METHODS OF TEACHING SPATIAL AND URBAN PLANNING AT GEODESY AND CARTOGRAPHY

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Abstract

Spatial and town planning is a complex process caused by the interaction between natural and social systems at different temporal and spatial scales. That is the reason, why it is difficult to introduce this subject to students studying disciplines other than spatial or urban planning. The main problem is to define goals, the scope and expected educational effects. The second step is to choose the appropriate teaching and assessment methods. In this paper authors introduce the spatial and urban planning issues presented to students of engineering course at Geodesy and Cartography, Gdansk University of Technology.

Firstly, in order to gain a better chance in labour market, some of students of Geodesy and Cartography decide to continue their studies on Spatial Economy. As engineers associated with the land use planning community have backgrounds in different disciplines, some students also decide to join them. They are employed in spatial planning offices due to their knowledge in the creation of maps and map data, data processing using Geographic Information System (GIS), projecting complex land consolidations and other abilities. On the other hand, students are expected to be potential investors and users of the spatial space. Thus the main goal of teaching spatial and urban planning is to prepare students for both better competitiveness in labour market and public engagement in planning.

To achieve the goals, a variety of learning activities have been introduced. The issues of spatial and urban planning are being introduced not only during the single courses but also during group and individual practices in cooperation with Gdynia Spatial Planning Office (SPOG). Each year, a few students also prepare their diploma projects referring to both geodesy and spatial or urban planning.

Some issues of spatial and urban planning are partly introduced during courses, for example Real Estate Cadastre and Land and Buildings Register or Geodesy and Building Law. But the main course is Basis of Spatial and Town Planning. The course is worth 2 ECTS (European Credit Transfer System) credits and it is delivered through group project work and based on case-based learning.

This article presents the essence, goals and tasks of the spatial and urban planning as well as the applicable approaches and methods of teaching, their correlations and effects. The authors describe the structure of the Basis of Spatial and Town Planning course and detailed account of the role and importance of student's practices and trainings, especially moderated by their potential future employers. The conclusions drawn from the analysis of all activities will be used as guidelines for future improvements of spatial and urban planning teaching process.

Keywords: spatial planning, urban planning, geodesy and cartography, methods of teaching.

1 INTRODUCTION

"(…) land planning encompasses various disciplines which seek to order and regulate the use of that land in an efficient and ethical way. That is, land planning is the scientific, aesthetic, and orderly disposition of land, resources, facilities, and services to ensure security of the economic and social efficiency, health and well-being of urban and rural communities." [1]

Spatial planning strongly influences our society as it addresses the environment and natural resources and the location of social and economic activities. Spatial planning defines the distribution of people and activities in spaces of various scales. In Poland, spatial planning is based on three levels: national, regional and local. The local planning is more land-use planning and leads to defining restrictions and regulation of zones. The plan regulates the types of activities that can be accommodated within the zone and its development (transportation rules, building parameters and regulation lines etc.). Urban planning designs settlements, from the smallest parts of towns to the largest cities and it is based on regulations specified in documents of local spatial planning level.

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The relation between spatial planning and geodesy can be considered on three stages. At first, the development of technology allows for the use of digital data. Spatial planning requires a set of geo-information data, collected by the use of geodetic surveying methods such as laser 3D scanners, photogrammetry and others. Since digital technologies have developed, geodesy has been constantly providing increasingly better data used in processes of planning and decision making. Geodesy provides techniques and technologies for handling, visualizing, and analysing quantitative (geometric or geographic) spatial data. Most of them are presented to students during several courses along their engineering studies such as spatial information on science, cartography, photogrammetry, etc.

Secondly, geodesy surveyors do not only work on managing spatial data, but they also use that spatial information for planning and effective administration of the land, sea and any other structures (for example Property Management and Cadastre). Surveyors are expected to conduct research in the above practices and to develop them. They are engaged in planning and development of land property, both rural and urban, land plots and buildings, for example by the preparation of the cadastral or land division documents. More and more often, geodetic administration seeks for surveyor prepared for critical usage of spatial and land related data (physical, economic, environmental, social attributes etc.) in spatial planning, urban and rural development or land management.

