Development of professional competencies of bachelors in applied Informatics to create an advertising product by means of information technologies

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Abstract. The article describes the experience of teachers of the Russian regional university in training IT specialists to develop an advertising product, while it is considered as an information resource developed as a result of targeted information activities of specialists. The article considers the structure and content of the components of professional competence of bachelors in the field of creating an advertising product by means of IT technologies, taking into account the levels of competence development of students in accordance with the development stages of an advertising product. The indicators of components of the considered professional competence are given, taking into account its development levels. Studying at the University, Bachelor students in the training course of "Applied Informatics" (speciality "Applied Informatics in design") get experience in creating an advertising product using IT technologies on the basis of methods of quasi-professional activity. For more effective training in this field, the following pedagogical conditions are developed and experimentally tested: a modular content structure of preparation for the use of IT technologies to create an advertising product, taking into account its development stages; the internal university training of teachers to use the information and communication technologies in the area of general pedagogical and subject orientation; the formation of experience of the bachelor quasi-professional activity on applied informatics through imitation of the future professional environment in the information and communication conditions of the university. Based on the example of conducted empirical research, that students of "Applied Informatics" course at the Russian University took part in, it is concluded that the purposeful implementation of special pedagogical conditions significantly affects the formation of all components of professional competence of bachelors in the field of development of an advertising product.

1. Introduction
In modern digital economy, when information activity and communication interaction become the most important aspects of any employee speciality [1, 2, 3], and advertising becomes one of the main ways of promotion of goods, the problems of quality improvement of students training in the field of creating an advertising product become relevant to ensure the competitiveness for bachelors in the training course of "Applied Informatics" (speciality "Applied Informatics in design") [4, 5].

An advertising product created by means of IT technologies is an information resource developed as a result of targeted information activity of advertising specialists [6]. This activity of collecting, processing, storing, transmitting, reflecting, and replicating information implements the marketing or other purposes of organizations or individuals in order to have a targeted influence on the crowd or
individual minds in order to elicit a certain response from the chosen audience. The stages of creating an advertising product by means of IT are project – development of static or dynamic versions of sketches; technological – creation of the components of an advertising product – includes layout, design, creating an electronic layout, its testing and adjustment; manufacturing – assembling all components together into the final advertising product – includes brochure printing; manufacture of photo panels and assemblage of the stand, assemblage of all parts of the Web site and its installation on the server; testing of the Web site by a development team and an independent team; adaptation of the layout to the final requirements of the customer and the manufacturer, training of the customer employees to manage a Web site.

Preparation of bachelors on applied Informatics in design to create an advertising product is a process of mastering the theory and practice of using IT technologies to design, develop and assemble components into the final advertising product.

Analysis of works in the field of competence approach [7, 8, 9, 10], author [11] definition of IT competence of specialists, as well as definition of an advertising product created using IT technologies [6] allow to determine the professional competence of a bachelor in applied Informatics in the field of creation of an advertising product, which includes three interrelated components: motivational (focus on the use of IT technologies, education and self-education in the use of IT technologies to create an advertising product); cognitive (a body of knowledge about the possibilities of using IT technologies to create an advertising product: possibilities of using IT technologies to create an advertising product, types of an advertising product, its production stages on the basis of IT, types of advertising media, nature of advertising influence on the senses of potential consumers and implementation of these methods on the basis of IT, requirements for an advertising product and their implementation on the basis of IT); activity (a set of skills and practice, necessary to create an advertising product: preparation and processing of the static (text, graphic) and dynamic (multimedia) parts of an advertising product) for their further assembly into the final advertising product).

Adopted in Russia, the federal regulatory legal documents for strategic planning (the Strategy for the Scientific and Technological Development of the Russian Federation, the Strategy for the Development of the Information Society in the Russian Federation for 2017 - 2030, etc.) [12, 13] indicate the importance of the problem of personnel training in the digital economy. It should be noted that many academic teachers consider the problem of personnel training in the digital economy, in particular, the development of competence in information and communication technologies. Thus, Khramtsova N. G., Mayboroda T. Yu. and others, consider the optimization problem of the educational standards of higher education in the digital era [14].

We support the viewpoint that it is necessary to increase the competitiveness and international ranking positions of Russian universities, taking into account that it requires the modernization of higher education system to improve the education quality and provide the students with modern competencies [15]. Team work on IT projects contributes to the development of IT competencies [16]. Project work is one of the most effective methods for training bachelors in applied Informatics to create an advertising product using IT.

