ISSN 0798 1015

REVISTA ESPACIOS

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EDUCACIÓN • EDUCAÇÃO • EDUCATION Vol. 40 (Number 29) Year 2019. Page 3

The impact integrative model of the project graphics training on the design education

El modelo integrador de impacto de la formación gráfica del proyecto en la educación de diseño

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Received: 13/02/2019 • Approved: 05/08/2019 • Published 02/09/2019

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ABSTRACT:

The purpose of this article is to provide information those, who teach designers project graphics in institutions of higher education, so that the professional training would improve and competitiveness in the present labor market would increase. The developed integrative model for student learning consists of four interconnected blocks that ensure integral and complete mastering of all the necessary types of graphic images. The acquired teaching experience can be applied in other educational institutions.
Keywords: design, education, project graphics, integrative model

RESUMEN:

El propósito de este artículo es proporcionar información a aquellos que enseñan a los diseñadores gráficos de proyectos en instituciones de educación superior, para que mejore la capacitación profesional y aumente la competitividad en el mercado laboral actual. El modelo integrador desarrollado para el aprendizaje de los estudiantes consta de cuatro bloques interconectados que aseguran el dominio integral y completo de todos los tipos necesarios de imágenes gráficas. La experiencia docente adquirida puede ser aplicada en otras instituciones educativas.
Palabras clave: diseño, educación, proyecto gráfico, modelo integrador

1. Introduction

Design is one of the booming areas of human activity. The profession itself doesn't cease to cause heated debate. Since the beginning of the 1990s many educational institutions have in Russia launched professional training for designers. The problem of uniting the graphic language, which would allow to record, store and transmit project information, was particularly acute. Project graphics is the principal language and method capable of fixing the ideal image that occurred in the designer’s head.

However, today there is little agreement about the concept of *project graphics*, though it is a trite one. The coordination of views makes it possible to create and evaluate the design of a future product basing on a comprehensive, complete and in-depth analysis. The results are to be submitted on precise, clear and even figurative language familiar to scientists and artists.

Our theoretical research included the study of the evolution of the "graphics" concept. Though widely used in the scientific and methodological literature the term failed to acquire the single and generally accepted definition. This is largely due to the fact that graphics are an integral part of various types of human activity and each of them focuses on different features. Dahl's Explanatory dictionary doesn't contain the word, although there is a word "Graph", which signifies a line dividing paper into columns, stripes or cells (Dahl, 1989). That was the way the second meaning of the word emerged.

The most complete explanation of the terminological diversity is given in the Dictionary of Foreign Words (1988), where an exact translation from the Greek "graphic" is given. The noun means "I write; I draw", while the adjective "graphic" means "drawn, represented by a drawing". The first meaning indicates the procedural side of the phenomenon, while the second indicates the result, the resulting image.

At the end of the 19th and the beginning of the 20th century, when graphics was established as an independent form of art based on a drawing with strokes and lines without colors, the new meaning of the term emerged. The graphics included easel drawing as an independent area, and various types of printed graphics: wood engraving (woodcutting), metal engraving (etching), lithography, linocut, cardboard engraving, etc.

Graphics unites the artistic and drawing activity together with different types of images. If we consider them from the standpoint of mechanical performance, it can be noted that drawings and sketches are done by hand. In drawing we use drawing tools of a high degree of accuracy, which is subject to state standards (ESKD). These qualities allowed the drawing to occupy its niche within the framework of the methods of storing and transmitting information about the world. From this point of view, perspective images should be considered as drawings, since they are also most often performed by means of a ruler.

Today, the word "graphics" can have several clarifying adjectives: easel, print, author, drawing, computer, and finally design graphics. After analyzing several dozen definitions of "project graphics", we came to the conclusion that the most precise, clear and succinct definition was given in the fundamental paper "Designing and modeling industrial products" written by the team of leading Russian designers. They interpret project graphics "as a way and result of fixing the developer's project idea" (Marchenko, 2013). Here we will build on this definition.

