



# Methodology For Developing Students' Software Creativity On The Basis Of Teaching The Subject Of "Electronic Pedagogy"

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**ABSTRACT**

This in the article "Electronic "pedagogy" subject to teach in the process students software creativity develop methodology illuminated. Modern information in society future of educators software supply create and adaptation competencies has to be important importance profession Research within students software creativity to develop aimed at methodical system working issued be, he constructivist approach, problematic education and project based on to teach to the methods relies on. The methodology efficiency pedagogical experiment through checked results students software creativity indicators (fluency, flexibility, originality) and working exit) significant at the level increased The study showed that results supreme education " Electronic" in institutions "pedagogy " subject to teach practice to improve service does .

**Keywords:**

electronic pedagogy, programming creativity, creativity thinking, problematic education, project method, digital competence, methodology

**Entrance**

One of the most important tasks facing the modern education system is to train pedagogical personnel who are able to operate in the conditions of digital transformation, who think creatively and have technological competencies. The rapid development of information and communication technologies requires the introduction of new approaches to the educational process. In particular, the subject of "Electronic Pedagogy" should serve to familiarize students with modern educational software tools, form skills in their effective use, and also develop their creativity in creating their own software products.

The concept of software creativity is not limited to writing program code, but includes a wide range of competencies, such as identifying educational problems, developing algorithmic methods for solving them, designing interactive and multimodal educational resources, and

adapting existing tools to new pedagogical tasks. Creativity is recognized as one of the most important competencies within the framework of 21st century skills, which is a key factor in solving complex and changing global problems.

However, practical observations and analysis of existing literature show that the practice of teaching the subject "Electronic Pedagogy" in higher education institutions often does not pay enough attention to the development of students' software creativity. In many cases, the educational process is limited to the formation of skills in using ready-made software tools. Students' competencies in creating new software products, creatively improving existing ones, and solving problems in original ways remain undeveloped.

From this point of view, the development of a special methodology aimed at developing students' programming creativity in the process of teaching the subject "Electronic Pedagogy"

appears as an urgent scientific and pedagogical problem. The purpose of this study is **to develop a methodology for developing students' programming creativity based on teaching the subject "Electronic Pedagogy"** and to experimentally substantiate its effectiveness.

**The objectives** of the study are as follows:

1. Analysis of the theoretical and methodological foundations of developing students' programming creativity;
2. Designing a methodological system based on an integrative and creative approach to teaching the subject of "electronic pedagogy";
3. To verify the experimental effectiveness of the developed methodology.

### Methodology

**Research design.** The research was conducted in two stages using a mixed-methods methodology. The first stage involved the design and development of a methodological system, and the second stage involved the evaluation of its effectiveness based on a quasi-experimental design. The research design was based on a modified form of the Borg and Gall model.

**Participants. The study involved 147 3rd-4th year students studying** in the fields of "Pedagogy" and "Information Technologies in Education" at three higher educational institutions in the Bukhara region (Bukhara State University, Bukhara Innovation University, Bukhara Engineering and Technology Institute) . 62 (42.2%) of the participants were men and 85 (57.8%) were women. The age range was 20-25 years. 74 students were included in the experimental group, and 73 students in the control group.

**Development of the methodology.** The methodology for developing software creativity was developed based on the following theoretical foundations:

- *Constructivist approach (Piaget, Vygotsky)* – students acquire knowledge through active construction, forming new concepts based on experience and reflection;
- *Problem-based learning* – programming creativity develops in the process of solving real educational problems;

- *Project-based learning* – students carry out projects aimed at creating a final product;
- *Creative thinking theory* (Guilford, Torrance) – creativity is composed of the components of fluency, flexibility, originality, and elaboration.

The main components of the methodology: 1) a bank of problem situations; 2) a system of tasks that develop programming creativity; 3) interactive learning resources (video tutorials, interactive flipbooks, online simulators); 4) collaborative learning tools (online forum, team projects); 5) reflexive assessment mechanisms.