2. Research methods

Effectiveness of the identified conditions was tested at the Russian university during experimental work with students in the training course of “Applied Informatics” at Chuvash State University in 2017–2018, 2018–2019 academic years. The experiment was conducted in three stages: stating, formative (2017 – 2018 academic year) and final (2018 – 2019 academic year). 23 students participated in the experiment (those students were selected out of 128 students studying at that period in this training course by the criterion of completeness of the implementation of pedagogical conditions).

The following methods were used in the research:

- the questionnaire [6] (to check the development level of the motivational component), testing (to check the development level of the cognitive component) and quality assessment of the final
advertising product (to check the development level of the activity component) were chosen as methods for determining the development level of professional competence.

- the degree of independence and awareness of actions [17] was selected as a criterion to diagnose the mastering level of creating an advertising product using IT technologies, adequately allocated to the components
- assessment of the components of professional competence formation in creating an advertising product based on IT technologies was conducted by methods of the theory of testing statistical hypotheses (correlation analysis and method of comparing distributions).
- the experimental results were analysed by methods of the theory of testing of statistical hypotheses, that is by calculation of the standard correlation coefficients and a method of comparing distributions by the $\chi^2$ criterion [18].

3. Results and discussion
The analysis of scientific sources and many years of own teaching experience allow us to suppose that preparation for the creation of an advertising product by means of IT technologies can be effective in the following pedagogical conditions:

- making a modular content structure to prepare for using IT technologies in creation of an advertising product, taking into account the stages of its creation;
- internal university training of teachers in the information and communication technologies within the context of general pedagogical and subject orientation;
- the formation of experience of the quasi-professional activity of a bachelor in applied Informatics through simulation of the future professional environment in the information and communication conditions of the university.

The hypothesis of the experiment was that the implementation of pedagogical conditions for the development of professional competence of bachelors in the training course of "Applied Informatics" in design of an advertising product using IT technologies could allow:

- the majority of students to achieve a productive level of readiness to use IT for the creation of an advertising product;
- to form the professional competence of bachelors in the training course of "Applied Informatics" in creation of an advertising product using IT technologies;
- to form the basic body of knowledge, skills and experience necessary for self-education in the use of information and communication technologies to create an advertising product.

The initial, reproductive, productive and creative levels of readiness of students to use IT technologies for creation of an advertising product are determined.

The initial level is determined by:

- lack of motivational and value orientations;
- lack of interest in education and self-education to use IT for creation of an advertising product;
- knowledge is unsystematic, superficial, which makes it impossible to apply in practice;
- the necessary skills are partially observed, but students are not able to create an advertising product based on IT technologies independently.

At the reproductive readiness level, the students show that:

- they have a slight motivation to use IT technologies in their future professional activity;
- they have minimal skills in using IT technologies to create advertising products;
they gain the skills to create advertising products based on the model.

When students reach the productive level:

• they show a positive attitude towards the use of IT technologies to create an advertising product;
• they express the need for professional development in using IT technologies;
• they get an attempt for education and self-education in this area;
• they have or gained the set of knowledge;
• they are able to successfully solve typical problems based on their skills and abilities, but they have difficulties in personal selecting of tools for creation of an advertising product and transferring existing knowledge, skills and experience to a new professional (not educational) activity.

The creative level is determined by:

• stable positive motivation, interest and need for education and self-education in order to implement the professional functions based on IT technologies;
• the systematic general and special knowledge in the field of technologies for development and creation of an advertising product;
• the corresponding modern thesaurus (corresponded to the current development level of IT technologies);
• possession of a set of skills and abilities that makes it possible to create an advertising product of any complex degree;
• the ability to choose technologies for creation of an advertising product, depending on its requirements.

Thus, students with a creative level of readiness can easily use IT technologies as a tool for creation of an advertising product.