Apart from above, a geodetic surveyor is also a citizen or an investor who should be prepared for spatial planning participation at various stages of a collaborative spatial planning process (at local, regional, national level) as well as urban/rural and land development and make a valuable contribution to the community. Thus the knowledge of spatial planning system, its documents and regulations, participation as well as urban planning rules, spatial order is necessary.

Most of issues from last two paragraphs, as well as relation between them, are presented to future geodetic surveyors, during the Basis of Spatial and Town Planning course carried on the sixth semester of engineering studies of Geodesy and Cartography of the Gdańsk University of Technology. Some of skills mentioned above are also acquired by students during individual or group practice after fourth semester and during work on diploma thesis.

2 THE COURSE

The Basis of Spatial and Town Planning course (2 ECTS credits) is conducted on the sixth semester of engineering studies of Geodesy and Cartography. It consists of 15 hours of lectures and 15 hours of practical exercises. The expected effects of the course are specified in general in the syllabus. During the course, apart from the knowledge on spatial and urban planning such as stating conditions and defining direction and presenting the concept plan for future land development, students gain abilities of:

- gaining data (internet, GIS applications, articles, books),
- managing and analysing data, using CAD and GIS,
- organizing work within the working group,
- practicing relevant methods and techniques of presentation to communicate the results and findings,
- discussing their attitudes and values behind visions, concepts and projects.

2.1 Course lectures

During fifteen hours of lectures students familiarize with spatial planning system, its documents and regulations in general. The main stress is put on the local level of spatial planning, which is discussed in detail, as it is the basis for practical exercises and future geodetic work. Students learn the rules of urban planning, basic acts, regulations used in planning small housing estate of single family houses and how to draw land management plans. During lectures, current spatial planning issues are often discussed. This helps students to understand the spatial changes which they can observe around themselves and it sometimes encourages them to participate in projects or discussions in their city. The course is supported with e-learning platform, where all news from the local planning are presented. Students can also develop their spatial planning dictionary where interested students add definitions of spatial and urban terms with their references.

2.2 Course Exercises

There are two practical exercises that need to be carried out to fulfil course requirements. Both of them are performed by groups of five students. The exercises are prepared in the way that students can practice and develop their knowledge and skills by working with real data. This can be achieved within the frames of cooperation with the Spatial Planning Office in Gdynia – SPOG [2].

The first exercise is the land inventory. It is based on collecting spatial data of the urban area and presenting them on maps as well as in excel sheets. The analysed area is indicated by SPOG as students' results are used by the office for the elaboration of spatial planning documents such as Local Development Plans. The set of required data is defined cooperatively by SPOG and the Tutor. Students have to collect a set of data for each plot from land registry using basic maps and site measurements.

The range and the amount of information, as well as its accuracy and precision, vary greatly depending on the scale and objectives of the land-use plan, quality of city GIS and possibility to access the data.

They are as follows:

1) Spatial data such as:

- present land use: residential: single family, two and more family, high buildings (more than five floors), public spaces, industrial, commercial, parks, water, public service, leisure and sport, transport: roads, rails, cycle lines, walking lines, car parks;
- ecological resources protected;
- historic, archaeological and cultural resources protected;
- public access;
- areas of significant threat (for example climatic hazards, areas of soil pollution, solid and hazardous wastes, noise, lack of spatial order).

2) Urban data: intensity, built area, biological area.

3) Architectural parameters: roof geometry and building height.

Apart from the obligatory data, students can add their own comments or mark on their maps other important areas or objects not mentioned above, but according to these of a high importance.

