
Methodological Approaches in Forming Web Programming Competences

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Abstract: This article examines methodological approaches to developing web programming competencies among polytechnic students. The study applied project-based learning, problem-based learning, gamification, flipped classroom, and collaborative learning methods. Results from a three-month experimental period demonstrated significant improvement in students' knowledge of HTML, CSS, and JavaScript, as well as enhanced teamwork, communication, and self-learning skills. The article also highlights the advantages of integrating different methodological approaches to improve the quality of education.

Keys words: web programming, competence, methodological approach, project-based learning, gamification, and flipped classroom, polytechnic.

Introduction. In the current era of rapid development of digital technologies, web programming has become an integral part of the educational sphere. One of the most important skills in demand in the modern labor market is the development of web applications and their optimization. Therefore, the formation of web programming competencies in students in polytechnics and secondary specialized educational institutions requires a thorough methodological approach from the teacher. The development of the Internet and the expansion of online services are increasing the need for qualified specialists in the field of web programming. In particular, the formation of web programming competencies in students in polytechnics and vocational educational institutions not only increases their professional qualifications, but also makes them competitive in the labor market.

Web programming competence is not only a set of technical knowledge and skills, but also includes the ability to independently solve problems, take a creative approach, work in collaboration and effectively present the result. Therefore, the methodological approaches used in the formation of these competencies must be scientifically based, systematic and innovative.

The purpose of this study is to analyze methodological approaches for the effective formation of web programming competencies in polytechnic students, to identify their advantages and develop proposals for their implementation in practice.

Literature review and methods. The issue of the formation of web programming competencies has been widely discussed in international and domestic scientific literature in recent years. Research shows that the competency-based approach is one of the main concepts of modern education, which includes not only theoretical knowledge, but also practical skills and personal qualities.

International experience. The model of digital competencies presented by UNESCO recommends the following approaches to teaching web programming in the educational process: project-based learning,

creative problem solving and collaborative work. Also, the work on determining the stages of competence based on Anderson and Kratvol's Bloom's taxonomy is widely used in the assessment of programming skills.

Research on methodological approaches (Johnson and Johnson, 2019; Thomas, 2020) shows that the **Project-Based Learning** (PBL) model helps to increase the level of deep learning, independent research, and creativity in students. Also, the **Problem-Based Learning** (PrBL) method develops logical and algorithmic thinking through solving real-world problems.

(2017) on **Gamification** have shown that adding game elements to the learning process can increase student engagement by 30–50%. This approach is particularly effective in preventing a decrease in motivation in programming subjects.

The Flipped Classroom concept was put forward by Bergmann and Sams (2012), and in web programming, this method allows for independent mastery of theoretical material and devotes class time only to practical work. Studies (Hung, 2015) show that this model significantly increases the level of student mastery.

Experience of Uzbekistan. Among local scientific works, the studies of Karimov A. (2021) and Ismoilova D. (2022) emphasize the need to integrate information technologies in the development of programming competence in polytechnic students. Their results show that interactive methods and virtual laboratories in teaching web programming increase efficiency.

In general, the analysis of the existing literature shows that a single method is not enough to effectively form web programming competencies. When methodological approaches are used in a complex way - PBL, PrBL, gamification, Flipped Classroom and collaborative learning are combined - students acquire not only technical knowledge, but also 21st century skills.

This study included the analysis and testing of methodological approaches aimed at forming web programming competencies in polytechnic students. The experiment was conducted in September–November 2024, with the participation of students of the 2nd stage. During the study, several methods that are widely used in the educational process and have proven their effectiveness were selected. They are:

1. Project-Based Learning (PBL). This method directs students to work on practical projects that solve real-life problems. In the web programming learning process, the PBL model was organized as follows:

Each group or individual student was given a real website or web-app project. The project specifications included HTML, CSS, and JavaScript technologies. During the process, students were introduced to version control via GitHub. Finally, the project was presented to the team and evaluated based on evaluation rubrics.

Advantages: Develops independent research, creative approach, and teamwork skills in students.

2. Problem-Based Learning (PrBL). In this method, students were presented with real problems encountered in the programming process (for example, code malfunctions, layout inconsistencies, script errors). They were implemented as follows:

Problem situations were given at the beginning of the lesson. Students analyzed the problem, developed solution options, and tested them in practice. Each solution was discussed collectively and the optimal option was selected. Advantages: Teaches analytical thinking, quick decision-making in problem situations.