The requirements for knowledge, skills and abilities at each of the defined readiness levels are given in the table 1.

| Readiness level | Characteristic |
|-----------------|----------------|
| **Initial** (recognition level) | Students show little interest in education and self-education in the use of IT technologies to create an advertising product. Students have a basic knowledge:  
  • of the available capabilities of standard software for creation of an advertising product;  
  • of available special software tools and their capabilities for creation of an advertising product;  
  • of some types of work programs;  
  • of correspondence of the content of work program to the subject area for which this product is created.  
Students have the following skills:  
  • they can partially reproduce the algorithm for creating work program elements;  
  • they can partially use the IT capabilities to create a work program. |
| Reproductive | Students have weakly expressed motives for using IT technologies in their future professional activities to implement their own needs. Students should have the following knowledge:  
  • a classification of standard software and their capabilities for creating a work program; |
Table 1. Indicators of student readiness to use IT to create an advertising product.

| Readiness level | Characteristic |
|-----------------|----------------|
|                 | • definition and classification of work programs; |
|                 | • a structure of work program; |
|                 | • development stages of a work program. |
|                 | Students should have the following skills and abilities: |
|                 | • use of standard software for creating a work program; |
|                 | • preparation and processing of the material using standard software for input and processing of text, graphic, video and audio information to present in work program; |
|                 | • creation of a work program using the given technology of a demo example. |
|                 | Students express a positive attitude to the use of IT technologies for creation of an advertising product, have a visible need for professional development in using of IT technologies, the attempt for education and self-education in this area. |
|                 | Students should have the following skills: |
|                 | • a classification of standard and special software AND their capabilities for the creation of work programs; |
|                 | • the development stages of a work program taking into account its structure and subject area; |
|                 | • the requirements for a work program (efficiency, creativity, manufacturability, ergonomics and accordance with customer requirements). |
|                 | Students should have the following skills and abilities: |
|                 | • a personal selection of a software tool to create a work program; |
|                 | • creation of a work program on the basis of standard and special software; |
|                 | • taking into account the requirements for a work program (efficiency, creativity, manufacturability, ergonomics and accordance with customer requirements). |
|                 | Students have a positive motivation, interest and need for education and self-education in order to implement their professional functions based on IT technologies. |
|                 | Students should have the following knowledge: |
|                 | • types of advertising media; |
|                 | • the nature of influence on the senses of potential consumers of work programs; |
|                 | • the development stages of a work program taking into account the types of advertising media (advertising in the press, TV advertising, radio advertising, outdoor advertising, transport, film advertising, Internet advertising, etc.); |
|                 | • the requirements for a work program (efficiency, creativity, manufacturability, ergonomics and accordance with customer requirements). |
|                 | Students should have the following skills and abilities: |
|                 | • independently create a work program based on the integrated use of standard and special software tools implementing multimedia capabilities; |
|                 | • independently choose the types of advertising media; |
|                 | • independently learn new software tools for creating a work program; |
|                 | • independently examine the target audience for which the work programs are intended; |
|                 | • assess the effectiveness of implementation of work programs in the real part of economy. |

It should be noted that the readiness formation at each of the following levels supposes the formation of the previous one. Thus, at the creative level of readiness to use IT technologies for creation of an advertising product, the student has knowledge, skills and abilities of the initial, reproductive and productive levels.

The results of processing of experimental data

At the ascertaining stage of the experiment, the initial level of formation of professional competence components of bachelors in the training course of "Applied Informatics" in creation of an advertising product...
product using IT technologies was determined.

A simultaneous survey of students and teachers who taught them, was conducted to determine the level of professional competence in creating an advertising product based on IT technologies. As a result, two types of estimates were obtained:

- self-assessments, that are the values of indicators students set for themselves;
- expert assessments, given to the students by teachers who worked with them.

The results of such parallel survey to determine the motivation level before the experiment are shown in table 2.

