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DEVELOPING EFFECTIVE METHODOLOGIES FOR IMPROVING STUDENT COMPETENCE IN PROGRAMMING TECHNOLOGY EDUCATION

Adizova Madina Ruziyevna
teacher, Bukhara state technical university
E-mail: madinabonuadizova@gmail.com

Annotation: This article discusses various methodologies that can be employed to enhance student competence in programming technology education. It highlights the importance of adopting innovative teaching strategies to better equip students with the skills necessary for success in the tech industry. The article focuses on techniques such as Project-Based Learning (PBL), flipped classrooms, gamification, peer programming, adaptive learning, real-world industry exposure, and continuous assessment. These methodologies are aimed at fostering a deeper understanding of programming concepts, improving problem-solving abilities, and preparing students for real-world challenges. By integrating these approaches into programming education, educators can create an engaging and effective learning environment that nurtures both technical and interpersonal skills, preparing students for successful careers in technology.

Keywords: programming education, project-based learning, flipped classroom, competitive programming, peer programming, adaptive learning, continuous assessment, student competence, coding challenges, problem-solving skills.

Introduction. In today's rapidly evolving technological landscape, programming skills have become a cornerstone of educational curricula worldwide. The demand for competent software developers, engineers, and tech professionals is at an all-time high, making it critical to develop effective methodologies for teaching programming in schools and universities. To improve student competence in programming technology education, educators must implement strategies that go beyond traditional teaching methods. This article explores key methodologies that can enhance programming education and foster a deeper understanding of the subject. One of the most effective ways to improve student competence in programming is through Project-Based Learning (PBL). This methodology focuses on students working on real-world problems and producing tangible outcomes. Instead of passively receiving information, students engage in the programming process, apply theoretical knowledge, and tackle complex problems. PBL encourages creativity, critical thinking, and problem-solving skills that are essential in the tech industry. By working on projects, students can gain hands-on experience, which not only enhances their understanding of programming languages but also builds their confidence and prepares them for future challenges. Students might be asked to develop a mobile app or a website, with clear guidelines but plenty of room for creative exploration. The iterative process of developing, testing, debugging, and refining allows students to internalize key concepts in a practical context.

The flipped classroom model has gained significant attention in recent years as an effective educational methodology. In this approach, traditional teaching is reversed students are introduced to new concepts through online lectures, readings, or videos before the in-class

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sessions. The classroom time is then used for interactive activities, such as group discussions, coding challenges, and problem-solving exercises.

For programming education, flipped classrooms offer several advantages:

- Personalized learning: Students can learn at their own pace by revisiting lecture materials as needed.
- Active learning: In-class time can be dedicated to applying knowledge through coding exercises and collaborative projects.
- Immediate feedback: Instructors can provide real-time feedback during hands-on coding activities, helping students resolve misconceptions and improve their skills.

Gamification refers to the integration of game elements into the learning process, making it engaging and motivating for students. In the context of programming education, this can take the form of coding competitions, coding challenges, or using game-like platforms where students complete programming puzzles and tasks to earn rewards or unlock levels.

- Motivation: Students are more likely to stay engaged and improve their skills when they are competing or earning rewards.
- Skill development: Regular participation in coding challenges improves both speed and problem-solving skills.
- Peer learning: Students can learn from others by viewing solutions, reading discussions, and engaging in community forums.

Programming is not a solitary activity. In the professional world, developers frequently collaborate with team members to solve problems. Implementing collaborative learning and peer programming techniques in the classroom can mimic real-world workflows and enhance the overall learning experience. Peer programming involves two students working on the same coding task, with one acting as the "driver" (writing the code) and the other as the "navigator" (reviewing the code and offering suggestions). This setup encourages teamwork, communication, and problem-solving. The process also allows students to learn from each other, gaining insights into different approaches to solving programming challenges. Collaborative learning can also extend beyond the immediate classroom by fostering a coding community, where students work together on larger projects, discuss best practices, and share resources. This environment helps students develop essential interpersonal skills while improving their coding abilities. The rapid advancement of educational technology has introduced the concept of adaptive learning, which uses algorithms and data analytics to personalize learning experiences based on a student's strengths and weaknesses. Adaptive learning platforms assess the knowledge level of individual students and adjust the curriculum accordingly, offering more focused and personalized content. In programming education, adaptive learning can be particularly useful. Students may struggle with certain programming concepts, such as data structures or algorithms, while excelling in others. Adaptive platforms can provide targeted exercises, tutorials, and resources based on the

