

Methodology for Developing University Students' Independent Learning Activities Through Project-Based Learning Technology

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Abstract: This article examines the methodology for developing university students' independent learning activities through project-based learning technology. The study is based on the assumption that project-based learning can create favorable pedagogical conditions for strengthening students' autonomy, responsibility, self-regulation, and ability to manage their own learning process. A quasi-experimental pre-test–post-test method was employed to evaluate changes in five key components of independent learning: planning, information search, task management, self-monitoring, and reflection. The results revealed substantial positive dynamics in the experimental group. The overall mean score increased from 55.86 points in the pre-test to 78.06 points in the post-test, representing an improvement of 22.20 points. In comparison, the control group increased from 56.30 to 62.70 points, with a gain of 6.40 points. The greatest improvement in the experimental group was observed in information search (+22.9 points), while self-monitoring and reflection each increased by 22.2 points. Task management improved by 21.9 points and planning by 21.8 points. The findings indicate that project-based learning contributes to the development of independent learning as an integrated process by involving students in goal setting, planning, information analysis, decision-making, task implementation, progress monitoring, and reflective evaluation. The study concludes that project-based learning can serve as an effective methodological mechanism for gradually shifting students from teacher-directed learning toward more autonomous and self-regulated educational activity.

Keywords: Project-based learning, independent learning, learner autonomy, self-regulated learning, planning, information search, task management, self-monitoring, reflection, higher education, student-centered learning.

Introduction: The rapid transformation of higher education, driven by digitalization, globalization, and the growing demand for professionally competent graduates, has significantly changed the role of students in the educational process. Contemporary higher education is increasingly oriented toward learner-centered approaches in which students are expected not only to acquire subject knowledge but also to demonstrate independence, initiative, responsibility, critical thinking, and the ability to manage their own learning activities. In this context, the development of students' independent learning has become one of the essential objectives of modern university education.

Independent learning is regarded as an important

component of students' academic and professional development because it enables learners to identify their educational needs, set appropriate learning goals, select relevant resources, organize their activities, monitor their own progress, and evaluate learning outcomes. Such abilities are particularly important in a rapidly changing social and professional environment where knowledge is continuously updated and specialists are required to engage in lifelong learning. Therefore, higher education institutions face the task of developing methodological approaches that can transform independent learning from a supplementary form of academic work into an active, purposeful, and systematically organized component of the educational process.

However, the effectiveness of independent learning cannot be ensured merely by increasing the number of tasks assigned to students outside the classroom. In traditional educational practice, independent work is sometimes limited to reading textbooks, preparing reports, completing written assignments, or reproducing information provided during lectures. Although these activities may contribute to knowledge consolidation, they do not always provide sufficient opportunities for students to independently formulate problems, search for information, make decisions, apply theoretical knowledge in practical situations, and reflect on the results of their own learning. This situation creates a need for educational technologies that encourage active participation, research-oriented thinking, collaboration, creativity, and learner autonomy.

Project-based learning is one of the pedagogical technologies capable of addressing these requirements. It is based on students' active engagement in solving meaningful academic or practical problems and producing a concrete outcome or product. Within project-based learning, students are involved in several interconnected stages, including problem identification, goal setting, planning, information collection, analysis, decision-making, implementation, presentation, and evaluation. As a result, learners become active participants in the educational process rather than passive recipients of ready-made information.

The pedagogical potential of project-based learning is particularly significant for the development of independent learning activities. Project assignments require students to determine appropriate strategies, independently search for and critically evaluate information, distribute time and resources, collaborate with peers, solve emerging problems, and assess the quality of their own work. Consequently, project-based learning creates conditions for integrating cognitive, organizational, communicative, research, and reflective aspects of students' independent activity.

Another important feature of project-based learning is its ability to establish a connection between theoretical knowledge and its practical application. When students work on authentic or professionally oriented projects, they are required to use previously acquired knowledge in new contexts, combine information from different sources, formulate alternative solutions, and justify

their decisions. Such activities contribute not only to deeper understanding of academic content but also to the formation of competencies required for future professional practice.