**Table 2.** Average values of the motivational component indicators before the experiment.

| №  | An indicator                                                                 | Self-assessment | External assessment |
|----|-----------------------------------------------------------------------------|-----------------|--------------------|
| 1  | Are you interested in achieving professional success?                        | 3.26087         | 1.869565           |
| 2  | Do you need self-education and self-development?                            | 3.652174        | 1.913043           |
| 3  | Do you want to achieve professional success?                                | 3.173913        | 1.652174           |
| 4  | How much do you realize the place and role of IT in modern society and advertising? | 4.086957        | 1.652174           |
| 5  | Do you have an attempt for self-education and professional training in development and creation of an advertising product? | 3.521739        | 2.043478           |
| 6  | Do you know the content and structure of an advertising product?            | 4.043478        | 1.869565           |
| 7  | Do you know the classification and purpose of an advertising product?       | 3.434783        | 2.043478           |
| 8  | Can you imagine the capabilities of applied and instrumental software tools for creating an advertising product? | 2.913043        | 1.434783           |
| 9  | Do you know the ergonomic and technical-technological requirements for the development of a work program? | 4.086957        | 2.434783           |
| 10 | Do you know the development stages of a work program?                       | 3.00            | 2.043478           |
| 11 | Do you know how to use software tools for processing text, graphic, audio and video files? | 3.913043        | 1.73913            |
| 12 | Do you know how to design a work program?                                   | 2.652174        | 2.391304           |
| 13 | Do you know how to create a work program using standard software (MS Office)? | 2.652174        | 2.478261           |
| 14 | Do you know how to create a work program using special software?            | 3.086957        | 2.000              |
|    | Average                                                                     | 3.39            | 1.96               |

The results of table 2 are graphically presented in figure 1.

It is obvious that self – assessment indicators are significantly higher than expert (external) assessments – the total average for self-assessment is 3.39, and for external assessment -1.96.

In addition, one significant point was revealed: the correlation analysis shows that there is no correlation connection be-tween two estimates (in figure 1, the absence of correlation is shown as the polygons of the indicators are not geometrically similar).
Thus, in addition to overestimated self-assessments, the absence of a correlation between indicators points at another feature of the student psychology - if the interpersonal communicative characteristics of students were determined in the work and a similar result was obtained, then we could talk about an insufficient level of socialization of the examined students. In our case, this indicates an insufficient level of correlation between their own and real capabilities to create an advertising product (a work program) using IT technologies.

A similar result was obtained at determining other components, as shown in table 3.

Table 3. Summary calculation results comparing indicators before the experiment.

| Indicators               | Average self-assessment | Average expert assessment | Correlation coefficient |
|--------------------------|-------------------------|---------------------------|-------------------------|
| Motivational component   | 3.39                    | 1.96                      | -0.234                  |
| Cognitive component      | 3.287                   | 1.96                      | -0.144*                 |
| Activity component       | -                       | 2.65                      | -                       |

* a correlation coefficient is not statistically significant.

Taking these results into account in further calculations, only expert assessments were processed, since it is supposed that expert assessments are more objective.

At the formative stage, we tested the pedagogical conditions for the formation of professional competence of bachelors in the development of an advertising product using IT technologies.

At the final stage, a repeated survey was conducted, aimed at assessing the readiness level achieved by students in creation of an advertising product using IT technologies and determining the impact of the proposed pedagogical conditions on effectiveness of the process of preparing students for this type of activity.

The results of the repeated survey are shown in table 4.

Table 4. Average values of motivational component indicators at the final stage of experiment.

| №  | An indicator                                | Self-assessment | External assessment |
|----|---------------------------------------------|-----------------|---------------------|
| 1  | Are you interested in achieving professional success? | 8.52            | 7.78                |
| 2  | Do you have a need for self-education and self-development? | 8.70            | 8.26                |
| 3  | Do you want to achieve professional success? | 8.57            | 8.04                |
4. How much do you realize the place and role of IT in modern society and advertising?  
5. Do you have an attempt for self-education and professional training in development and creation of an advertising product?  
6. Do you know the content and structure of an advertising product?  
7. Do you know the classification and purpose of an advertising product?  
8. Can you imagine the capabilities of applied and instrumental software tools for creating an advertising product?  
9. Do you know the ergonomic and technical-technological requirements for the development of a work program?  
10. Do you know the development stages of a work program?  
11. Do you know how to use software tools for processing text, graphic, audio and video files?  
12. Do you know how to design a work program?  
13. Do you know how to create a work program using standard software (MS Office)?  
14. Do you know how to create a work program using special software?  

Average  8.46  8.03

The calculation results of the remaining components are shown in table 5.

**Table 5. Summary calculation results comparing indicators after the experiment.**

| Indicators               | Average self-assessment | Average expert assessment | Correlation coefficient |
|--------------------------|-------------------------|----------------------------|-------------------------|
| Motivational component   | 8.46                    | 7.92                       | 0.75*                   |
| Cognitive component      | 8.48                    | 8.06                       | 0.555*                  |
| Activity component       | -                       | 7.04                       | -                       |
* a correlation coefficient is statistically significant.