3. Gamification. In order to increase student motivation, game elements were introduced into the learning process:

At the end of each module, students who passed the test or practical assignment were awarded points, ratings, and badges.

Additional bonus assignments were provided for the most active and creative students.

Students monitored their progress through the online progress tracking system (Trello and ClassDojo).

Advantages: Increases interest in the lesson process, creates a competitive environment, and encourages them to work on themselves.

4. Flipped Classroom. Theoretical materials (lectures, video lessons, electronic manuals) were provided to students in advance via an online platform. During the lesson:

Practical exercises, coding, and project development were performed.

Students discussed the parts they did not understand individually with the teacher.

Advantages: Effectively distributes class time, increases the share of practical work.

5. Collaborative Learning. Students had the opportunity to learn from each other by working in groups.

Roles were distributed within the group (frontend developer, backend developer, designer, tester).

Weekly meetings were held within the team for each project.

Advantages: Develops teamwork, communication, role distribution, and leadership skills.

To evaluate the methods:

Initial and final knowledge test

Analysis of the quality of practical tasks

Measurement of the level of motivation through a questionnaire

Student activity observation sheets were used.

Results. The study was conducted for three months with the participation of 48 students studying at the 2nd stage of the polytechnic. They were divided into two groups: an experimental group (24 people) and a control group (24 people). In the experimental group, methods such as project-based learning, problem-based learning, gamification, flipped classroom and collaborative learning were used in a comprehensive manner to form web programming competencies. In the control group, teaching continued based on traditional teaching methods.

At the end of the experiment, the following results were observed:

1. Increase in knowledge level

The level of knowledge of the experimental group students in HTML and CSS was 54% on average at the beginning, but reached 89% at the end of the experiment (+35% increase).

The level of correct completion of practical tasks in JavaScript increased from 47% to 75% (+28% increase). In the control group, an increase of only 12–15% was observed, respectively.

2. Development of practical skills

Students in the experimental group presented their sites in a fully functional state at the final project presentation.

The average score for code quality, design consistency, and functionality was 4.6 points (on a 5-point scale).

In the control group, the average score was 3.8 points, and it was found that in some projects the functionality was not sufficiently implemented.

3. Collaboration and communication skills. Through group projects, the level of teamwork, division of responsibilities, and joint solving of technical problems significantly increased in the experimental group students.

According to the survey results, 83% of students noted that “the experience of working in a group made the learning process more interesting.”

4. Increased motivation. After the introduction of gamification elements, the participation rate of students in the experimental group was 92% (78% before the experiment).

The ability to accumulate points and receive badges through the rating system motivated students to complete additional tasks.

5. Independent learning habits. As a result of the Flipped Classroom model, the level of pre-lesson preparation of students increased from 45% to 75%.

The frequency of watching video lessons and using online materials doubled.

6. Overall final assessment. In the experimental group, students showed an average result of 87% on the competency test, while in the control group this figure was 68%.

The difference was found to be statistically significant ($p < 0.05$).

The results of the analysis showed that the integrated use of methodological approaches significantly increases students' technical knowledge, practical skills, creativity and motivation. In addition, students formed independent learning habits and developed skills to work in a collaborative environment.

Discussion. The results of the study show that the use of a single method in the formation of web programming competencies among polytechnic students is not sufficiently effective. On the contrary, combining several methodological approaches significantly increases the level of knowledge, skills and motivation of students.

1. Project-based learning (PBL). During the experiment, students not only strengthened their technical knowledge by developing real-life projects, but also gained experience in project management, time planning and presentation of results. This, in turn, developed the “soft skills” required in the labor market - communication, teamwork and creativity.

2. Problem-based learning (PrBL). This method taught student’s algorithmic and analytical thinking. For example, the processes of finding and correcting errors in the code, eliminating malfunctions in the interface increased the level of logical thinking of students.

3. Gamification. The introduction of gamification elements significantly increased student motivation. The rating, points, and badge system created a competitive environment, increasing class attendance and on-time completion. These results are consistent with the research of Deterding et al. (2017), confirming the effectiveness of game elements in increasing student engagement.

4. Flipped Classroom. The model of studying theoretical materials outside the classroom and devoting class time to practical work encouraged students to study independently. The ability to directly apply theoretical knowledge acquired through video lessons and electronic manuals during the lesson increased the level of mastery.

5. Collaborative Learning. Group work formed a culture of mutual knowledge exchange, mutual assistance, and joint responsibility among students. The distribution of tasks according to group roles (front-end developer, back-end developer, designer, and tester) simulated the workflow in real IT projects.