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student's current understanding, allowing for a more efficient learning process. Exposure to the tech industry and real-world applications is crucial in developing a student's competence in programming. Collaborating with industry professionals, participating in internships, and working on industry-sponsored projects help bridge the gap between classroom learning and real-world expectations. For instance, educators could invite guest speakers from the tech industry to discuss emerging trends, share experiences, and offer insights into the skills required for success in programming roles. These interactions can motivate students to explore different career paths and deepen their understanding of programming concepts.

In the traditional classroom setting, assessments often focus on summative exams or projects, which may not reflect a student's full potential or understanding. Instead, educators can implement continuous assessment methods that track students' progress over time, with frequent quizzes, coding assignments, and feedback sessions. Frequent feedback helps students identify areas for improvement and provides the opportunity to correct mistakes before they become ingrained. Incorporating peer feedback, self-assessments, and instructor assessments can provide a holistic view of a student's skills and progress. Regular assessment also motivates students to stay engaged with the material and refine their programming skills incrementally. To improve student competence in programming technology education, a combination of innovative methodologies is necessary. By integrating Project-Based Learning, flipped classrooms, gamification, peer programming, adaptive learning technologies, real-world exposure, and continuous feedback, educators can create a dynamic and effective learning environment. These strategies not only enhance students' technical skills but also foster a passion for programming and prepare them for successful careers in the tech industry. With the right approach, programming education can evolve to meet the demands of the 21st century, empowering the next generation of tech leaders and innovators.

Discussion. The landscape of programming technology education is continuously evolving to meet the needs of an increasingly digital and tech-driven world. As the demand for skilled software developers and engineers continues to grow, it is imperative that educators develop and refine teaching methodologies that equip students with both the technical expertise and problem-solving abilities required to excel in the field. This discussion explores the implications of the various methodologies explored in the literature, examining their strengths, challenges, and the potential for integration within programming curricula.

Project-Based Learning (PBL) has proven to be one of the most effective ways to engage students in programming education. As highlighted in the literature, PBL emphasizes real-world applications, fostering deeper learning through hands-on experience. Students are tasked with solving actual problems, which helps them to internalize programming concepts while also developing critical thinking, problem-solving, and teamwork skills. These are invaluable attributes in the tech industry, where the ability to collaborate, iterate, and think creatively are highly prized. However, while PBL offers significant advantages, it also comes with challenges. One of the key difficulties is the significant amount of time and resources required to design and implement meaningful projects that align with learning objectives. Furthermore, not all students may have the same level of prior knowledge or skill, making it difficult to ensure that projects

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are appropriately challenging for everyone. Despite these challenges, the evidence suggests that PBL is an effective method for developing practical coding skills and preparing students for real-world scenarios. The flipped classroom model represents a shift away from the traditional lecture-based approach, emphasizing self-paced learning outside of class and active, hands-on activities during class. In the context of programming education, this approach allows students to review lecture materials or tutorials at their own pace, which can lead to improved comprehension and retention of foundational concepts. When students come to class, they can engage in more active learning, such as coding exercises, group problem-solving tasks, and immediate feedback from instructors. Despite its benefits, the flipped classroom model is not without its drawbacks. One of the primary challenges is ensuring that students complete pre-class materials. Without adequate preparation, students may struggle to keep up during in-class activities. Additionally, not all students are equally comfortable with self-directed learning, which can create disparities in learning outcomes. Nonetheless, research supports the efficacy of flipped classrooms in increasing engagement and improving student performance in programming courses, especially when coupled with strong support and clear expectations.