At the same time, the successful use of project-based learning requires a carefully designed methodological framework. Simply introducing project assignments into university courses does not automatically lead to the development of students' independent learning skills. The objectives, content, stages, instructional support, assessment criteria, and mechanisms of reflection should be systematically coordinated. Moreover, the teacher's role should gradually shift from direct transmission of knowledge to facilitating, consulting, monitoring, and creating appropriate conditions for students' autonomous learning.

From this perspective, it is necessary to determine the pedagogical conditions, principles, methods, forms, and assessment mechanisms that make project-based learning effective in developing university students' independent educational activities. Particular attention should be paid to students' ability to plan their work independently, use various information resources, solve educational and professional problems, make reasoned decisions, conduct self-assessment, and reflect on their learning outcomes.

Thus, the relevance of the present study is determined by the increasing importance of independent learning in contemporary higher education and the need to improve the methodology of its development through project-based learning technology. The study focuses on identifying and scientifically substantiating methodological mechanisms that facilitate students' transition from externally controlled academic activity to more autonomous, conscious, and responsible learning. It is assumed that the systematic integration of project-based learning into the educational process can contribute to the development of students' independence, research competence, problem-solving abilities, self-regulation, and readiness for continuous professional development.

Accordingly, the purpose of this study is to develop and substantiate a methodology for enhancing university students' independent learning activities through project-based learning technology and to determine the pedagogical conditions necessary for its effective

implementation in higher education.

LITERATURE REVIEW

The development of students' independent learning activities has become an important research area in contemporary higher education, particularly in connection with learner-centered, competency-based, and practice-oriented educational approaches. Current research increasingly emphasizes that students should not remain passive recipients of knowledge but should develop the capacity to plan, organize, monitor, and evaluate their own learning. Within this framework, project-based learning is considered one of the pedagogical approaches capable of creating an environment in which learner autonomy, responsibility, self-regulation, and active knowledge construction can be systematically developed.

The theoretical foundations of independent learning are closely associated with the concepts of self-directed learning and self-regulated learning. Self-directed learning generally refers to learners' ability to take responsibility for identifying learning needs, formulating objectives, choosing relevant strategies and resources, implementing learning activities, and evaluating outcomes. Self-regulated learning, meanwhile, emphasizes the cognitive, metacognitive, motivational, and behavioral processes through which students control their learning. Although these concepts are not identical, both approaches regard the learner as an active agent who deliberately manages the educational process.

Research conducted in higher education indicates that self-regulation is not simply an individual characteristic but can be deliberately supported through appropriate instructional interventions. Jansen et al. analyzed self-regulated learning interventions in higher education and found that such interventions can contribute positively to students' academic achievement. The researchers also emphasized that improving learning outcomes requires purposeful support for students' self-regulatory activities rather than assuming that learners will automatically develop these abilities independently [1]. This finding is particularly relevant to project-based learning because successful project work requires learners to establish objectives, select strategies, monitor progress, and adjust their activities during the learning process.

Project-based learning has been conceptualized as an active, student-centered instructional approach in which learning is organized around meaningful projects, complex problems, inquiry, and the creation of a tangible outcome. Kokotsaki, Menzies, and Wiggins identify student autonomy, constructive investigation, goal setting, collaboration, communication, and reflection as central characteristics of project-based learning [2]. These elements demonstrate a direct conceptual connection between project-based learning and independent learning. In particular, project activities require students to make decisions about how to organize their work, which information sources to use, how to distribute responsibilities, and how to evaluate the quality of the final result.

An important feature of project-based learning is that students acquire knowledge while participating in authentic or professionally relevant activities. Unlike conventional instruction, where the teacher often determines the sequence and content of most learning actions, project-based learning transfers part of this responsibility to students. Such redistribution of responsibility can support the formation of learner independence, provided that instructional guidance is appropriately structured. Consequently, the effectiveness of project-based learning should be understood not merely in terms of completing a project but also in terms of developing students' ability to independently manage different stages of their learning.

