

How to Cite:

Amandykova, D., Gulmira, A., Myrzakhmetova, S., Mukanovna, A. I., Nigmatova, A., & Popov, Y. (2021). The method of formation of interdisciplinary principles in the educational program of the specialty "architecture". *Linguistics and Culture Review*, 5(S3), 486-498. <https://doi.org/10.37028/lingcure.v5nS3.1521>

The Method of Formation of Interdisciplinary Principles in the Educational Program of the Specialty "Architecture"

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Abstract---This article analyzes modern requirements for professional education of student architects. New educational documents and the trajectory of their further development are examined. Special attention is paid to innovative interdisciplinary principles of the educational process, as well as methodological requirements. The experience of a separate school on formation of the concept of interdisciplinary methods of teaching of the main discipline is considered. As well as promising directions of development of the specialty in this school.

Keywords---architecture, BIM technology, competence, interdisciplinary, methodology education, soft skills.

Introduction

Modern challenges of development of science, engineering and technology pose new challenges to higher education in Kazakhstan to improve professional education for all types of specialties. The Ministry of Education and Science of Kazakhstan has formed a classifier of educational fields, developed new educational documents, carried out work on modernization of educational programs. The new paradigm of education is aimed at transition from passive assimilation of a large number of disciplines by students to the acquisition of new knowledge as a result of active learning activities with the development of practical skills (Williams, 1994; Gibert et al., 2017). The innovativeness of the formation of new educational programs is directly related to the acquisition of the most important competencies from various fields of knowledge by young specialists. The process of acquiring competencies is the ability to apply blocks of knowledge and skills in real practical situations, i.e. to do something "competently", anticipating or predicting the outcome of their activities. Synergistic and interdisciplinary directions of development of science, technology, production have led to the need for interdisciplinary integration of knowledge and skills transfer in the educational process. Scientific synthesis of knowledge from different areas of science, wide introduction of information and communication technologies become the basis of innovative production technologies (Bulanova-Toporkova, 2002).

Research Methodology

The methodological basis for the establishment of interdisciplinary links of any educational program is a professional qualification characteristic of a specialist, as an important condition for the competitiveness of young professionals in accordance with the needs of the labor market. Rapidly developing digital technologies of building information modeling (BIM) create conditions for the transfer of the construction industry in the category of high-tech industries. In accordance with the new classification of directions of specialists training in the Republic of Kazakhstan transition of the specialty "Architecture" to a group of engineering specialties means the strengthening of the role of engineering knowledge and skills for the upcoming technological innovation in the construction industry.

It should be noted that educational programs of training of architectural personnel in different countries of the world have a similar structure of development of knowledge and understanding of the importance of architecture for society, accurately formulated by the first theorist and architect Vitruvius as "utilitas" (benefit), "firmitas" (strength), "venustas" (beauty). Blocks of scientific and technical knowledge for the architect and are formed in the curriculum in three basic areas:

- Natural science and Humanities - knowledge about the natural world and the natural habitat of man, knowledge about man and his needs, the social laws of society.
- Engineering and technical direction - knowledge of technical and engineering aspects of creating an artificial human habitat.

- Cultural and aesthetic direction - knowledge of the development of civilization and all kinds of arts, the laws of creativity and perception of works of art, including architecture.

The professional activity of the architect is based on a constant and dynamic interdisciplinary interaction between these three areas of scientific knowledge, equally important for effective work in the field of architecture. When developing the content of educational materials of the new educational training program for the specialty "Architecture" it is extremely important to maintain a balance of all three areas of knowledge with the effort of their interdisciplinary connections in the blocks of academic disciplines necessary for mastering the professional skills of design and construction of architectural objects (Suryasa, 2019).

In the technical sense, the result of the professional activity of the architect is the production and engineering description of the project of the future building or types of construction transferred for further implementation in construction. The architectural part of the project contains a comprehensive package of technical documentation for the implementation of engineering solutions and calculations, for the selection of building materials, etc. In General, the production of the project of the future building is an example of a multidisciplinary complex technological process. Educational programs for training architects traditionally use a multi-factor orientation of professional knowledge from various fields of science and technology in the block of professional disciplines in the development of students through the cycle of educational architectural projects performed by students from the first to the final year (Ogunsiji & Ladanu, 2017; Suarez et al., 2018).

