Architectural design and manual graphics in the student’s educational activities, their relationship with the mental peculiarities of a future specialist

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Abstract. The article presents the results of the scientific studies of the plasticity / rigidity of thinking among the bachelors of the Academy of Architecture and Arts, receiving training in the specialties: architecture, design of the architectural environment. In the field of modern architectural design, there is a process of reanimating the importance of hand-made graphics as an indispensable component of professional competence, which cannot but affect the content of training programs in training the specialists in this field. The author proves the hypothesis that there is a relationship between the abilities of students to use manual graphics in the design of projects with such a property of thinking as creative flexibility. The deliberate development of this ability through the educational tools will optimize the students’ assimilation of basic professional competencies in the field of architecture and design, increase the competitiveness of a university graduate.

1 Introduction
Today, one of the many tasks in creating an innovative high-tech economy is the formation of a professional elite in the field of architecture and design. This factor determines the informative context of professional guidelines and the basic competencies of educational disciplines of specialties in the field of architecture and design. The modern requirements of higher education require efforts to transform the system of training bachelors and masters of architecture, urban planning, restoration and design. The study of the thinking process of a person that distinguishes him from other people occupies a significant place in the scientific research of classics and modern scholars. In the works of L.S. Vygotsky, P.Ya. Halperin, Yu.B. Gippenreiter, V.V. Petukhova, Z.I. Kalmykova the problems devoted to the study of individual characteristics of human thinking as a psychological process have been solved. With thinking, its processes and qualitative features, the scientists S.L. Rubinstein, J. Gilford associate the qualitative result of practical activity in all spheres of human life [10]. According to B.M. Teplova, R.S. Nemova, the formation of professional thinking among the students occurs under the influence of their individual natural features, mental processes, forming the conditionality of his educational, activity preferences and needs, affecting the level and nature of his or her social activity. In pedagogical science, the interest in the use of diagnostic tools to determine the significant correlations between the professional competencies and the unique properties of the student’s psyche in the context of educational inclusion has increased. The modern term combines the personality-oriented escort techniques and the special educational needs of each student, embodying the reality of the program of an individual educational route for everyone who needs it. Today, there are no ready-
made algorithms for personally oriented coaching in the formation of relevant professional competencies of students. Perhaps this is due to the lack of training of specialists who are able to integrate the specifics of pedagogical experience with the scientific knowledge. Most research in this area is carried out on the personal initiative of those who are interested in it.

2 Main part
The study is of particular importance for adolescents and youth and is expressed in the acute need for them to realize their own individual mental characteristics for the directed development of personal abilities and self-diagnosis during the development of professional competencies. The growing generation is experiencing difficulties associated with self-reflection and orientation in a large flow of information, including the constant updating of professional requirements in the labor market. In the field of architectural design, there is a process of updating manual graphics as an essential component of professional competence, but the younger generation is influenced by the undeniable charm of modern gadgets, having a somewhat twisted idea of the future profession and the importance of applied visual skills that develop thinking.

2.1. Purpose, tasks, methods of study
The aim of the study is to discover the relationship of the individual characteristics of the student’s thinking with his ability to fine practice, which contributes to the development of creativity and competitiveness in the labor market.

The object of the study was the individual thinking ability of students - architects. The subject of the study is the flexibility of thinking as an integral part of the features of the intellectual activity of the individual.

A hypothesis that the visual activity develops the student’s flexibility of thinking was formulated. It is expressed through the use of manual graphics by them at the initial stage of architectural design and when designing a design project.

Upon reaching this goal, the following problems were under consideration:

Theoretical problems:
1. to study theoretical approaches to the study of thinking and, in particular, the flexibility of thinking of undergraduate students;
2. to reveal the basic concepts and analyze the methodological basis of the study;

Methodical tasks:
1. preparation of the course and order of the research;
2. determination of the research methodological tools in the context of the chosen goal;

Empirical tasks:
1. differentiation of the respondents by groups;
2. diagnostics of the subjects for plasticity / rigidity of thinking;
3. identification of patterns, description and statistical analysis of the test results

The results of the study were processed using the statistical program R version 3.6.1. from 05.07.07. To determine the significance of differences in indicators between groups, the Kruskal-Wallis method was used.