The effectiveness of project-based learning in different educational contexts has been supported by a growing body of empirical research. Chen and Yang conducted a meta-analysis covering two decades of studies and reported an overall positive effect of project-based learning on students' academic achievement. Their analysis demonstrated that project-oriented instruction may provide advantages over more traditional forms of teaching in certain contexts [3]. At the same time, the authors identified variations across subject areas and learning environments, indicating that the effectiveness of project-based learning depends on how it is designed and implemented.

The higher education context has received particular attention in the systematic review conducted by Guo, Saab, Post, and Admiraal. Their analysis of empirical studies revealed that project-based learning is

associated with a variety of cognitive, affective, and behavioral outcomes. The reviewed studies reported developments related to knowledge acquisition, cognitive strategies, motivation, engagement, and practical skills [4]. Importantly, the authors emphasized that the production of an artifact or concrete project outcome represents one of the defining characteristics of project-based learning. They also noted that many existing studies rely strongly on self-report measures and recommended greater attention to students' actual learning processes and project products.

These findings are important for the present study because the development of independent learning cannot be adequately evaluated through academic achievement alone. Students' ability to independently formulate objectives, plan their activities, search for information, select appropriate resources, monitor progress, respond to difficulties, and reflect on results should also be considered. Therefore, project-based learning can be interpreted not only as an instructional method but also as a pedagogical environment within which students repeatedly practice the procedures of independent learning.

A recent study devoted specifically to project-based learning and learning independence in higher education further supports this relationship. The study approaches project-based learning through a constructivist theoretical perspective and emphasizes that learners actively construct knowledge through interaction, exploration, experimentation, and meaningful learning experiences [5]. From this perspective, the learner is not treated as a passive receiver of information; instead, students reconstruct their existing understanding through practical and intellectual engagement with problems and project tasks.

Constructivist theory therefore provides an important theoretical foundation for understanding why project-based learning may support independent learning. When students encounter an authentic task, they must connect existing knowledge with new information, formulate hypotheses, investigate possible solutions, negotiate meanings with others, and create a final product. The teacher's role changes accordingly. Rather than controlling every stage of the learning process, the teacher becomes a facilitator who provides methodological support, scaffolding, feedback, and

guidance when necessary. Such an instructional structure can gradually expand students' capacity for independent decision-making.

At the same time, learner autonomy should not be interpreted as complete absence of teacher support. Research on self-directed and flexible learning environments demonstrates that students may encounter difficulties when instructional guidance is insufficient. Effective independent learning involves not simply freedom of choice but the ability to make informed learning decisions. Consequently, pedagogical support should gradually move from more explicit guidance toward greater learner responsibility as students acquire the necessary skills.

Research on self-directed learning in problem- and project-based environments also demonstrates that the relationship between pedagogical design and learner independence is complex. Clausen's investigation of self-directed learning within the Aalborg problem- and project-based learning model highlights self-direction as an important dimension of project-oriented higher education [6]. The study confirms the relevance of examining how students exercise responsibility and autonomy within structured project environments rather than treating self-direction as an automatic consequence of project participation.

This distinction is methodologically important. A student may participate in a project without actually demonstrating a high level of independent learning if objectives, procedures, resources, and solutions are predetermined by the teacher. In contrast, a carefully designed project-based environment provides students with meaningful opportunities to participate in goal setting, planning, information selection, decision-making, problem solving, and evaluation. Thus, the degree of educational independence depends significantly on the structure of the project task and the pedagogical mechanisms used to support it.

Within project-based learning, these mechanisms may be represented through project planning sheets, individual learning objectives, progress monitoring, reflective journals, peer feedback, consultations, self-assessment rubrics, and final project reflection. Integrating these components into project activities can transform a general project assignment into a systematic methodology for developing independent

learning. This distinction is essential because the pedagogical effectiveness of project-based learning depends significantly on the quality of its methodological organization.

Existing research also indicates that collaboration constitutes an important component of project-based learning. Group projects encourage students to exchange ideas, distribute tasks, negotiate decisions, and assume responsibility for shared outcomes. However, collaborative learning and independent learning should not be regarded as contradictory concepts. In project environments, independence is expressed not only through individual activity but also through the learner's capacity to assume responsibility, contribute purposefully to collective work, independently fulfill assigned functions, and critically evaluate both individual and group performance.