Project graphics have a significant effect on the process and level of training, which should be considered as a dynamic process with the formation of a complex of professional qualities of an individual as its ultimate goal. We consider the professional training not as a preparatory stage, but as a purposeful process of direct mastering. The final result is the individual designer's high level of readiness to perform his/her professional activity in various conditions and at various levels. A special role is played by the capacity of the individual for further self-improvement and self-development.

Experimental study of the professional designers activities has shown that most of them, still at the early stages of design, fix their thoughts by hand, using records or images and applying various types at once. When performing a task, they accurately select the type of image that reveals the intent to the fullest. Thus, the assumption was confirmed that a mandatory part of designers' training must be project graphics with all its variety of images.

In design education, mastering design graphics is complicated by the fact that different types of images are taught within different academic disciplines:

- Classical drawing (making drawings and sketches);
- Technical graphics (making sketches and axonometric projections);
- Computer graphics (computer visualization);

- Composition (abstract and decorative drawing).

However each academic discipline pursues its own goals, without taking into account the final application of the acquired knowledge and skills. Each of them uses the traditional terminology for its subject matter and considers examples that are far from design reality. As a result, graphic images are mastered at different levels, and some are not studied at all.

So, we have a contradiction. On the one hand, there is a need to teach students all kinds of graphic images that will enhance their professional skills. On the other hand, in process of training the degree of mastering this or that type of images is not uniform, as they are being studied within various academic disciplines under the guidance of teachers who do not have a coordinated viewpoint on the notion of project graphics. The problem arises of changing the learning process so as to resolve this contradiction.

Thus, initially we aimed at finding the ways to harmonize the views and educational activities of the teaching staff, as well as to achieve integrity in the development of future graphic designers.

Project graphics is a visual design language that allows you to represent the designed object. We carried out an experiment in order to model an optimal educational process. Using such methods as theoretical analysis, comparison and classification we studied the activities of professional designers. We found out that they use a large variety of images. Their style of work formed the basis for creating a reference pattern for mastering project graphics.

That’s why we developed an integrated learning model, allowing students not only to master the project graphics, but also to apply it in new conditions. The experimental work was carried out in several stages with several generations of students. In this joint process, not only students advanced, but also the teachers who were aware of the efficacy of joint efforts.

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2. Materials and methodology

Project graphics together with the design is past centenary. In recent decades and it have been developing intensively. The following methods have been used do clarify the basic concepts of project graphics:

- theoretical analysis;
- linguistic comparison;
- classification.

At the first stage, in order to elaborate a training model we studied the professional activities of more than 50 practicing designers of different ages. They all voluntarily took part in the experiment. The following methods were used:

- observation and comparison;
- multiplication;
- graphic analysis and image comparison;
- image classification.

Before performing the test graphic tasks, all the designers indicated their age, gender, education and experience in teaching and professional activities. They performed two tasks. The method of multiplication helped to trace the sequence of executing different images and create a reference pattern of activity.

At the second stage, a method of pedagogical modeling was the key one. We developed an integrated learning model on its basis - the one that allows mastering the project schedule in full. Pedagogical system and activity approaches formed a methodological basis for elaborating and verifying the model.

The third stage of introducing the model took more than 10 years, which allowed accumulating and processing a large amount of empirical data. Each training year there was an adjustment and refinement of the component parts of the model, which led to its greater

efficiency. The model has changed the method of teaching several academic disciplines.

The control and measurement materials testified that students acquired competencies that enable them to solve tasks of varying complexity and present the results in a precise graphical way.

3. Literature review

A system approach has long existed in design and education. Here we will focus on the pedagogical system, i.e. a set of interrelated means, methods and processes necessary for creating an organized, purposeful and deliberate pedagogical influence on the formation of the student's personality. The main ideas and principles of the system approach to solving pedagogical problems are present in the works of Yu. K. Babansky (1989), V. P. Bespalko and Yu. G. Tatur (1999), N. Y. Saigushev and others (2017).

The analysis of pedagogical theoretical works and practice shows that "it is impossible to solve one or another research problem within the framework of one particular approach" (Belikov, 2004). In our study, along with the system approach, the activity approach was used, since it took into account the activity of the personality itself, determining its ability to transform the world around it. The implementation of the activity approach was outlined in the works of V. A. Belikov (2004), L. A. Kayumova and others (2016), I. P. Yakovlev (1987).