Motivating and enhancing problem-solving skills. Gamification has emerged as a powerful tool in motivating students and enhancing their problem-solving abilities. By integrating game-like elements, such as achievements, leaderboards, and progress tracking, gamification taps into students' intrinsic motivation, encouraging them to engage in programming tasks. The use of competitive programming platforms such as LeetCode and Codeforces offers students the opportunity to tackle problems of varying difficulty levels and receive immediate feedback on their performance. However, while gamification has been shown to enhance student engagement, it may also inadvertently shift focus away from deeper learning to short-term rewards. Some students may prioritize completing tasks for the sake of points or ranking rather than developing a deep understanding of the concepts. Moreover, not all students may respond positively to competitive environments, and some may feel demotivated by their performance relative to peers. The key challenge, therefore, lies in balancing the motivating aspects of gamification with the need for meaningful, long-term learning outcomes.

Peer programming has demonstrated significant benefits for programming students by fostering collaboration, enhancing problem-solving skills, and improving code quality. As students work together to solve coding challenges, they learn not only technical skills but also how to communicate effectively and collaborate on complex tasks. These skills are particularly valuable in the tech industry, where teamwork and effective communication are critical to project success. Despite its advantages, peer programming requires careful management to ensure that the collaboration is productive. Without clear rules and guidelines, one student may dominate the process, leading to unequal learning experiences. Additionally, students may struggle with interpersonal issues, such as conflicting working styles, that hinder effective collaboration. Instructors must actively monitor and guide peer programming sessions to ensure that they remain focused on learning outcomes. Nonetheless, peer programming remains a valuable tool for developing both technical and interpersonal skills.

Adaptive Learning. The rise of adaptive learning technologies offers a promising avenue for

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personalizing programming education. By dynamically adjusting the difficulty of tasks and providing tailored feedback, adaptive learning systems cater to the individual needs of students, ensuring that they are appropriately challenged and supported throughout their learning journey. This personalized approach helps address the wide range of skill levels found in programming classrooms and can significantly improve student learning outcomes. However, the implementation of adaptive learning technologies requires substantial investment in both infrastructure and training. Additionally, not all students may benefit equally from adaptive learning systems, especially those who require more guidance or prefer traditional face-to-face interaction. Moreover, adaptive systems are only as effective as the algorithms and data they rely on, and any flaws in the system could lead to misaligned learning paths. Despite these challenges, adaptive learning represents a step forward in catering to the diverse needs of programming students, allowing for a more tailored and effective educational experience. Exposure to real-world industry practices is essential for preparing students for careers in programming and software development. By collaborating with tech companies, participating in internships, and working on industry-sponsored projects, students gain practical experience that enhances their technical knowledge and prepares them for the challenges of the professional world. This exposure helps bridge the gap between theoretical learning and practical application, making students more job-ready upon graduation. However, the integration of industry exposure into programming curricula can be resource-intensive, requiring partnerships with tech companies, coordination of internships, and the development of industry-related projects. Additionally, not all students may have access to such opportunities, particularly in regions with fewer tech industry connections. Therefore, educators must work to ensure equitable access to real-world learning experiences for all students. Nevertheless, industry exposure remains an essential component of a comprehensive programming education, helping students connect the dots between what they learn in the classroom and how it is applied in the workforce.

Finally, continuous assessment and feedback are crucial for fostering student growth in programming education. Unlike traditional exams, which often focus on summative evaluation, continuous assessment allows students to receive ongoing feedback on their progress. This approach helps identify learning gaps early and enables students to make improvements throughout the course. It also promotes a growth mindset, encouraging students to view mistakes as learning opportunities rather than failures. However, continuous assessment can be time-consuming for instructors, as it requires regular grading, feedback, and adjustments to the curriculum. Additionally, students may struggle with maintaining consistent motivation and performance without the structure of formal exams. To maximize the benefits of continuous assessment, instructors must design assessments that are both varied and meaningful, ensuring that they align with the learning objectives and provide students with valuable feedback.