The Faculty of Architecture of Kazgas (Kazakh head Academy of architecture and construction) always pays great attention to the organization of integrated with the production model of training, which combines academic theoretical training and practice-oriented educational activities. This is an invitation to manufacturers to conduct a series of seminars on design and production issues, participation in creative and research competitions on request of the enterprise, the implementation of diploma and course projects on current topics of architectural practice, obtaining advice from manufacturers at the enterprises-branches (Iwata et al., 1995; Arayici et al., 2011).

In methodological terms, the principle of interdisciplinary is important because it allows you to apply methods specific to one discipline in other areas of knowledge. At the same time, new interdisciplinary tools of activity are most often formed (Lysak, 2016). Interdisciplinary is understood as the interaction of two or more scientific disciplines, each of which has its own subject, its own terminology and research methods. At the same time, interdisciplinary makes it possible to identify new forms of knowledge that are not included in the content of a particular discipline. At the junction of scientific disciplines create conditions for new, inventive or creative solutions (Akinade et al., 2018; Klein, 2008).

In the preparation of new educational programs in the specialty "Architecture" methodical principle of establishing interdisciplinary connections in the curriculum is mandatory due to the interdisciplinary nature of the profession

itself. The three main blocks of disciplines establishes substantive links between them as follows:

- General subjects – professional subjects.
- Basic disciplines – professional disciplines.
- Design of discipline – the discipline of specialization.

At the same time there are different types of educational and interdisciplinary connections. Direct connections arise when the assimilation of one discipline is based on the knowledge of another. These include, for example, through cycles of study of the history of culture, art, history of architecture, modern architecture. This type of communication is typical in the study of basic and professional disciplines. The main means of interdisciplinary is the consistency of intermediate types of control (Shestakov, 2013). Interdisciplinary connections of a problematic nature arise when two or more disciplines have a common object of study. Such connections arise in the study of General and professional disciplines. To consider the General interdisciplinary problems characterized by scientific and practical approach, the observance of unity in the interpretation of General scientific concepts, interlinked coordination of stages of the educational process, as well as the preservation of the continuity of the learning outcomes. Applied interdisciplinary connections are formed when the concepts of one discipline are used in the study of another.

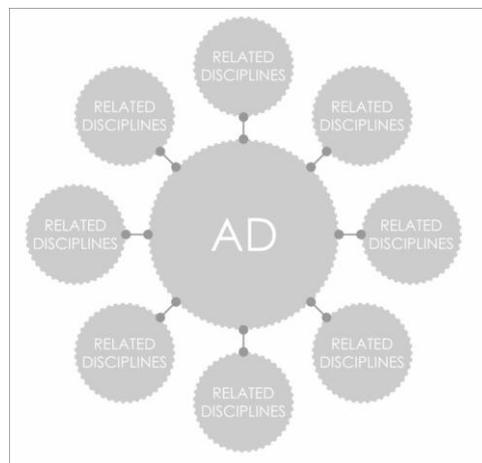


Figure 1. Model of the organization of the educational process.

For example, in the development of disciplines engineering and professional specialization. Mental-mediated connections arise in the formation of research skills and intellectual abilities necessary in professional activity [2]. In the context of architectural education it can be scientific methods of analysis and conclusions from the cycle of General subjects, from the basic disciplines of the development of compositional and artistic skills and spatial imagination, imaginative and intuitive thinking, etc. The forthcoming digital modernization of the design and construction production process forms new professional competencies for the practical development of information types of design in educational programs on

architectural and construction specialties (Spear et al., 2006; Imahori & Lanigan, 1989).

The emerging transition in the world practice of construction to a new paradigm of design and production processes based on BIM-technologies, has identified new aspects of the competencies of future professionals associated with improving the quality of design and construction, as well as with increasing productivity. The responsibility of participants in team working practices in BIM is increasing. They need to possess positive social attitudes in communication and cooperation, have creativity, analytical thinking, entrepreneurship, and self-organization. Digital, language, legal, financial competencies are becoming increasingly mandatory requirements of the modern labor market (Shipilov, 2019).