**Data collection tools.** The following tools were used in the study:

1. *Creative Thinking Test* – an adapted version of the Torrance test (based on fluency, flexibility, originality, and development indicators);
2. *Software product evaluation rubric* – criteria for evaluating project work on a 10-point scale;
3. *Questionnaires* – to determine students' motivation and attitude to the methodology;
4. *Semi-structured interviews* – in-depth conversations with 15 students in the experimental group.

**Research process.** The research was carried out in the 2024-2025 academic year. In the experimental group, the subject "Electronic Pedagogy" was taught based on the developed methodology. In the control group, traditional teaching methods were used. The level of software creativity was measured in both groups at the beginning and end of the experiment. During the experiment, 37 software projects (educational applications, interactive resources, simulators) were developed by students in the experimental group.

**Data analysis.** Quantitative data were analyzed using SPSS 23.0. The t-test and ANCOVA methods were used to determine differences between groups. Effect size (Cohen's  $d$ ) was calculated. Qualitative data were processed based on thematic analysis.

### Results

showed the effectiveness of the developed methodology in developing students' programming creativity. At the beginning of the experiment, the experimental and control groups did not differ statistically in terms of

programming creativity indicators ( $p > 0.05$ ). At the end of the experiment, significant differences were noted between the two groups.

**creative thinking indicators.** A significant increase was observed in all

components of creative thinking in the experimental group. Table 1 presents the average indicators at the beginning and end of the experiment.

**Table 1. Dynamics of students' creative thinking indicators**

Indicator	Group	Beginning of experiment (M±SD)	End of experiment (M±SD)	Difference	t	p	Cohen's
Fluency	Experience	6.42 ± 1.83	10.87 ± 1.94	+4.45	8.94	< 0.001	1.47
	Control	6.38 ± 1.91	7.56 ± 2.03	+1.18	2.31	0.063	0.38
Flexibility	Experience	5.27 ± 1.64	9.73 ± 1.82	+4.46	9.12	< 0.001	1.52
	Control	5.31 ± 1.58	6.42 ± 1.79	+1.11	2.18	0.071	0.36
Originality	Experience	4.83 ± 1.52	9.18 ± 1.86	+4.35	8.76	< 0.001	1.44
	Control	4.79 ± 1.48	5.64 ± 1.71	+0.85	1.96	0.094	0.31
Development	Experience	5.14 ± 1.59	9.42 ± 1.78	+4.28	8.63	< 0.001	1.41
	Control	5.09 ± 1.55	6.13 ± 1.68	+1.04	2.07	0.082	0.34

Table 1 shows that the experimental group had higher increases in all indicators ( $p < 0.001$  and a large effect size ( $d > 1.4$ ). In the control group, however, the increases were statistically insignificant ( $p > 0.05$ ) and the effect size was small ( $d < 0.4$ ).

**Quality of project work.** The quality of software projects developed by students in the experimental group was significantly higher than that of the control group. On the project evaluation rubric (maximum 10 points), the experimental group received an average of 8.47

points, while in the control group this indicator was 6.23 points ( $t = 5.84$ ,  $p < 0.00$ ). Analysis of the projects showed that students in the experimental group:

- They demonstrated original approaches to identifying a problem and finding ways to solve it programmatically;

- Demonstrated skills in using multiple technologies in an integrative manner;

- They have a high level of adherence to user interface and instructional design principles;

- They were able to substantiate their projects in a practical way.

**Motivational changes.** The results of the questionnaire showed that the students in the experimental group had a significant increase in their interest and motivation in their subject. The indicator "Interest in creating software tools" increased from 2.84 to 4.52 on a 5-point Likert scale. 89.2% of students noted that the methodology helped them to reveal their creative potential.