The selected approaches allowed elaborating a model of the educational process, so we became interested in the papers on this phenomenon (Danilenko & Nazarova, 2016; Zhdanova, 2014; Saigushev et al., 2017; Shentsova et al., 2016; Zhdanova et al., 2018). Modeling of pedagogical phenomena and processes is based on the general didactic principles and laws of the functioning of the pedagogical system.

The system approach has determined the conditions for interdisciplinary integration, which, in turn, repeatedly became the object of study by various researchers. Most often the attention was paid to the integration of science and production (Mironov, 2008; Yakovlev, 1987). Interdisciplinary integration has been repeatedly used and described as an effective way to achieve good results in the training of designers (Gabrielyan, 2017; Sokolova & Sokolov, 2018; Zhdanova et al., 2018).

Design has always been associated with innovative processes in society, manufacturing and art; therefore, future designers were taught innovative methods. The students were taught to form such personality qualities that would contribute to the perception of the new and non-standard phenomena (Shokorova, 2017; Bureeva et al., 2017; Chmykhalo et al., 2017; Kayumova et al., 2016; Shokorova & Mamyrina, 2016). Originality in design and art has always been welcomed and nourished (Kasatova et al., 2015).

The interest of researchers to the project graphics arose intermittently: sometimes it grew, sometimes it waned. Today, everyone agrees that this is a combination of drawing methods. The designer has to have the skills of working with various types of images included in the project graphics (Danilenko & Nazarova, 2016; Marchenko, 2013; Textbook on Design …, 2004; Yushchenko, 2014). In this regard we must mention E.N. Lazarev's paper (1988) on the problem of the development of a professional design language.

The applications of project graphics in various types of designer's activities were discussed in several papers in recent years (Antonova, 2005; Lunchenko, 2016; Lvova, 2018; Yushchenko, 2014). This suggests that the problem of learning project graphics remains relevant.

The intrusion of computers into the design world has led many researchers to turn to computer graphics and consider it as an active tool for design (Kober & Tokmakov, 2016; Lvova, 2018; Mironov, 2008). Today, most researchers consider computer graphics as an equal part of the project one.

4. Results

To clarify the role of project graphics and build a learning model, we turned to the analysis of the professional activities of practicing designers. The experiment involved designers

living in different parts of the country, having different education and work experience. All of them filled out a questionnaire. The results helped us to determine education, place of work, work experience, preferred design objects and assessment of modern design education. Then they performed two tasks of different orientation and requiring the use of different types of images. We used the method of multiplication, which allowed us to track the sequence of the task and the process of the appearance and development of each image.

Monitoring the activities of the designers led to the following conclusions:

- the design process is not linear: the multitude of images reflects the variety of solutions;

- job content determines the type of images used;

- designer’s degree of qualification is confirmed by the accuracy of the choice of the type of image;

- project graphics is a tool not only for fixing, but also for clarifying and identifying project design.

The last position is the most important for us here. Project graphics constitute a factor, that is, a driving force of the design process itself and an integral part of designers’ training.

Of all the completed projects, the work of one designer was chosen. The work of the designer with a classic design education and 34 years of professional experience combined with lecturing and sciences was chosen as the reference pattern. It took him 10 minutes to create a project "Winnie-the-Pooh", where he used 8 different images with six classic and two combined ones. The last two were used for maximum identification of the shape or the purpose of the object. All students' works were compared with this one.

The control task was carried during one class with students performing it only with a simple pencil. This time was always enough to think about the project plan and implement it. A classification table was drawn up for each student, which reflected lecturers’ assessments {for each type of the images), as well as the diversity and accuracy of images.

Table 1

Amount of students	Does not match with reference pattern	Overlaps with reference pattern	Almost coincides with reference pattern
68	13	43	12

During the year, experimental training on the developed model was conducted with these students.

