a team decision and allows students to understand the impact of decisions on the course and duration of the investment in a project.

The method allows the length of a project to be optimised. In the first stage of work, students focus on organisational requirements, which can affect the way events are arranged. For example, they note that for implementation of the project they need information from electricity and water, and sewerage network managers regarding the connection of utilities. They note that these activities can be shifted, so they occur in parallel with other activities, and thus do not extend the time. These simple observations become possible only after completing the first stage.

Presenting the process as a series of individual events illustrated graphically facilitates the distribution of each activity on a time axis. This enables the exchange of knowledge between students from different teams, and also facilitates the understanding of solutions adopted by other groups during the public defence of projects. This also highlights the impact of different legal or environmental conditions on the activity over time.

An important aspect of conducting classes based on case studies is the coordination of activities within student teams. The classes are supported by *expert* consultations with the teacher. Classes are carried out in accordance with the turquoise teaching model - in a relaxed atmosphere, but with the assumption that a group of students joining the consultation interacts with the teacher on the correctness of their solution.

Case Study Effectiveness

The first survey (mid-term) was carried out through anonymous, voluntary surveys, in which 109 students took part. The questions made it possible to determine the degree of attractiveness and usefulness of the case study method for course participants. These surveys were combined with a test to check the state of knowledge, which was the benchmark for the second study.

At the end of the semester, another assessment of the students' knowledge was made based on final grade in the subject. Such a procedure enabled the demonstration of changes in the degree of teaching effectiveness and satisfaction of course participants - in contrast to the traditional method of transferring knowledge only during lectures.

In the case of knowledge assessment: the first study was performed after the lectures, during the initial phase of the exercises. The questions referred to the content of the lectures and were formulated, so that answers could be based on knowledge provided in the lectures. All test results were divided into three groups: 1) very good or good; 2) medium-satisfactory; and 3) poor or very poor. The results below are from the test:

- Group 1: 29% of students.
- Group 2: 40%.
- Group 3: 31%.

In the second study, questions put to students at the end of the semester, during the defence, were related to both theory and practice. The final grades obtained were divided into three groups (as in the first study). This indicated a positive teaching effect. The results were:

- Group 1: 71% of students (more than twice as much as from the first study).
- Group 2: 17%.
- Group 3: 12% (a decrease of two-thirds from the first study).

There is a large discrepancy between students' experience and its real impact on improving knowledge acquisition. Students appreciated the attractiveness of classes using this method, but did not rate highly its impact on improving teaching. However, the level of their theoretical and practical skills did increase. The results obtained agree with the results reported at the beginning of the 21st Century by teachers, such as Montessori and Freinet [13].

A high level of acceptance is apparent among course participants. This is indicated by the assessment of the suitability of case study methods (on a scale of 1 to 10, where 1 means *not useful at all* and 10 means *very useful*). This was made taking into account the relationship between the students' grade and the state of their knowledge. The majority of students assessed the method highly, regardless of the level of knowledge (Figure 3). The distribution of values refers to the Gaussian distribution, with left-hand asymmetry.

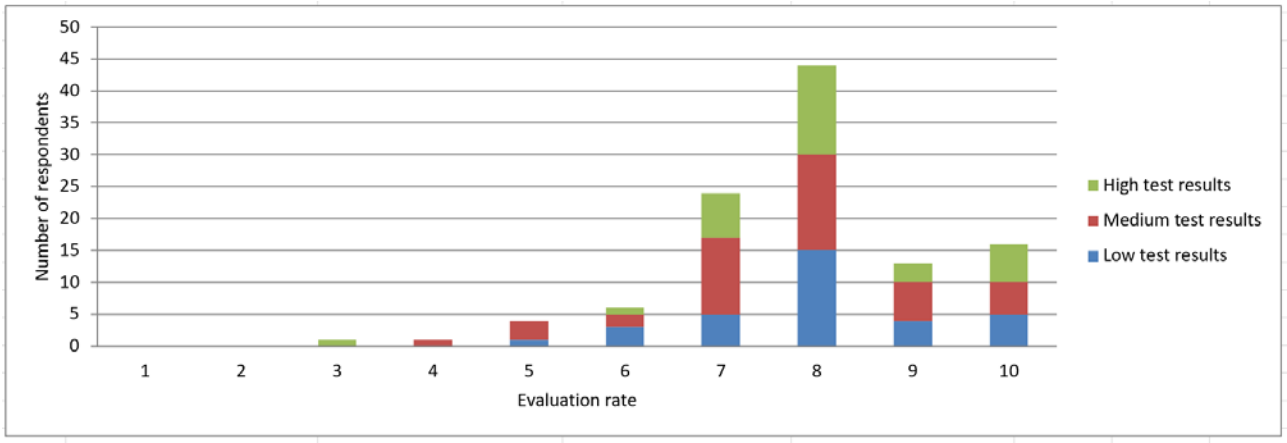

Figure 3: Results of the suitability assessment survey conducted among students.