The methodological basis of the study: Rubinstein S.L. “Fundamentals of General Psychology” [7], Nemov R.S. “Psychology” [5].

2.2. Analysis of publications and achievements
Thinking is:
1) the highest level of human cognition, the process of reflection of objective reality, the human ability to think;
2) the process of action;
3) reasoning, reflection, aimed at knowledge of reality [1].

Thinking is defined as a unique ability to solve new, rapidly changing tasks in the situations where previous solutions no longer work. In primary forms, the process of thinking is the processing of information in the flow of the flow of thoughts, sensations and images. Thinking is a very personal
phenomenon, and its types can be distinguished as many as types character or other individual characteristics [2]. The disclosure of the relations and connections between the objects and phenomena constitutes the purpose of thinking itself and is a property and essence of the objective world and phenomena: this determines the specific way of thinking to an even deeper knowledge of being [3].

Psychological studies of thinking were carried out already in the 17th century with a firm conviction that it depended on logic. The first teachings on thinking shared the psyche and thinking of a person, considering this ability as an innate instinct. Intellectual abilities were considered reflection, contemplation, logical judiciousness. The advent of associative psychology reinforced the view that thinking comes down to association and is an innate ability. In the Renaissance, the scientists turned to ancient postulates that mental processes are the result of the brain, but this hypothesis remained largely abstract because it was not supported by empirical research. Two phenomena were opposed to each other: sensation and perception of the thinking process. The problem of what constitutes the greatest significance for a person was of interest. The sensualists (D. Locke, E.B. de Condillac) considered sensation and perception to be the only true way of true cognition and that the mind is complicated sensations, that is, they believed that cognition has a sensual nature. The rationalists (Spinoza, I. Kant, R. Descartes), on the contrary, believed that feelings give impetus to reflection and analysis, they inform about a certain process, but we know it and react thanks to reason. But even then, the process of thinking was considered an autonomous act, independent of feelings. The emergence of the science of reflexology (I.M. Sechenov, I.P. Pavlov, V.M. Bekhterev), which considers mental activity in connection with nervous processes. The scientists used the objective methods to substantiate and draw the scientific conclusions and, appearing as a direction in the field of psychology, affected psychiatry, sociology, and pedagogy. Reflexology gave a mechanistic interpretation of mental processes as the side factors of behavior; it was a time of physiological sociology. The merit of this direction in the consideration of practical thinking as skills in solving problems; in recognizing the existence of unconscious forms of thinking (psycho-analysis) and the fact of the relationship of thinking, activity preferences and needs. The thinking process during this period was at the center of the interest of O. Külpe, the German psychologist who founded the school at the University of Würzburg. His students studied mental processes using experimental methods related to self-observation. The representatives of this school assigned a special place to the role of motivation in the process of thinking, believing that this variable directly affects the result of thinking. It is believed that by developing a new, holistic view of the process of thinking, O. Külpe created a solid foundation for the development of gestalt psychology, paying particular attention to the study of both the process, decomposed into stages, and the content of thinking.

The theoretical analysis of the research on the problem of the psychological process of thinking, its types and individual characteristics made it possible to compare and classify theoretical data. Studying thinking, like any other mental process, psychological science takes into account and specifically investigates this or that degree:
- needs and motives that force a person to engage in mental activity;
- specific circumstances in which a person has a need for analysis, synthesis, etc.

The motives of thinking studied in psychology are of two types:
1) specific cognitive;
2) non-specific.