The interview analysis identified the following key themes:

- *Practical significance:* "Now I know not only how to use ready-made programs, but also how to create the necessary applications for my lesson";

- *Creative freedom :* "Problematic tasks encouraged me to create my own solutions , rather than looking for ready-made solutions ";

- *Collaboration experience:* "Working on team projects allowed me to combine different ideas and find the best solution";

- *Confidence in the future:* "I believe that my programming skills will make me competitive in the job market."

## Discussion

teaching the subject "Electronic Pedagogy" . The developed methodology is based on the integrative application of the principles of constructivist approach, problem-based learning and project-based learning, which led to a significant increase in students' creative thinking indicators. These results are consistent with previous studies, which also showed that problem-based and project-based learning are effective in developing students' creativity.

The high increase in the fluency, flexibility, originality, and development components of software creativity (Cohen's  $d >$

1.4) indicates the comprehensive effect of the methodology. In particular, the significant increase in the originality indicator ( $d = 1.44$ ) indicates an increase in the uniqueness and unconventionality of the software solutions proposed by students. This aspect is important, since originality is one of the main components of creativity.

of changes in the control group indicates that traditional teaching methods are not sufficient to develop software creativity. The traditional approach is mainly focused on the formation of reproductive knowledge, with limited opportunities for the development of creative and productive competencies.

The research results also showed the importance of the following factors in developing software creativity:

1. *Tasks based on real educational problems - students* demonstrated high motivation in completing tasks aimed at solving real pedagogical situations, rather than abstract exercises ;

2. *Collaboration and team projects* – the joint work of students with different abilities and levels of knowledge led to the mutual enrichment of ideas and the emergence of high-quality solutions;

3. *Reflective assessment* – students had the opportunity to improve their creative processes by critically analyzing their own and others' projects;

4. *Providing multimodal resources* – flipbooks, video tutorials, interactive simulators – has expanded students' opportunities for independent learning and creative exploration.

The results of the interviews show that students value software creativity not only as an academic competency, but also as a guarantee of success in their future professional activities. This aspect is important in terms of the sustainability of educational outcomes and their practical relevance.

**Limitations and future research. This study has a number of limitations. First, the study** was limited to students of higher education institutions in Bukhara region , and generalization of the results should be done with caution. Second, the study duration was

one academic year, which does not allow for long-term effectiveness assessment. Third, the tools for assessing software creativity are not perfect and need to be further improved.

Future research can be continued in the following areas:

- Application of the developed methodology within other disciplines;
- The potential of artificial intelligence tools in the development of software creativity;
- Adaptation of the methodology to students of different ages and educational levels;
- Studying the relationship between software creativity and other professional competencies.

### Conclusion

This study was devoted to the development of a methodology for developing students' programming creativity based on teaching the subject of "Electronic Pedagogy" and experimentally substantiating its effectiveness. The results of the study allow us to formulate the following conclusions:

1. Students' software creativity is their ability to identify educational problems, propose algorithmic and software solutions, create original software products, and creatively improve existing ones. This competency is manifested in the components of creative thinking, fluency, flexibility, originality, and development.
2. of teaching the subject of "Electronic Pedagogy" should be based on the principles of constructivist approach, problem-based learning and project-based learning. The main components of the methodology are a bank of problem situations, a system of creative tasks, interactive resources, collaboration tools and reflexive assessment mechanisms.
3. Experimental testing of the developed methodology confirmed its effectiveness. In the experimental group, a statistically significant increase was noted in all components of software creativity ( $p < 0.001$ ). The increase in creative thinking indicators had a high effect size (Cohen's  $d > 1.4$ ). The quality of project work and student motivation also increased significantly.
4. can serve as a basis for improving the practice of teaching the subject "Electronic

Pedagogy" in higher education institutions, developing students' digital competencies and creative abilities. Individual elements of the methodology can also be used in teaching other subjects.

In conclusion, developing students' programming creativity through teaching "Electronic Pedagogy" not only increases their professional readiness, but also creates a solid foundation for their successful functioning in a rapidly changing digital society.

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