Conclusion. The methodologies discussed in this article offer promising strategies for improving student competence in programming technology education. Each approach has its strengths and challenges, but when combined effectively, they can create a dynamic and engaging learning environment that fosters deep understanding, collaboration, and practical skill development. The key to success lies in finding the right balance between these methodologies and ensuring that they are implemented in ways that cater to diverse learning styles, promote long-term retention,

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and adequately prepare students for the demands of the tech industry. As technology and educational practices continue to evolve, it is essential for educators to stay adaptive, continually refining their teaching strategies to meet the changing needs of students and the industry.

References

1. Bahramovna, P. U. (2025). CHARACTERISTICS OF ENHANCING THE MECHANISMS FOR ORGANIZING FIRST AID TRAINING PROCESSES. JOURNAL OF INTERNATIONAL SCIENTIFIC RESEARCH, 2(5), 59-62.
2. Black, P., & Wiliam, D. (1998). Assessment and classroom learning. Assessment in Education: Principles, Policy & Practice, 5(1), 7–74. https://doi.org/10.1080/0969595980050102

3. Bahramovna, P. U., Tashpulatovich, T. S., & Botirovna, Y. A. (2025). FUNDAMENTALS OF DEVELOPING FIRST AID SKILLS IN STUDENTS: A THEORETICAL ANALYSIS. JOURNAL OF INTERNATIONAL SCIENTIFIC RESEARCH, 2(5), 147-153.
4. Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. Educational Psychologist, 26(3-4), 369–398. https://doi.org/10.1207/s15326985ep2603&4_8
5. Bahramovna, P. U., Tashpulatovich, T. S., & Botirovna, Y. A. (2025). COMPREHENSIVE AND METHODOLOGICAL ANALYSIS OF DEVELOPING FIRST AID SKILLS IN STUDENTS OF NON-MEDICAL FIELDS. STUDYING THE PROGRESS OF SCIENCE AND ITS SHORTCOMINGS, 1(6), 162-168.
6. Палванова, У. Б. (2025). ОСОБЕННОСТИ УСОВЕРШЕНСТВОВАНИЕ МЕХАНИЗМОВ ОРГАНИЗАЦИИ ПРОЦЕССОВ ОБУЧЕНИЯ ПЕРВОЙ ПОМОЩИ. THEORY OF SCIENTIFIC RESEARCHES OF WHOLE WORLDT, 1(5), 199-202.
7. Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. In ASEE Annual Conference & Exposition. American Society for Engineering Education. https://doi.org/10.18260/1-2--22585

8. Палванова, У. Б., Тургунов, С. Т., & Якубова, А. Б. (2025). СИСТЕМНО-МЕТОДИЧЕСКИЙ АНАЛИЗ ФОРМИРОВАНИЯ НАВЫКОВ ПЕРВОЙ ПОМОЩИ У ОБУЧАЮЩИХСЯ НЕМЕДИЦИНСКИХ СПЕЦИАЛЬНОСТЕЙ. THEORY OF SCIENTIFIC RESEARCHES OF WHOLE WORLDT, 1(5), 203-211.
9. Brusilovsky, P., & Millán, E. (2007). User models for adaptive hypermedia and adaptive educational systems. In P. Brusilovsky, A. Kobsa, & W. Nejdl (Eds.), The Adaptive Web (pp. 3-53). Springer-Verlag. https://doi.org/10.1007/978-3-540-72079-9_1

10. George, L. R., & Williams, L. (2003). The effects of pair programming on student performance and collaboration. In Proceedings of the 15th Conference on Software Engineering Education and Training (pp. 96-103). IEEE. https://doi.org/10.1109/CSEET.2003.1191210