In the international educational standards the group of the specified competences has the name "soft skills". For the architect, as one of the key coordinators of the design and production of the construction process, "soft"-competence consists of the ability and willingness to work in a team, the ability to work with a variety of blocks of information, the presence of critical thinking skills, tolerance. Digital transformation of educational programs in the specialty "Architecture" is associated with the development of the level of 3D modeling in BIM-technologies to create a complex of architectural, structural and computational information models made on object-oriented software. Educational and methodical principles of teaching students to create computer information models will differ from the established principles of practical training in architectural design. Computer modeling itself is an interdisciplinary method of design, implying teamwork of students of different specialties under the guidance of teachers-consultants. It is necessary to organize practical training using interdisciplinary problems of engineering and design direction, interdisciplinary laboratory work on the development of information modeling technology, for example, with the help of digital simulators. The solution of problematic issues of coordination of information model creation should be discussed at interdisciplinary seminars with the obligatory presence of all participants of BIM-design (Bulanova-Toporkova, 2002).

An important issue is the coherence under the training methods of modern digital infrastructure of the University in the form of network and cloud resources, wireless Internet for students and teachers, equipped computer labs. For a new form of organization of training in architectural and construction specialties with the use of BIM-design should be created a working environment with databases, developed didactic digital materials, instructional videos, online tests, training scenarios, used digital training simulators, games (Koester & Lustig, 2015; Heckman & Kautz, 2012).

Ultimately, training in digital skills to perform professional tasks leads to the creation of an integrated information learning environment based on full interdisciplinary interaction in the learning process. The integration is based on the new operational tools, which include digital development of the program shell of the workshop, questionnaires for the analysis of assimilation of the material, means of control and adjustment of the individual learning path, simulators of personal advancement. The integrated information learning environment creates

an active and attractive form of learning information technology, promotes student motivation to develop professional competence.

Integration interdisciplinary environment is associated with the development of integrated interdisciplinary educational complexes. Interdisciplinary disciplines of the curriculum implemented by teachers of different specialties should have common goals and a common conceptual framework, a subject Glossary. The structure of the interdisciplinary educational complex consists of three parts: the target part, which reflects the interdisciplinary pedagogical learning objectives; content and reflexive part, containing control interdisciplinary tasks, development criteria and recommendations for the correction of the result.

Effective forms of educational interaction is an interdisciplinary seminar-conference on problematic issues of academic disciplines. This seminar creates a platform for joint activities of students and teachers of different specialties, concentrates information on the development and status of problems, and activates the implementation of research in architecture and construction. It can be conducted with the invitation of leading practitioners of design companies or research institutions. However, it should be noted that for the successful organization of the interdisciplinary educational process can be an obstacle to the lack of training areas for collaboration, personalized for the tasks of specialty jobs and equipped multimedia lecture halls.

The process of successful implementation of intersubject communications is facilitated by the development of schedules of network planning of the educational process. Network schedule, as a model of the educational process, coordinates the content and volume of training activities over time. The network planning map establishes logical and practical links between the disciplines of the curriculum. The General nodal themes are distributed in the points of concentration of the greatest number of connections with other disciplines. Such a schedule is a mandatory Annex to the regulatory standards of each design and production company working in BIM - technologies.

An important competence of a young specialist is the competence for self-realization of a specialist, which implies the strengthening of the role of independent work of students in learning. To assess the effectiveness of independent work of the student, it is important to use the means of feedback and mandatory evaluation control, for example, in the form of a Colloquium on the solution of specially developed interdisciplinary problems, debates, business games, case studies, remote and interactive network interaction between the student and the teacher.

Thus it is necessary to observe balance of unity of educational and methodical approaches and individual features of the trained having different degree of development of educational materials, features of psychological type, for example, mainly figurative or logical thinking (Shipilov, 2019). It is necessary to adopt the experience of foreign universities in the organization of training with the choice of a personally motivated learning path in the form of mandatory or additional modules of professional specialization and the development of practical skills. Expediency of interdisciplinary educational complexes should be considered by

experts – members of the methodical Commission on the specialty made of representatives of scientific schools in the directions, design and production enterprises. The training complex should also include evaluation lists of criteria for the examination of interdisciplinary programs, allowing to constructively assess the quality of educational programs by diverse specialists.