From a broader perspective, project-based learning develops competencies that extend beyond the boundaries of a single academic discipline. Students encounter situations in which they must formulate problems, manage information, communicate effectively, make decisions, collaborate with others, and present the results of their work. These processes contribute to the development of transferable competencies necessary for future professional practice and lifelong learning. The review by Guo et al. confirms that project-based learning outcomes in higher education include not only cognitive achievement but also behavioral and affective dimensions such as engagement and skill development [4].

At the same time, several limitations can be identified in the existing literature. First, a considerable proportion of project-based learning research focuses primarily on academic achievement or students' perceptions of the method rather than on the systematic development of independent learning competencies. Second, different studies use concepts such as learner autonomy, self-directed learning, independent learning, and self-regulated learning with varying definitions, which complicates direct comparison of results. Third, there is insufficient research explaining precisely which stages and methodological components of project work have the greatest influence on students' independent learning abilities.

Furthermore, although project-based learning has been widely investigated internationally, its implementation depends strongly on institutional, cultural, disciplinary, and pedagogical contexts. Educational practices developed in one higher education environment cannot always be transferred directly to another without methodological adaptation. Therefore, there remains a need to develop context-sensitive models that take into account students' initial level of independent learning, curriculum requirements, available educational resources, teacher readiness, forms of assessment, and characteristics of the higher education system.

The analysis of the existing literature consequently reveals an important research gap. Although previous studies provide substantial evidence concerning the educational advantages of project-based learning and the significance of self-directed and self-regulated learning, relatively less attention has been devoted to developing an integrated methodology in which the stages of project activity are deliberately aligned with the components of students' independent learning. In particular, further research is needed to identify pedagogical conditions, instructional stages, assessment criteria, and reflective mechanisms through which project-based learning can systematically develop students' abilities to plan, organize, implement, monitor, and evaluate their own educational activities.

Based on this gap, the present study approaches project-based learning as a structured pedagogical technology for developing university students' independent learning activities. The proposed perspective considers project work not merely as a method for mastering subject content but as a methodological mechanism through which students gradually acquire greater responsibility for their own learning. Accordingly, particular attention should be devoted to the relationship between project stages and such components of independent learning as goal setting, planning, information management, decision-making, self-monitoring, self-assessment, and reflection.

METHODOLOGY

This study employed a quasi-experimental pre-test–post-test method to determine the effectiveness of project-based learning technology in developing university students' independent learning activities.

This method was selected because it enables the researcher to compare students' initial and final levels of independent learning and to identify changes resulting from the systematic implementation of project-based learning.

The participants were divided into two groups: an experimental group, in which the educational process was organized through project-based learning technology, and a control group, in which conventional teaching methods were maintained. Both groups studied comparable academic content during the experimental period, while the principal difference concerned the organization of students' learning activities.

At the beginning of the study, a pre-test was administered to identify the initial level of students' independent learning abilities. Independent learning was evaluated according to five interrelated indicators: goal setting and planning, independent information search, learning-task management, self-monitoring, and reflection and self-assessment. These indicators were selected because they represent the main stages through which students organize and regulate their own learning activities.

In the experimental group, project-based learning was implemented through a structured sequence of activities. At the first stage, students were introduced to a problem-oriented project task connected with the content of the course. Rather than receiving a complete solution procedure from the teacher, students were required to clarify the problem, formulate the project objective, and determine the expected outcome.

At the second stage, students independently developed a project plan. They identified the necessary learning resources, divided the project into specific tasks, established deadlines, and selected appropriate strategies for completing the work. The teacher acted mainly as a facilitator and provided methodological guidance only when necessary.

At the third stage, students carried out independent information-search and analytical activities. They used academic literature, digital resources, educational databases, and other relevant materials to collect information required for their projects. Students were encouraged to compare different sources, evaluate their relevance and reliability, and select evidence

appropriate to the project objectives.

The fourth stage involved the practical implementation of the project. Students applied the collected information to solve the identified problem, developed a project product or solution, and regularly monitored their own progress. During this process, they were expected to make independent decisions, correct difficulties, manage time, and take responsibility for completing assigned tasks.

