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PERSONALIZED LEARNING STRATEGIES FOR ENHANCING PROFESSIONAL-PRAGMATIC COMPETENCE IN ENGINEERING STUDENTS

Abstract. This study investigates personalized learning strategies aimed at improving professional-pragmatic competence in future engineers. It focuses on the application of individualized learning plans, project-based tasks, and reflective practice as key components of a student-centered educational approach. By tailoring instruction to students' needs, interests, and learning pace, the study seeks to enhance both academic performance and practical skills. The findings reveal that students who participated in personalized learning environments demonstrated significant improvements in technical reasoning, problem-solving abilities, and professional communication skills. In addition, they showed increased motivation, autonomy, and engagement in the learning process. The research also examines the role of instructors in facilitating personalized learning and creating supportive educational conditions. Overall, the study highlights the importance of integrating student-centered approaches into engineering education and provides practical recommendations for effectively implementing personalized learning strategies to strengthen professional competence and better prepare future engineers for real-world challenges.

Keywords: professional-pragmatic competence, personalized learning, engineering education, reflective practice, project-based learning

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MUHANDISLIK YO'NALISHI TALABALARIDA KASBIY-PRAGMATIK KOMPETENSIYANI RIVOJLANTIRISH UCHUN PERSONALLASHTIRILGAN TA'LIM STRATEGIYALARI

Annotatsiya. Ushbu tadqiqot kelajakdagi muhandislarning kasbiy-pragmatik kompetensiyasini rivojlantirishga qaratilgan individual (personallashtirilgan) ta'lim strategiyalarini o'rganadi. Unda individual o'quv rejalar, loyiha asosidagi topshiriqlar va reflektiv amaliyot talabalarga yo'naltirilgan ta'lim yondashuvining asosiy komponentlari sifatida tahlil qilinadi. Ta'limni talabalarning ehtiyojlari, qiziqishlari va o'zlashtirish tezligiga moslashtirish ularning akademik natijalari hamda amaliy ko'nikmalarini yaxshilashga xizmat qiladi. Tadqiqot natijalari shuni ko'rsatadiki, personallashtirilgan

ta’lim muhitida ishtirok etgan talabalar texnik tafakkur, muammolarni hal qilish qobiliyati va kasbiy kommunikativ ko‘nikmalar bo‘yicha sezilarli o‘sishga erishgan. Shuningdek, ularning motivatsiyasi, mustaqilligi va o‘quv jarayoniga jalb etilishi oshgani kuzatilgan. Bundan tashqari, o‘qituvchining personallashtirilgan ta’limni tashkil etishdagi roli va qulay ta’lim muhitini yaratish masalalari ham yoritilgan. Umuman olganda, tadqiqot muhandislik ta’limida talabalarga yo‘naltirilgan yondashuvlarni joriy etish muhimligini ta’kidlaydi va kelajak muhandislarining kasbiy kompetensiyasini oshirish uchun amaliy tavsiyalar beradi.

Kalit so‘zlar: kasbiy-pragmatik kompetensiya, personallashtirilgan ta’lim, muhandislik ta’limi, reflektiv amaliyot, loyiha asosida o‘qitish.

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ПЕРСОНАЛИЗИРОВАННЫЕ СТРАТЕГИИ ОБУЧЕНИЯ ДЛЯ РАЗВИТИЯ ПРОФЕССИОНАЛЬНО-ПРАГМАТИЧЕСКОЙ КОМПЕТЕНТНОСТИ У СТУДЕНТОВ ИНЖЕНЕРНЫХ СПЕЦИАЛЬНОСТЕЙ

Аннотация. В данном исследовании рассматриваются стратегии персонализированного обучения, направленные на развитие профессионально-прагматической компетентности будущих инженеров. Основное внимание уделяется применению индивидуальных учебных планов, проектных заданий и рефлексивной практики как ключевых компонентов студентоцентрированного подхода в образовании. Адаптация обучения к потребностям, интересам и темпу освоения материала студентов способствует повышению как академической успеваемости, так и практических навыков.