In the first case, the motivators and driving forces of mental activity are the interests and motives in which cognitive needs are manifested. In the second case, thinking begins under the influence of more or less external causes, rather than purely cognitive interests [1]. That is, a person begins to think under the influence of certain necessities, and in the course of his activity, deeper and stronger cognitive needs arise and develop. J. Guildford believed that the “creativity” of thinking is associated with the dominance of four features in it:
1. Originality, non-triviality, unusual ideas expressed, pronounced desire for intellectual novelty. A creative person almost always and everywhere seeks to find his own, different solution from the others.
2. Semantic flexibility, i.e. the ability to see an object from a new angle, to discover its new use, to expand its functional application in practice.
3. Figurative adaptive flexibility, i.e. the ability to change the perception of an object in such a way as to see its new side, hidden from observation.
4. Semantic spontaneous flexibility, i.e. the ability to produce a variety of ideas in an uncertain situation, in particular in one that does not contain guidelines for these ideas [5]. Based on this classification, we can conclude that the author insists on flexibility as the predominant feature of creative thinking.

In the study of R.S. Nemov the classification of thinking types was proposed a:
1. theoretical: conceptual, figurative;
2. practical: visual-figurative, visual-effective.

To prove our hypothesis, it is important that the scientist highlighted the characteristic of visual-figurative thinking as the main distinguishing feature - this thought process is directly related to reflection on reality, reaction to reality, attachment to it. He claims that this type of thinking prevails over the elementary school students and adults in creative professions who regularly practice visual activity. “The visual-figurative thinking of an artist can be more perfect than the verbal-logical thinking of a mediocre scientist” [3]. This idea was developed by B.M. Teplov, emphasizing that “Visual-figurative thinking is a type of thinking characterized by reliance on representations and images. With visual-figurative thinking, the situation is transformed in terms of image or representation” [6]. And what’s important is being transformed. Here he points to the manifestation of the flexibility of the mind by which the author implies freedom of thought from preconceived assumptions, patterns and stereotypes, expressed as the ability to find the new solutions when changing the situation and conditions of the problem. The flexibility of the mind, according to the author, “is expressed not only in freedom from the shackling influence of screen-printing techniques, but also in the ability to diversify the attempts to solve, not to repeat those whose incorrectness has already been discovered” [6].

Turning to more modern research, we observe a steady concepts’ combination of the creativity and visual activity. In particular, E.M. Bazilevich, with his work “Developing the Creativity of Students in Educational Visual Activities,” substantiated the hypothesis that, by analyzing the psychological studies of creativity and the visual activities of students at an architectural university, it is possible to get an idea of visual activity as a purposefully organized and effective means of developing the students’ unique abilities in the educational process [7]. At the same time, the author of the scientific research focuses on the importance of the prevailing characteristics of the individual’s thinking, since creativity is a quality of thinking that enhances its special characteristics and makes it more creative. Further, E.M. Bazilevich provides an evidence base that confirms the hypothesis that the development of thinking plasticity in students does not require the unique conditions for the implementation of the proposed methods and it is enough to optimize the educational and developmental tasks in existing programs. Of course, it is necessary to provide the teaching staff with an information base of professional development for this. The experience of the domestic and foreign pedagogical community is a scientific resource for the training of specialists and the increase of civilization throughout his professional life. In particular, the study of Swedish colleagues about independent judgments in collegial discussions in the pedagogical community seems noticeable [8].

Kokorina E.V. in her dissertation, “Architectural Drawing as a Creative Component of the Language of Professional Communications”, presented the way of the research, formation and disclosure of the artistic expressiveness of the design decision idea as a process of reflective understanding and flexible search. The author of a unique scientific work proves that the basis of architectural design is currently manual graphics [9]. In conclusion, the author convincingly argues the assertion that the conceptual and intuitive development of the idea is provided exclusively in the process of manual sketching, when thinking controls the construction of the image, and the drawing develops the idea when using artistic graphics as a creative, associative, figurative component of the basis of visual communication creates an artistic space of the author’s idea of an architectural or design project. With a similar opinion we will meet with L.P. Kholodova in the scientific publication “Global Creativity: Synthesis of Architecture
with Other Scientific Disciplines”, which addresses the synthesis of the design skills and manual graphics in the practice of an architect and proves its relevance. One of the main factors affecting the student’s ability to integrate the competencies in practical activities was named a feature - thinking plasticity [10].

Based on the analysis of the scientific sources, we can conclude that the skills of visual activity and thinking plasticity can be in direct connection and there are reasons for empirical research.