Discussion

A new qualitative level of teaching architectural design can be achieved by focusing on the interdisciplinary connection of subjects. In Kazakhstan, the experience of drawing up working curricula (RUP), along with the main subjects, there are related disciplines. The main idea developed in the Kazakh head architectural and construction school includes a cross-cutting connection of the tasks on the main subject "Architectural design" with other related disciplines. For admission to the 1st course of the Architectural profession, the applicant passes the examinations in the subjects of "drawing" and "Drawing". The exam allows you to determine the level of graphic training of students. After entering the higher education institution the student-architect on the basis of studying a complex of graphic disciplines continues to improve skills in graphic subjects.

In the current working curricula, the discipline "drawing" includes a series of exercises: the image of simple geometric bodies, plaster casts of the head and figure, drawing of living nature (portrait, Phi-Gur), sketches of architectural monuments and compositional sketches. Learning to draw brings up the ability to see the main thing, to grasp the subject as a whole. The student acquires the experience of spatial thinking, learns to analytically perceive and understand the shape of the object, its plastic, structure, proportions, and location in space, black and white relations. Drawing from life involves a course of anatomy, for a long period of drawing and sketches, drawing from memory based on the skills of observation of reality. Mastering graphic skills improves the ways of expressing architectural ideas, develops spatial and structural imagination.

The discipline "Painting" includes: full-scale tasks on color relations, sketch miniatures and light-color environment in architectural graphics; compositional work on still life on the three-dimensional and planar visual composition and light-color perspective in architectural graphics. Discipline "Sculpture" — the construction of bas-relief, head and figure of man, bas-relief stigma in architecture — is important for the disclosure of expressive possibilities of planar and three-dimensional forms. Thus, the main purpose of teaching art disciplines is not only applied purposes, but also the education of a single aesthetic platform for architecture, sculpture, painting and decorative arts.

A special place is the study of the course "Engineering graphics" graphical method of displaying studies of spatial forms using drawings. The study of engineering graphics forms a strange thinking and skills in the image of spatial architectural compositions on the plane. "Architectural composition" in the Kazakh head Academy of architecture and construction was introduced into the program of the first course of the second semester. The course includes lectures and practical exercises. In the process of performing compositional models, the student studies

the properties and regularities of the three-dimensional composition, develops compositional abilities, imagination and three-dimensional representations.

The course "Fundamentals of architectural design" provides training in architectural composition, graphics and the basics of design, with the main attention paid to the structural and compositional side of architectural objects and the mastery of graphic means of expression. In addition to mastering the graphic technique, the student learns to compose projections on a sheet of paper, to convey the character of the depicted structure in unity with the environment. For understanding the forms of architectural classics, the compositional foundations of order modular architecture are studied, which fosters sensitivity to the beauty and expressiveness of the architectural language, forms the artistic taste. Not unimportant place is occupied by "Measurement practice", which also contributes to the formation of students' visual perception of architecture and the idea of the scale of the structure and its details.

At the present stage of development of Architectural education in Kazakhstan, a new method of formation of interdisciplinary principles is proposed. The following diagram shows a possible cross-cutting connection between the topics of the tasks in the discipline "Architectural design" and the tasks in related disciplines. For example, if the theme of the course project on the discipline "Architectural design" (AP): "Designing an individual house", the other 4 disciplines (the number of related disciplines, depending on the number of disciplines included in the working curriculum of each course for each semester), should also reflect the goals and objectives of this topic. Let's assume that the 4 disciplines presented in this scheme are: "Philosophy", "Kazakh language", "and Painting" "Engineering graphics". The proposed principle of constraint: AP "Individual house", respectively, the task of the subject "Philosophy" is to study the philosophy of houses of different ethnic groups, cultures or different philosophical views of the formation of residential facilities. Discipline "Engineering graphics" should solve the problem of perspective and situational placement of the projected architectural object-an individual house. "Painting"-color-color solution of the designed individual house. "Russian language"- development and discussion of the description of the theoretical "portrait" of the projected individual house.



Figure 2. Diagram of an interdisciplinary communication model.