Результаты исследования показывают, что студенты, участвовавшие в условиях персонализированного обучения, продемонстрировали значительное улучшение технического мышления, навыков решения проблем и профессиональной коммуникации. Кроме того, у них наблюдались рост мотивации, самостоятельности и вовлечённости в учебный процесс. Также рассматривается роль преподавателя в организации персонализированного обучения и создании благоприятной образовательной среды. В целом, исследование подчёркивает важность внедрения студентоцентрированных подходов в инженерное образование и предлагает практические рекомендации по эффективной реализации стратегий персонализированного обучения для повышения профессиональной компетентности будущих инженеров.

Ключевые слова: профессионально-прагматическая компетентность, персонализированное обучение, инженерное образование, рефлексивная практика, проектно-ориентированное обучение.

INTRODUCTION

Modern engineering education requires graduates not only to possess strong theoretical knowledge but also to demonstrate the ability to apply this knowledge effectively in professional and real-world contexts. Engineers must communicate technical information clearly, collaborate with multidisciplinary teams, and solve complex problems in dynamic environments. These abilities are often described as professional-pragmatic competence, which combines technical expertise with practical decision-making and communication skills.

However, traditional lecture-based instruction frequently focuses on the transmission of theoretical knowledge rather than the development of practical skills (Rustamova, Gaybullayeva, 2026). As a result, many students struggle

to apply their knowledge in professional settings. This challenge has led educators to explore alternative pedagogical approaches that support the development of professional competence.

One promising approach is personalized learning, which adapts teaching strategies to the individual needs, abilities, and learning styles of students. Personalized learning environments allow students to progress at their own pace, engage with meaningful tasks, and reflect on their learning experiences. Such approaches are particularly effective in engineering education, where problem-solving and practical application are essential.

The purpose of this study is to examine how personalized learning strategies can enhance professional-pragmatic competence among engineering students. The research also evaluates the effectiveness of project-based learning, reflective practice, and individualized instruction in improving communication skills, technical reasoning, and collaborative abilities.

LITERATURE REVIEW

Recent studies emphasize the importance of student-centered teaching approaches in higher education. Problem-based and project-based learning environments encourage students to engage actively with complex problems and develop deeper conceptual understanding. These approaches also help students acquire practical skills such as teamwork, critical thinking, and communication (Hemlo-Silver, 2004). Active learning strategies significantly improve student performance in science, engineering, and mathematics disciplines. Their research suggests that students who participate in collaborative problem-solving activities achieve higher levels of comprehension compared to those who rely solely on traditional lectures (Freeman et al., 2014).

Another important aspect of personalized learning is reflective practice. Reflective learning encourages students to analyze their experiences, identify strengths and weaknesses, and develop strategies for improvement. Activities help students become more independent learners and better prepared for professional challenges (Bishop & Verleger, 2013).

In engineering education, personalized approaches are particularly beneficial because students often have diverse backgrounds, learning styles, and levels of prior knowledge. By integrating individualized instruction with collaborative and project-based tasks, educators can create learning environments that support both technical development and professional competence.

Table 1.

Participant Distribution and Intervention

Group	Number of Students	Intervention Type	Duration
Experimental	60	Personalized learning plans, PBL, workshops	2 semesters
Control	60	Traditional lectures	2 semesters

METHODOLOGY

It is important to note that the study involved 120 undergraduate engineering students from a technical university. Participants were randomly divided into two groups: the Experimental group (n = 60), in which students participated in personalized learning activities, including project-based tasks, reflective exercises, and individualized learning plans. Next, the Control group (n = 60), in which students received traditional lecture-based instruction.

Definitely, the research was conducted over two academic semesters, allowing sufficient time to observe changes in professional competence. Several instruments were used to collect data and evaluate learning outcomes. One of the instruments that was used for collecting data was pre- and post-tests, which really helped in measuring communication skills and technical problem-solving abilities.