Today, in most educational institutions, it is distributed among separate academic disciplines, but the time allowed by the state educational standard makes it impossible for students to master it in full. Consolidation, expansion of work methods in the future is carried out in different academic disciplines, and is integrated into the design course, as a rule, due to the mental and volitional tension of the students themselves. Some of them manage to do this with great difficulty, and some still cannot pass this test.

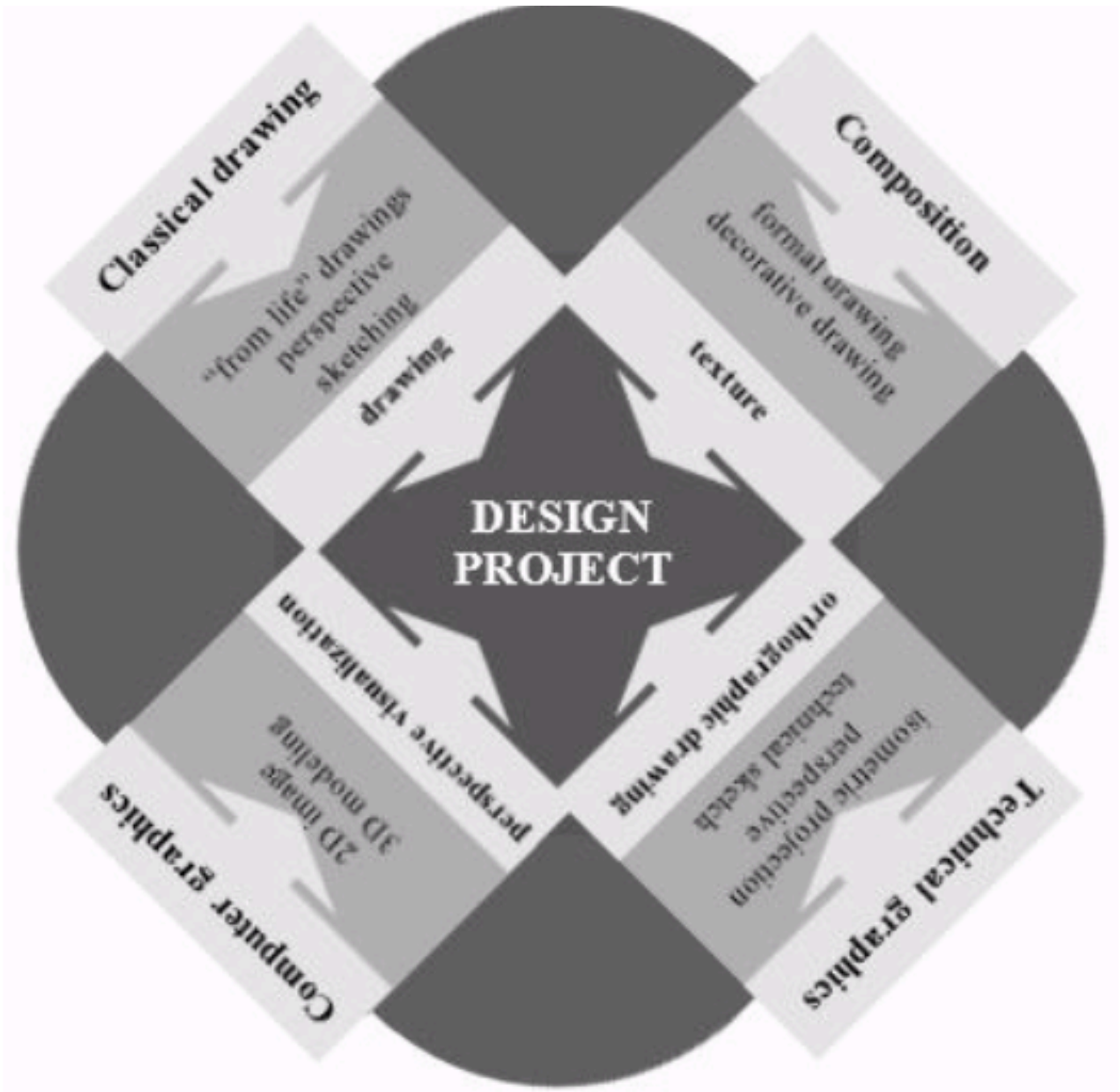
The pedagogical system approach that formed the basis for the training helped to understand the mechanism of functioning of each element, as well as to realize the integrity of the structure and to master the mechanism of managing it on a scientific basis. The activity approach ensured the activity of all participants of integrated learning.