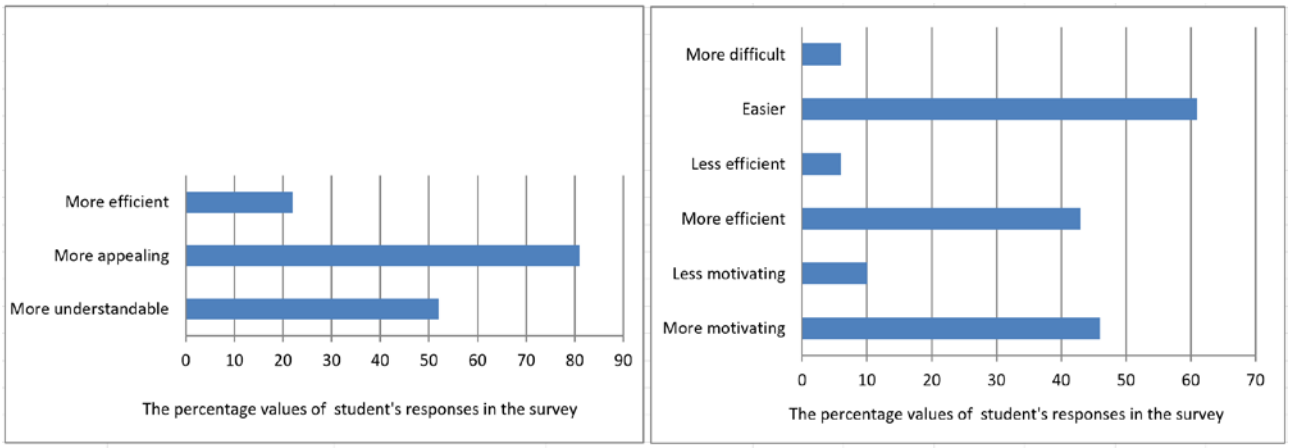

Figure 4: Survey results: assessments case study method (on the left); assessment of group work (on the right).

Students in the survey referred highly positively to the case study method (Figure 3 and Figure 4). They found it very pleasant (81% of responses), and also that it contributes to understanding (52%). However, only 22% of students considered the method more effective in learning.

Assessed also in the study was how the learning was influenced by group work. The majority of respondents considered co-operation with others as facilitating the implementation of the project. It was more effective and more motivating compared to one-man activities (Figure 4).

The advantages of using a case study applying the graph method in class include:

- analysis of real investment situations;
- analysis of a long and complicated process distributed into individual activities, each of which is treated as a separate event, requiring the fulfilment of initial conditions;
- students' work on standard elements;
- transparency of solutions, verified by the teacher (both during class consultations and during the final presentation of the group's work);
- ease of making changes in activities;
- variety of correct solutions;
- students' expansion of knowledge of administrative procedures required by the investment process;
- case study method building on architecture students' knowledge and abilities developed during their education.

The method discussed here of conducting the course enables the students to fulfil the requirements of the study programme. Students gain knowledge of the rules and procedures employed in investment and are able to set priorities for the implementation of a group of tasks, as well as recognising their project context and formulating design guidelines for the proposed facilities. The improvement of the attractiveness of the subject through practical exercises indicates that this can significantly affect the reception of the subject in class. The method presented here can be applied to most subjects and contribute to improving the teaching of engineer-architects.

CONCLUSIONS

Indications from surveys carried out are that employing the case study method based on a network of connections using a graph method in the training of engineer-architects is highly effective in architectural investment teaching. This allows for a very clear presentation of consecutive events. The method contributed to the increase of learning of theory, but above all to practical issues that were better understood and assimilated.

This method of teaching classes of students increases awareness of the investment process. An increase in student satisfaction resulted from an understanding of the mechanisms and relationships between documents and the practical use of knowledge acquired during internships, subject lectures and other classes. By teaching management through the application of case studies, teachers are ensuring theoretical knowledge is related to real issues that could arise during the implementation of construction projects.

REFERENCES

1. Eco, U., *La Struttura Assente: Introduzione alla Ricerca Semiologia, [The Absent Structure. Introduction to Semiological Research]*. Milano: Bompiani (1968).
2. Barnaś, J., Kania, O. and Barnaś, K., Framework for teaching construction law in a rapidly changing legal environment. *World Trans. on Engng. and Technol. Educ.*, 17, **3**, 362-366 (2019).
3. A Guide to the Project Management Body of Knowledge (PMBOK Guide), Project Management Institute, 45-46 (2013).
4. Subramani, T. and Karthick, T.M., Study on time and resource management in construction projects using MS project. *Inter. J. of Engng. & Technol.*, 7, 3.10, 23-26 (2018).
5. Shanmuganathan, N. and Baskar, G., Effective cost and time management techniques in construction industry. *Inter. J. of Advanced Engng. Technol.*, 7, **2**, 743-747 (2016).
6. Suswanto, H., Hamdan, A., Mariana, R.R., Dardiri, A., Wibawa, A.P., Nafalski, A. and Vianiryzki, A.F., The effectiveness of project-based learning and STAD learning on improving Web programming competency. *World Trans. on Engng. and Technol. Educ.*, 15, **4**, 368-371 (2017).
7. Uziak, J., Oladiran, M.T., Eisenberg, M. and Scheffer, C., International team approach to Project-Oriented Problem-Based Learning in design. *World Trans. on Engng. and Technol. Educ.*, 8, **2**, 137-144 (2010).
8. Yan, Y., Application of task-based teaching in a foreign language course. *World Trans. on Engng. and Technol. Educ.*, 13, **2**, 133-137 (2015).
9. Memon, A., Rahman, I., Ismail, I. and Zainun, N., Time management practices in large construction projects. *Science and Engng.*, 61-65 (2014).
10. Laloux, F., *Reinventing Organizations: a Guide to Creating Organizations Inspired by the Next Stage in Human Consciousness*. Brussels: Nelson Parker (2014).
11. Gero, A., Stav, Y. and Yamin, N., Use of real world examples in engineering education: the case of the course Electric Circuit Theory. *World Trans. on Engng. and Technol. Educ.*, 15, **2**, 120-127 (2017).
12. Gainsburg, J., Real-world connections in secondary mathematics teaching. *J. of Mathematics Teacher Educ.*, 11, **3**, 199-219 (2008).
13. Koerrenz, R., Blichmann A. and Engelmann, S., *Alternative Schooling and New Education: European Concepts and Theories*. Springer (2017).