2.3. Experimental part
Diagnostics of individual characteristics of the respondents’ thinking was carried out using a test according to the method of A.S. Lachins “The flexibility of thinking” and the method of mathematical processing.

The feasibility of choosing this test for the research is justified by the following provisions: the development of individual characteristics of human thinking is recognized as an essential and most important condition for achieving high professionalism; this test allows to determine the coefficient of thinking flexibility, recognized as one of the main characteristics of the mental activity of a professional in the field of fine art and architectural design.

The study was attended by the students of the Academy of Architecture and Arts of the Southern Federal University, areas of preparation 07.03.01 Architecture, 54.03.01 Design, Applied Bachelor. According to the results of the respondents’ observation in the educational process, the subjects were divided into two groups according to the following criteria:
Group 1 – the students of the training direction 03.07.01 Architecture, preferring the use of manual graphics in working with an architectural project, combining it with computer technology;
Group 2 – the students in the field of preparation 54.03.01 Design, who prefer the use of manual graphics in working with a design project, combining it with computer technologies;
Group 3 – the students experiencing difficulties in visual practice, having satisfactory performance in creative disciplines, and performing design tasks only with the help of computer programs.

Number of respondents: 120.
The main, 1 group - 40 people; Group 2 - 42 people; Group 3 - 38 people.
Age indicator: 18 - 20 years old.

A technique for diagnosing thinking flexibility was developed by A.S. Lachins to identify the thinking plasticity / rigidity. The respondents were asked to write the phrase “Snow has already melted in the field” in four different ways. The indicator of the respondents’ thinking flexibility can confirm the factor of creativity and will allow ranking the groups of respondents by the levels of creativity. Flexibility as a quality of thinking, which determines a person’s ability to react sensitively to changing conditions of tasks and at the same time quickly solve them, is a complementary component of his creativity. The testing procedure was carried out in groups of 12-16 people. The students were to write the same phrase in four ways described in detail in the instructions in a limited time. Then, according to the formula, the coefficient of creative flexibility was determined, which is interpreted by the author of the test on a two-level scale: low / high level.
Figure 1. The results of the study of the thinking flexibility in the groups of respondents

Figure 1 shows the result of the study. Of course, we took into account the fact that in its pure form this feature of thinking is extremely rare, but when it is dominantly included in a specific situation it is a sign of an individual’s ability to easily and quickly switch from one activity to another, quickly respond to changes in an input situation, and the ability to take the adequate decisions when changing strategies. Conversely, with a low level of its manifestation, the test respondent is not able to quickly and adequately react to the changes in the situation; he has difficulty changing the subjective program of activity.

As a result of quantitative processing of group research data, the following statistics were obtained:

- index K plasticity from 0 till 0,4 – 24%; from 0,5 till 1,5 – 76%;
- index K plasticity from 0 till 0,4 – 19%; from 0,5 till 1,5 – 81%;
- index K plasticity from 0 till 0,4 – 38%; from 0,5 till 1,5 – 63%.

We see that in groups 1 and 2, where the respondents who successfully mastered the skills of manual graphics were collected, a high indicator of the coefficient of flexibility of thinking is revealed. The respondents from the control group who did not practice manual graphics in the designing projects showed a low coefficient of thinking flexibility. To identify the significance of differences in indicators in groups, the Kruskal-Wallis method was used.

Table 1. The significance levels of differences in thinking flexibility indicators.

| Index                  | $H$ Kraskal Wallis | Relevance $p$ |
|------------------------|--------------------|---------------|
| Thinking flexibility    | 12.365             | 0.0020        |

The reliability coefficient of differences in the indicators of thinking flexibility in the groups presented in Table 1 makes it possible to conclude that the hypothesis of the relationship between the thinking flexibility and the pronounced tendency of subjects to visual practice is proved.