According to the provided data, the following conclusions can be made:

- The average values of the indicators significantly increased compared to the same indicators before the experiment (table 3).
- There is a statistically significant correlation between self-assessment and expert assessment.

**Table 6. Data on the level of the motivational components in groups (before and after the experiment).**

| Level         | Before the experiment begins | At the end of the experiment |
|---------------|-----------------------------|-----------------------------|
|               | Count | %               | Count | %               |
| Elementary    | 22    | 95.65          | 0     | 0.00            |
| Reproductive  | 1     | 4.35           | 2     | 8.70            |
| Productive    | 0     | 0.00           | 18    | 78.26           |
| Creative      | 0     | 0.00           | 3     | 13.04           |

The frequency of competence levels before and after training was analyzed to assess the real changes in the training level (and corresponding levels of competences). The results of frequency calculations for the motivational component are given in table 6 (the results of calculations for the other components are almost identical). Figure 3 shows the same results in a diagram.
The statistical significance of frequency changes in groups was determined by the criterion $\chi^2$. Its calculated value was equal to 43.33. This value significantly exceeds the critical value of the criterion, which is equal to 7.81 at the significance level $\alpha=0.05$ and the number of freedom degrees $f=3$.

Consequently, the results of repeated diagnostics of students indicate that there is a positive dynamics in the level of professional competence in creating an advertising product based on IT technologies for all components by the end of the pedagogical experiment, which indicates clear positive changes in the theoretical and practical preparation for this type of activity. Thus, the implementation of pedagogical conditions during the experiment led to a more significant increase of all indicators. The conducted statistical analysis proves that there were statistically significant changes in the development level of professional competence in creating an advertising product based on IT technologies by the end of the pedagogical experiment.

As a result, students formed a basic body of knowledge, skills and abilities necessary for self-education in the field of using IT technologies to create an advertising product. In this regard, we can say that the hypothesis is correct, and the proposed set of pedagogical conditions provides the necessary level of professional competence in creation of an advertising product based on IT technologies.

4. Conclusion

In the digital economy, an advertising product is created and promoted by means of IT technologies. In this regard, one of the most popular professional competencies of IT specialists is professional competence in the field of creating an advertising product which is an information resource developed as a result of purposed information activities of specialists.

The effectiveness of the preparation of bachelors in the training course of “Applied Informatics” is achieved by the implementation of following pedagogical conditions: a modular content structure of preparation for using IT technologies to create an advertising product taking into account its development stages; internal university training of teachers in using information technologies within the context of general pedagogical and subject orientation; the formation of the experience of the quasi-professional activity of a bachelor in applied Informatics through simulation of the future professional environment in the information and communication conditions of the university.

Self-assessment and external assessment of the formation level of all components of competence are researched, it is shown that the self-assessments of students in aspect of their competencies for development of an advertising product by means of IT technologies significantly exceeds the expert external assessment (the total average of self-assessments is equal to 3.39, and external assessment is 1.96), and therefore, the results of expert assessment of formation of the motivational, cognitive and activity components of a professional competence are used in the analysis of experimental data.

The targeted training of future IT specialists in the field of development of an advertising product allowed the majority of students to achieve a productive readiness level to use IT for creation of an advertising product; to form a professional competence of bachelors in the training course of “Applied Informatics” in creating an advertising product using IT technologies; to create a basic body of knowledge, skills and abilities necessary for self-education in using the information and communication technologies to create an advertising product.

78% of students reach a productive level, future IT specialists express a positive attitude to the use of IT for creation of an advertising product, need for professional development in using of IT, an attempt for education and self-education in this area. In general, they mastered the complex of knowledge, are able to successfully solve typical problems based on their skills and abilities, but they have difficulties at independent selecting of tools for the development of an advertising product and transferring existing knowledge, skills, and abilities to a new professional (not educational) activity.

13% of students reach the creative level, the bachelors have a stable positive motivation, need for education and self-education in order to implement their professional functions on the basis of IT. They have a deep and systematic common and special knowledge in development and creation of an advertising product. Students have the formed corresponding modern thesaurus (corresponded to the modern level of IT development), they have a complex of necessary skills and abilities, are able to create
an advertising product by integrated use of standard and special software, choosing them depending on
the character of a target audience, nature of influence on the senses of potential consumers, types of
advertising media, students having the creative readiness level easy use IT as a tool for creation of an
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