During the second exercise, students have to design a small single family housing estate. Firstly, they have to acquire the basis map from GIS, calibrate it and import to AutoCAD. Secondly, physical constraints and opportunities of the site need to be identified and quantified. Data sources include topographic base maps, air photographs and satellite imagery, existing surveys and departmental records, local vision, spatial planning documents, web pages of institutions, city GIS and others.

Students analyse the conditions and directions determined in local spatial documents, available GIS data, maps and other documents. They have to search for and get right documents from the internet. To analyse data, they use simplified SWOT analysis. SWOT (alternatively SWOT Matrix) is a structured planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a project or in a business venture. A SWOT analysis can be carried out for a product, place, industry or person. It involves specifying the objective of the business venture or project and **identifying the internal and external factors** that are favourable and unfavourable for the achieve of that objective. The expected output is the thematic map and excel sheet.

The SWOT analysis helps to know conflicts of land use. Students have to formulate detailed directions for the analysed land development taking into account the sustainable development and spatial order and developing realistic options that best meet the needs and minimize learnt conflicts. Having defined assumptions, they elaborate their first conception of the settlement. Even though the group works on this project, each student is asked to prepare his own conception, which is later being discussed within the group and the best proposal is developed by the whole group as the final project. The solutions presenting unconventional subdivision protecting green areas, opening to surrounding, with safe solutions for cyclists and pedestrians, giving a chance for future development are strongly promoted. The expected output of this exercise is the map of the Concept Development Plan of housing estate.

2.3 Course effects

The required course effects of knowledge and abilities are as follows:

Knowledge:

- of geodesy and cartography engineering and assessment of the risk and effect of this business. A student has the basic legal and geodetic knowledge which is necessary to solve problems related to cadastre, **spatial planning** and property management considering map elaboration and land division,
- a student has the basic knowledge of an architecture, **urban planning**, building construction and environmental and transport engineering necessary to plan the investment,
- a student has the basic knowledge of **circulation of geodetic documents** in the investment process.

Abilities:

- a student has the conscience of working towards completing one's education within geodesy and cartography,
- a student is able to define the priorities of his tasks,
- a student can solve problems connected with practicing profession.

Knowledge effects are achieved during lectures and self studies. They are verified by final test and partly by exercises, discussions and oral presentations of project work. Considering abilities, it is important to define the goals in more detailed way as in syllabus they are mentioned as very general ones. The stress is put on students self-reliant during lectures and working in groups during exercises.

When we consider the effect that ***a student has the conscience of working towards completing one's education within geodesy and cartography***. During fifteen hours of lectures, it is difficult to gain the whole theoretical knowledge. As a result, during exercises students meet problems without "ready answers". They are asked to search for answers or problem solutions and discuss them within the group. They have to present their solutions to the tutor and argue for them. This way they both realize that lectures present limited knowledge and they need constantly to widen it, as well as to perfect themselves.

When we consider the effect that ***a student is able to define the priorities of his tasks***, working in groups seems to be a good way to achieve this goal. Solving tasks in a cooperatively way requires using good management strategies, especially when the task deadline is defined. Thus the priorities are to stated for each person and each task to fulfil the exercise requirements and achieve goals.

There is also an effect that ***a student can solve problems with practicing profession***. This effect is achieved by working on real data, which are further used in spatial planning. At first, students realize the correlation between future spatial documents and the responsibility for the accuracy of data. Thus they involve the knowledge gained during other courses to do their best. Secondly, they solve several practical problems, probably they would not solve on theoretical exercises. During exercises carried out within the frames of cooperation with SPOG, students also gain the professional support and have contact with practitioners in the fields of different professions.

3 SUMMER PRACTICE

Summer practices at Geodesy and Cartography are realized after the first, second and third year of studies. After the first and second year of study they allow to get 2 ECTS credits and they are realized in project groups, whereas the specialty practices generate 6 ECTS credits after the third year and they are individual for each student. Within the frames of practices, many tasks in the field of geodesy and cartography as well as interacting and interdependent disciplines are realized.