Another important aspect of the proposed new methodology is the practical organization of the educational process in the discipline "Architectural design". This is necessary to devote considerable amount of time (R1-7 weeks) the search operation, by performing 5 or more sketches.

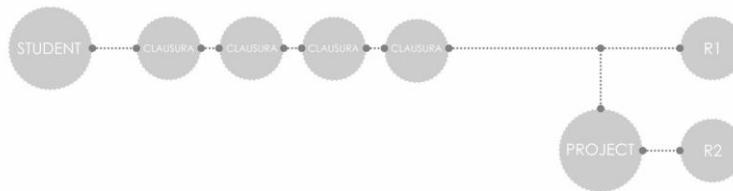


Figure 3. Student search work.

In the process of Clausen, the main objective should be to develop and search a variety of artistic and imaginative solutions to architectural object, taking into account climatic, socio-economic problems. For example: the Cosmogenic form of an individual residential object taking into account the cold climate or the Land form solution of the architectural form taking into account the hot climate, etc. This principle, according to the developers, should be applied to each task of Architectural design in all courses from the 1st to the 5th. Therefore, when distributing the academic load by semester, the 1st rating (7 weeks) of the 1st semester (15 weeks) should be devoted to search work. On the second ranking, the student must draw an approved version of Clausura in scale. On the 1st and 2nd year of work on the project is proposed to conduct on the principle of individual design. That is, 1 - 1 student carries out an individual project on a given topic. This principle applies to students of the 5th year.

According to the proposed methodology, starting from the 3rd year the principle of organization of training sessions on the subject: "Architectural design" should be based on the system of "workshop". Students of the group (20-25 students) should be divided into subgroups of 5 people, who will represent 1 workshop. The

division into workshops is based on the students' interest in a single concept, architectural solution or simply the students' personal good relationship with each other. Search work (execution of Clausura) architectural solution of the object of a given General theme, also takes 1-semester. According to the results of performed klausur that solved different types of artistic and imaginative solutions given the 1st of the architectural object, the students are divided into workshops of 4-5 students. One workshop performs five different types of architectural solutions of a given object. If the topic was design –school buildings, it should be 5 different types of schools. They can vary artistic and imaginative solution, location, climate conditions, etc. For submission as a draft to scale, sketches must pass a strict selection and to be selected by the members of the workshop. Therefore, each of the members of the workshop will present his best (of 4-5 pieces) Clausura to the students to include it in the design of the workshop works. After selecting the works, each workshop performs 5 different types of architectural solutions of the school. The advantage of this method is to instill in students the skills of teamwork, participation and co-authorship in 5 different types of projects within the 1st semester.

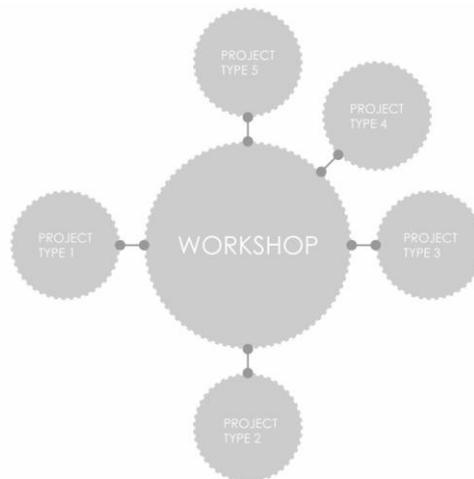


Figure 4. Workshop scope

The principle of the project, can also have a model of design and production organizations. When one specialist is responsible for the defined composition of the project. For example, one specialist draws plans only, other only sections, and still others busy 3-D visualization. This is within the framework of one project. When drawing another architectural object, the members of the workshop can change their function, that is, the specialist who drew the plans on another project draws facades, etc. The principle of the project, can also have a model of design and production organizations. When one specialist is responsible for a certain part of the project. For example, one specialist draws only plans, another only sections, and the third is engaged in 3-D visualization. This is within the framework of one project. When drawing another architectural object, the members of the workshop can change their function, that is, the specialist who drew the plans on another project draws facades, etc.