Apart from these instruments, reflective journals, in which students recorded their learning experiences and challenges, were considered one of the most beneficial ones in terms of improving the learning experiences.

Besides that, project performance evaluations, assessing students' ability to apply theoretical knowledge to practical engineering tasks, were accepted as primarily instruments in terms of gaining specialty-related tasks.

Finally, instructor observations, documenting participation and collaboration during learning activities, were also important in measuring the quality of collaborative tasks.

Table 2.

Pre- and Post-Test Scores of Professional-Pragmatic Competence

Competence Area	Experimental Group (Pre)	Experimental Group (Post)	Control Group (Pre)	Control Group (Post)
Communication Skills	62.5	76.8	63.1	69.6
Technical Problem-Solving	58.2	70.0	57.9	63.1

RESULTS

The findings show that the use of personalized learning strategies led to a noticeable improvement in the professional-pragmatic competence of engineering students.

Students in the experimental group achieved higher results in both communication and problem-solving tasks. Their average communication scores increased by 14.3 points, while problem-solving scores rose by 11.8 points. In comparison, the control group demonstrated smaller gains, with increases of 6.5 and 5.2 points, respectively.

Data from reflective journals suggest that individualized learning plans helped students better identify their weaknesses and work on them more systematically. Many participants noted that this approach made their learning process more focused and effective. Project-based activities, in turn, supported the practical application of theoretical knowledge and contributed to a clearer understanding of complex engineering concepts.

In addition, classroom observations indicated a higher level of student engagement in the experimental group. Students participated more actively in discussions, collaborated more effectively during group tasks, and showed greater confidence when presenting their technical solutions.

DISCUSSION

The findings of this study confirm that personalized learning strategies play an important role in the development of professional-pragmatic competence in engineering education. When instruction is adapted to individual learning needs, students tend to engage more consistently with the course material and develop practical skills that are directly relevant to their future professional activities.

Project-based learning was found to be particularly effective in supporting the application of theoretical knowledge in realistic contexts. Through participation in collaborative tasks and problem-solving activities, students strengthened their analytical thinking and improved their ability to communicate technical information more clearly and confidently.

Reflective practice also made a noticeable contribution to the development of professional competence. By analyzing their own learning experiences, students became more aware of their strengths and areas that require further improvement. This process encouraged greater responsibility for learning and supported the development of more effective individual learning strategies.

Another important outcome of the study is related to student motivation and engagement. The results suggest that personalized learning environments create more favorable conditions for active participation. When students perceive that their individual needs are taken into account, they are more likely to be involved in learning activities and demonstrate better academic performance.

Overall, the findings indicate that the combined use of personalized instruction, project-based learning, and reflective practice contributes to the creation of a comprehensive learning environment. Such an approach supports not only

the development of technical knowledge but also the formation of professional-pragmatic competence required in engineering practice.

From a practical perspective, these results suggest that engineering curricula can be improved by incorporating elements of personalized learning that address individual differences among students. At the same time, greater emphasis on project-based activities would help strengthen the connection between theoretical knowledge and its practical application. The inclusion of reflective tasks within courses may further support students in evaluating their own progress and developing more effective learning strategies. In addition, it appears important for higher education institutions to support instructors through targeted professional development aimed at implementing student-centered teaching approaches.

CONCLUSION

Thus, the study demonstrates that a more individualized and practice-oriented approach to teaching can lead to measurable improvements in both academic performance and professional skill development. At the same time, it should be noted that the effectiveness of such approaches may depend on factors such as course design, instructor experience, and institutional support. Therefore, further research could focus on exploring how these variables influence the outcomes of personalized learning in different educational contexts. Despite these considerations, the results provide a solid basis for integrating student-centered methods into engineering education and highlight their potential for preparing graduates who are better equipped to meet the demands of modern professional environments.

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