The model contains four academic disciplines “Classical drawing”, “Technical graphics”, “Computer graphics” and “Composition” (Figure 1). Each of them teaches its own types of images, which are shown in the corresponding blocks. The arrows point to the center of the model, where the design project is located. It is the field of combining and mixing, the place of gaining new quality.

Drawing is the fundamental principle of all graphic images within the professional designer

training process. It is one of the oldest methods of representation on a plane. This is a fundamental concept that came from the visual arts. For an artist, drawing serves at the same time as a means of learning, studying life and a subject-shaped language, which he uses when communicating with the audience in order to influence it in one way or another, as well as to convey his attitude. Almost the same function drawing has in the design. Both the person's speech and the figure reflect the process of thinking and communicating with other people.

Figure 1
Integrative model of project graphics training



Since the designer's activity is related to the design of the objective world, he is to master the techniques of drawing spatial objects and systems, reflecting the laws of their shaping, plastic qualities and properties, which is unthinkable "without knowledge of the laws of various types of perspective and professional possession of graphic tools" (Sokolova & Sokolov, 2018).

The future designer should have a confident sense of form, the ability to arrange and interpret it, as well as vary it in accordance with the creative task to be solved. Therefore, the education of this feeling - the most important professional quality of the designer - is one of the tasks of drawing classes. The images of project graphics include sketches - a quick reflection of the form - which is also learned during the drawing lessons. Among the principal features of the sketch are generalization and brevity, which are perceived from outside as incompleteness. What actually happens is that it stimulates the further activity of the artistic imagination of both the author and the viewer. The difference between sketching and drawing is not so much in the time spent on the performance of one or the other, but in the methods of work themselves.

The incompleteness of the sketch allows the author to make changes of improvement easily.

To enrich the sketch with details one draws them from nature. The difference between sketching and drawing is not so much in the time spent on the performance, but in the methods of work. A somewhat vague image in sketch allows the viewer to supplement his imagination with the image. The understatement and incompleteness puts the perceiver on the position of an active viewer and stimulates his mental and emotional activity.

At a certain design stage orthogonal drawings are sure to appear as a result of the concretizing work of the brain. First technical hand drawn sketches appear made according to the laws of orthogonal projection and Unified system for design documentation (ESKD). First, several differently mutually located projections are drawn or illuminated. Then axonometric or perspective projections are added. The set of drawings should disclose the content of the project, and not only its external form. Drawing training is carried within the "Technical Graphics" discipline.

In the design, they use general view drawings, which allow for a good composition and presentation of the product. They serve to give an idea of the possible location of blocks and assemblies, their shape, proportion and scale. It approaches engineering drawings, conditional (normalized) symbols are introduced into it that can be made in color. In this regard, the range of students' professional knowledge and skills is greatly expanded.

In the long run, the idea will be embodied in a project with a complete set of design documentation: drawings of product types, assembly drawings with sections, specifications, drawings of components and parts. Integration of all types of graphic images will occur if the student has sufficient knowledge and skills.

Composition is an educational discipline specially created for designers as a substitute for a plot composition. Using all sorts of abstract forms, students learn the basic patterns of combination and harmonization of elements, actively using the elements of decoration and textures.

In recent decades, the computer has become an active assistant in the design process. Today, most projects include computer processing. All educational design institutions have the "Computer Graphics" discipline, wherein students master various computer programs. Computer sketching greatly facilitates the process of layout, freeing the designer from redrawing. The computer, using specified orthogonal drawings, creates three-dimensional images, filling them with color, light and highlights. Visualized perspectives are created by the hands of professional designers - tempting offers that fulfill their advertising role. However, this computer knowledge is rapidly becoming obsolete. Newly created graphic editors offer more and more new possibilities of reflecting design ideas, which urges the designer towards endless life-time self-education. Project graphics is the area of activity where diversity and modernization are welcomed, as it allows you to convey the designer's intent more accurately.