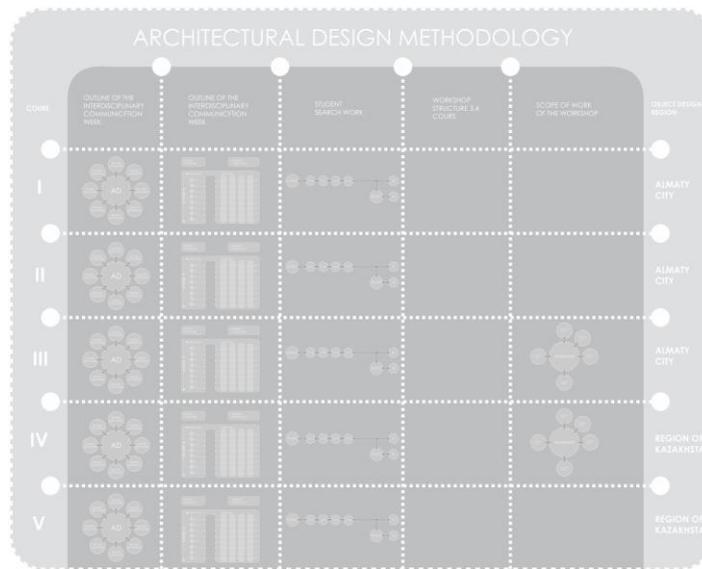


Figure 5. Organization model of discipline "Architectural design" by courses

Design of architectural objects for the regions of Kazakhstan, requires the inclusion in the curriculum of disciplines aimed at studying the urban foundations, regional characteristics, architectural and typological types of designed objects. As already shown in the scheme, starting from the 3rd year, the student must offer design solutions for different regions of Kazakhstan. One of the tasks of urban planning training of the student-architect is to expand and deepen the student's knowledge about the role of architecture in the organization of the environment. The task of the architect is not limited to the design of an independent object with its functional and typological structure, but consists in the design of the object in a system of higher rank — as part of a complex or ensemble. The complex, in turn, is part of a more complex urban system — residential education or district and further—in the spatial organization of social life of the city and inter-settlement systems. Urban planning is nothing more than a broader and more comprehensive manifestation of the social significance of architecture. The new approach in urban planning is based on the idea of balanced management of social and natural processes and conditions (Kabylov et al., 2017; Dinara et al., 2020).

Therefore, in the curriculum of the architectural specialty city-building education is provided by a number of disciplines: the history of urban planning, the basics of the theory of urban planning, environmental protection and improvement, economic geography and district planning, planning of industrial complexes, landscaping and welfare, engineering preparation of the territory of settlements and transport in the planning of cities. At the present stage, society actively develops and transforms the natural space of nature, creates specific forms of organization, "second nature" — social space, the laws of which are set not only by natural conditions, but also by social work. This is the understanding of the subject of architecture. Architectural creativity is inseparable from other types of human activity associated with the organization of the environment and society. The science of the environment becomes part of the architecture. The concept of

"living environment" covers a set of conditions of material and spiritual life of man and society. The quality of the living environment is determined by the structure of settlement, the regularities of which depend on social conditions, economic development, demographic factors and peculiarities of the geographical environment.

Conclusion

In order for the teacher-architect to be able to organize classes in architectural design as a core, profiling discipline, he needs to understand the structure of the curriculum. The curriculum of the specialty "architecture" in accordance with the model of the specialist is based on the General principles of the educational process, the ideological and political orientation of training and education and the unity of theory and practice in training. The curriculum provides for the construction of a logically coherent system of education, providing for the mutual coordination of various courses and the implementation of continuous training of students in fundamental and core disciplines. The curriculum should meet the specifics of the architectural profession and meet the modern level of architectural education.

In conclusion, it should be noted that the renewal of the higher education system in architectural and construction specialties is a necessary condition that should ensure a confident transition of Kazakhstan to the digital technological zone and integration into the world labor market. The use of interdisciplinary training programs is an inevitable process of modern education. Innovative training programs for future professionals should be developed in the field of BIM-technologies, Industrial architecture, Architecture of smart homes and cities, Reconstruction and restoration of architectural heritage. The implementation of these programs is carried out and developed not only through the content of educational programs, but also due to the quality of the educational environment of the University, the scientific and personal potential of teachers, the use of innovative educational technologies and interdisciplinary cooperation.

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