6. Advantages of a comprehensive approach. The combination of methods in the learning process developed not only technical, but also communicative and creative abilities of students. This approach helps them to form independent specialists in the future. This is also confirmed by the numerical indicators obtained in the experiment (growth in knowledge level, increased motivation, frequency of

independent study).

7. Practical recommendations. Clearly plan the sequence and harmony of methods in web programming lessons. Introduce experience in working with real clients or orders when developing projects. Maintain constant interest by regularly updating gamification elements. Pay special attention to the quality of video lessons when using the Flipped Classroom model.

The results obtained show that the integrated use of methodological approaches is highly effective in forming web programming competencies. In particular, project-based and problem-based teaching methods help to develop independent thinking and practical creativity in students. Also, gamification elements actively involve students in the lesson process. The Flipped Classroom model allows for effective distribution of class time.

Conclusion. The correct selection and combination of methodological approaches in the formation of web programming competencies significantly increases the quality of education. In the future, enriching these methods with artificial intelligence tools, online laboratories and virtual environments will serve to make the learning process more effective.

The combined use of methodological approaches in the formation of web programming competencies among polytechnic students significantly increases the effectiveness of education. When project-based learning, problem-based learning, gamification, flipped classroom and collaborative learning methods are used together, students:

Their technical knowledge (in HTML, CSS, and JavaScript) has deepened and their skills in independently performing practical tasks have increased.

Creativity, logical thinking and problem-solving skills have developed.

A culture of teamwork and communication has been formed. The habits of independent learning and self-development have increased. Motivation and interest in the learning process have increased to a high level. Complex methodological approaches are an effective tool for organizing web programming education in polytechnics based on modern requirements. In the future, the integration of these methods with artificial intelligence tools, virtual laboratories, and online learning platforms will further improve the educational process and serve to form students as competitive specialists.

References:

1. Nuritdinova G. (2024). *Sun'iy intellekt vositalarining o'quvchi shaxsiy kompetensiyalarini rivojlantirishdagi roli*. Pedagogik innovatsiyalar jurnali, №2, 45–50.
2. Nuritdinova G. (2025). *Ta'limda kommunikativ ko'nikmalarni shakllantirishda sun'iy intellektning metodik imkoniyatlari*. "Zamonaviy ta'lim va texnologiyalar" ilmiy to'plami, №1, 66–72.
3. Bilolov I. O'. Nuritdinova G. T. Sun'iy intellektning ta'lim jarayonini takomillashtirishdagi o'rni. "Maktabgacha va maktab ta'limi" Pedagogik, psixometodologik va tabiiy fanlarga ixtisoslashgan ilmiy jurnal. 2025-yil, mart, №3-son, 350-352-betlar. <https://doi.org/10.5281/zenodo.15142186>
4. Bilolov I. O'. Nuritdinova G. T. Ta'limda sun'iy intellekt texnologiyalarining qo'llanilishi bo'yicha xorijiy tajriba. Qo'qon davlat pedagogika instituti ILMIY XABARLARI (2025-yil 1-son), 1019-1022-betlar.
5. Warschauer, M. (2011). *Learning in the Cloud: How (and Why) to Transform Schools with Digital Media*. Teachers College Press.
6. Harasim, L. (2017). *Learning Theory and Online Technologies*. Routledge.
7. Gee, J. P. (2008). *What Video Games Have to Teach Us About Learning and Literacy*. Palgrave Macmillan.

8. Kukushkin, V. S. (2020). *Sovremennye tekhnologii v obrazovanii: iskusstvennyy intellekt i obuchayushchie sistemy*. Moskva: Prosveshchenie.
9. Ahmadaliyeva D., Karimov B. (2022). *Interaktiv ta'lim texnologiyalari va kommunikativ yondashuv*. Toshkent: O'qituvchi nashriyoti.
10. UNESCO (2023). *Artificial Intelligence in Education: Challenges and Opportunities*. <https://unesdoc.unesco.org>
11. Alieva N. (2021). *O'quvchilarda kommunikativ ko'nikmalarni shakllantirishda innovatsion yondashuvlar*. Ta'lim va rivojlanish, №4, 30–36
12. Salomova Z. (2020). *Sun'iy intellekt va pedagogik faoliyatda raqamli vositalar*. "Axborot texnologiyalari" ilmiy jurnali, №3, 21–26.