As a part of the classic course of the 'spatial planning' training at other majors (e.g. environmental engineering, construction) the effects of learning are achieved only within the framework of lectures, exercises and projects [3]. In contrast, at the major of 'geodesy and cartography' the experimental work with SPOG was introduced also within the framework of group practices (after the second year) and specialty practices.

During the individual practice, student is supervised by the SPOG specialists and during group practice, students are supervised by both: the SPOG specialists and academic tutor. Students are engaged in land inventory and data collecting as well as presenting data on thematic maps. They get input data such as basic, original maps and make the land inventory using GIS data and local inspection. The data are analysed and students have to elaborate thematic maps.

Group practice according to the students' opinion, despite the purchase and improvement of a number of skills, proved to be however too high difficulty and load (although the result of the effects of cooperation was evaluated by SPOG as very high). In contrast, individual practices were assessed by students and tutors as important and essential in the further development.

Nevertheless, the experience gained by students within the practice can be reflected in their further development path, while connecting the geodesy and cartography with other fields of knowledge. Students also participate in projects and research conducted by the staff of the Department of Geodesy [4-7]. Practice in conjunction with the scientific and research issues allows for the significant improvement of the graduate quality.

4 DIPLOMA THESIS

Students, who are interested in spatial planning issues or urban planning can work on diploma thesis which connects geodetic knowledge and spatial or urban planning. In most cases, they prepare geodetic data such as 3D terrain models or thematic maps and 3D visualisations using CAD system or GIS for specific spatial planning process, for example "Development of Digital Terrain Model for the part of the Nowa Karczma – Grabowo Kościerskie commune and on the basis of selected materials for the purpose of spatial planning" [8].

Some students develop the thematic maps presenting the land conditions or the historically urban or spatial development of the city or chosen parts of the city, for example "Analysis of the functional and spatial structure in WMS services of Gdańsk Kokoszki Przemysłowe district" [9]. Some elaborated thematic maps within diploma thesis are based on spatial planning documents, for example „Elaboration of thematic map; the map of acoustical sensitivity for chosen part of Gdynia city" [10].

Students often choose the diploma subjects, were they can also use their knowledge in planning land subdivisions and preparing documents for gaining local building conditions, for example "Land subdivision project of the plot in Gdynia Chwarzno – Wiczlino district" [11].

There are also more theoretical tasks where students analyse the relation between geodesy and spatial planning according to Polish or European regulations "The comparison of geodetic surveyor profession and elements of cadastre in Poland and Great Britain" [12].

5 CONCLUSIONS

The Geodesy and Cartography studies provide the theoretical and practical background concerning technologies and methodologies for acquisition, integration, management, analysis and presentation of spatial data, models and knowledge as support for applications for a number of uses (civil engineering, spatial planning etc.). The study focuses on the knowledge of the shape and size of the Earth and the abilities of using several geometrical surveying and measurements. Traditional education of surveyors focuses on geometry and technology more than on land use and administration and the issues of land management, cadastre and spatial planning are realized within limited hours.

But nowadays, students face many other tasks to solve in the future and they need the skills in different scientific fields to be competitive on the labour market. To enrich their chances, the presented ways of introducing spatial and urban planning issues were carefully planned. The interdisciplinary and more managerial approach in solving the tasks is promoted. Students have several opportunities to gain the knowledge such as the course in spatial and urban planning, the individual and group summer practice or diploma thesis to be defined by themselves or chosen.

The effort to present spatial and urban planning brings effects measured by the number of students choosing the diploma thesis based on geodesy and spatial planning and applying for individual practice in spatial planning. Also the results of final course informal questionnaire are satisfying. Students find the subject interesting and are eagerly attend classes. Even though they find the

exercises challenging, they also find them as important ones and giving a chance to learn new, useful issues and skills.

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