At the same time, the process of vocational training should begin with "traditional" ways of mastering the whole variety of project graphics, since they provide for diverse, multi-faceted hand movements. They help the brain to fix the design image, which at first is very unstable and ephemeral, and then specify and make it available to consumers (Danilenko & Nazarova, 2016; Zhdanova, 2014; Shokorova & Mamyrina, 2016).

Students' mastery of the design language - design graphics - depends largely on the general settings of the educational institution. There are several ways to ensure the full-fledged graphic design training of designers based on integration. The most productive option is when teaching all types of project graphics is carried out by one department with its lecturers holding the same views. Our case was much more typical with lecturers accredited to different departments.

In the process of introducing an integrative model, much depends on the pedagogical team, which sets an example and teaches the professional design language. Interdisciplinary integration requires lecturers to develop a single "pedagogical strategy", an indispensable application of certain concepts and facts not only in training courses, but also in communication with students. These requirements should be considered both necessary and sufficient indicators for integrated teaching. The main thing that makes the course

integrated is “the prospective goal set and specific tasks aimed at its implementation, planned by all lecturers providing vocational training” (Zhdanova et al., 2018). Well-organized interdepartmental methodological seminars may contribute to the development of common approaches to the process and learning outcomes. Participation of various specialists at defending the projects allows having a productive influence on the level of knowledge and skills of students.

Professional designers training should take into account that designers’ activity, on the one hand, is the process of consistent performing of actions (operations) to obtain the intended result. On the other hand, it is a movement unfolded in time, from some initial situation to the final goal. In this case, the actions and time are interrelated. At each time interval, when performing certain actions, there is a definite result expressed by this or that project image.

To test the efficacy of the integrative model and the activities of the staff, we carried out a control task at the end of each year, and the students' projects were compared with a reference pattern. Students were given the same task as the professional designers at the first stage of our study: they had to develop a playground with a pond and a parent's rest area. The results of their activities are presented in Table 2, where they are compared with the results of initial testing.

Table 2
Results of students’activities

	Amount of students	**Does not match with reference pattern**	**Overlaps with reference pattern**	**Almost coincides with reference pattern**
beginning of the school year	68	13	43	12
end of the school year	68	9	26	33

We must admit that the reference pattern was not surpassed, but the number of images used by students steadily increased from year to year. Their diversity has been a pleasant surprise. Monotonous perspective drawings were replaced by plans, and drawings and diagrams. The quality of the implementation has increased, and the performance has become more confident. The pedagogical team engaged in training students remained the same for several years, which contributed to the stability of the experimental work itself. The methodological seminars held at the end of the year not only stated the increase in the level of project graphics for students, but also analyzed the existing shortcomings. All this contributed to the improvement of professional design language.

5. Conclusion

Our goal is to achieve integrity and completeness of the design graphics training, which may be done in different ways. Integration may not be the only, but very efficient way to improve the training process.

In theory and practice of design there is a truth universally acknowledged: a designer can freely express a design idea even in an unexpected language. The technique of design images is continuously enriching with new methods, as it is a creative business. However, at the very beginning, in the process of learning, the designer has to master a certain “minimum” of project images; this will determine the level of his professional training.

The training of project graphics was carried out through the creation of an integrative model based on the study of the activities of professional designers. The path we have chosen allowed us to adjust the content and methods of teaching four academic disciplines and engage the teaching staff in the integration process. This had a positive effect not only on the level of student learning, but also on the lecturers opinions, as they took a different

stance on the pedagogical process.

Design graphics have a special artistic status, an individual identity, and play a leading role in the figurative solution of a design task. The developed training model allowed not only to preserve most of the students' knowledge and skills on the project schedule, but also taught them to actively use the obtained competences in the new environment.

Proper organization of the training process creates the necessary conditions for the development of all types of design graphics. This reflection on the ways of mastering design graphics within the designers' professional training can be continued in different planes, which will only contribute to the improvement of this process.

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Revista ESPACIOS. ISSN 0798 1015
Vol. 40 (Nº 29) Year 2019

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