3 Summary

The presented evidence of the hypothesis about the relationship between the thinking flexibility of the students and their abilities for manual graphics allows to conclude that the possession of these visual skills gives the student expression freedom, gives courage to follow the idea, conduct the searches without being tied to patterns and stereotypical models. And, in turn, the level of the students’ thinking flexibility can be, along with an indicator of creativity as the ability to analyze and constructively implement a plan, which is the basic professional competence. We believe that this correlation is important and necessary to verify, but already at this stage it should be taken into account when developing educational tasks and exercises in the programs of the main and accompanying disciplines of the educational program of the training direction 03.03.01 Architecture and 03.03.01 Design, applied undergraduate.

The scientific pedagogical community conducts the research on the modern understanding of youth about the professional activities in the field of architecture and design, its results are presented to the general public [11]. Unfortunately, we are forced to state the fact that these ideas are very different from the professional choice of a student and the real situation on the labor market, which, of course, poses a number of paramount tasks for the specialized pre-university training of senior students and optimization of programs in the disciplines of the propaedeutics section [12].

3.1. Recommendations

There are grounds for recommendations to turn to the experience of specialized architectural and artistic
training of applicants. To draw special attention of teachers to significant factors of graphic skills; in practical classes in drawing and painting, special attention should be paid to the exercises that develop the students’ thinking flexibility [13]. For example, in the performance of educational tasks of a drawing from nature, alternate the focus of the student’s attention from the analytical drawing of the object’s construction to the drawing of plastic forms in the visual space and the perception of nature as a situation, and the object as its part, is an integral element. There are techniques for teaching this method.

Multitasking in drawing will lead the student away from copying nature and provide an opportunity to rely on their own subjective perception of reality, which will open freedom for creativity and development, in particular, professional competencies. The history of education presents us with the materials of the unique pedagogical experience of VKHUTEMAS [14], where the basic disciplines of educational programs were drawn. Only a few perceivers of drawing methods and schools for design and architecture, brought up by the teachers of the printing institute, have retained a principled approach to the formation of, first of all, the thinking and artistic taste of the student throughout the entire period of study [15]. VKHUTEMAS School - All-Union Art Workshops. They arose in 1921 as a kind of experiment in organizing the training of new artistic disciplines. Later, the institution was renamed VKhUTEIN - Institute. The leading teachers were: Arkhipov, Falk, Krymov, Tatlin, Rodchenko, Popova and others. The founder is Favorsky V.A. Recruitment was conducted from all over the country, regardless of the level of training. The students were allowed to independently form an educational trajectory and, in addition to compulsory disciplines, attend additional classes at their own discretion. The teachers of this educational institution had a main goal - to prepare a person for professional activity in a short way. Istomin Konstantin is the author of the training program. Favorsky Vladimir Andreevich is the author of a lecture course on composition theory. Unfortunately, today it is not possible to convey the nuances of the author’s interpretation of one or another practical exercise, since most of the methodological texts of Istomin of that period are known only from students’ notes. Of course, the most valuable thing in Istomin’s teaching system, as in any system of teaching practical discipline, was oral recommendations for a concrete analysis of the tasks completed. The legacy of VKHUTEMAS was adopted by many Russian institutions: MSPU, MSAU name after Strogonov, as well as the artists who recognized this approach as close to working with a fine surface, are close. Drawing at the VKHUTEMAS school is a drawing system created experimentally as a result of an experiment organized on the basis of training workshops. The foundation of this system was a course of lectures “Fundamentals of composition”, which was taught by V.A. Favorsky to all the students who work with the visual surface. It is very important for a modern higher education teacher working with the students in creative professions in the fields of architecture and design to know and be able to integrate this unique technique of quick drawing, including the search for a plastic topic, the ability to react sensitively to changes in reality and instantly fix a compositional idea into the curriculum - all that will contribute to the development of creativity of the future specialist. She will make him in demand in the labor market.

The significance of our study lies in the presentation of statistically confirmed information that visual activity develops the student’s flexibility of thinking. In particular, it is expressed through the use of manual graphics by them at the initial stage of architectural design and when designing a design project. This is the basis to assert that the importance of developing the thinking plasticity in the future architect and designer is conducive to the development of his professional creativity and competitiveness in the labor market.

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