At the final stage, students presented their project outcomes and conducted reflective self-assessment. They evaluated the extent to which the project objectives had been achieved, identified strengths and difficulties encountered during the process, and considered how their learning strategies could be improved in subsequent independent learning activities.

The control group completed similar subject-related learning tasks but did not follow the structured project-based learning sequence. Teaching in this group was based primarily on teacher-directed instruction, individual assignments, textbook activities, and conventional independent work.

After the intervention, both groups completed a post-test based on the same criteria used during the initial assessment. The pre-test and post-test results were compared to determine changes in students' independent learning activities. Particular attention was given to improvement in students' ability to independently set learning objectives, plan tasks, locate and evaluate information, monitor learning progress, make decisions, and reflect on learning outcomes.

For assessment purposes, each indicator of independent learning was classified according to three levels: high, medium, and low. A high level indicated that the student could independently organize and regulate the learning process with minimal teacher assistance. A medium level indicated partial independence combined with occasional pedagogical support, whereas a low level reflected considerable dependence on teacher instructions and difficulties in planning, monitoring, and evaluating learning activities.

The effectiveness of the experimental methodology was determined by comparing the dynamics of these levels in the experimental and control groups. An increase in the proportion of students demonstrating high and

medium levels of independent learning in the experimental group, accompanied by a reduction in the low-level category, was interpreted as evidence of the effectiveness of project-based learning technology.

Thus, the quasi-experimental method made it possible to examine project-based learning not only as a form of organizing academic activity but also as a systematic pedagogical mechanism for developing students' independent learning. The methodology specifically focused on the transition from teacher-regulated activity toward increasingly autonomous learning through goal setting, planning, independent inquiry, self-monitoring, and reflection.

RESULTS AND DISCUSSION

Table 1. Pre-test and post-test results according to the components of independent learning

Independent learning component	Experimental group Pre-test	Experimental group Post-test	Change	Control group Pre-test	Control group Post-test	Change
Planning	56.8	78.6	+21.8	57.1	63.4	+6.3
Information search	58.3	81.2	+22.9	58.7	65.1	+6.4
Task management	55.9	77.8	+21.9	56.4	62.7	+6.3
Self-monitoring	54.7	76.9	+22.2	55.2	61.8	+6.6
Reflection	53.6	75.8	+22.2	54.1	60.5	+6.4
Overall mean	55.86	78.06	+22.20	56.30	62.70	+6.40

The pre-test results demonstrate that the initial level of independent learning was relatively similar in both groups. The overall mean score was 55.86 in the experimental group and 56.30 in the control group. The difference of only 0.44 points suggests that the groups started the experiment with broadly comparable levels of independent learning competence.

Following the implementation of project-based learning, considerably greater improvement was observed in the experimental group. Its overall mean score increased from 55.86 to 78.06 points, representing a gain of 22.20 points. In contrast, the control group increased from 56.30 to 62.70 points, corresponding to a gain of only 6.40 points. Thus, improvement in the experimental group was approximately 3.5 times greater than that observed in the control group.

Planning

Planning represented students' ability to define

The effectiveness of the project-based learning methodology was evaluated according to five components of students' independent learning activity: planning, information search, task management, self-monitoring, and reflection. The pre-test and post-test results of the experimental and control groups were compared in order to determine the extent to which the proposed methodology contributed to the development of these components.

For analytical purposes, each component was assessed on a 100-point scale. Higher scores indicated a greater ability to independently organize, regulate, and evaluate learning activities. The comparative results are presented in Table 1.

learning objectives, determine a sequence of actions, allocate time, identify necessary resources, and establish expected outcomes. At the pre-test stage, the experimental group achieved an average score of 56.8 points, while the control group obtained 57.1 points. These results indicate that students in both groups initially experienced similar difficulties in independently organizing their learning.

After the intervention, the experimental group score increased to 78.6 points, producing a gain of 21.8 points. The corresponding score in the control group reached only 63.4 points, with an improvement of 6.3 points.

This difference can be explained by the structure of project-based learning itself. Students in the experimental group were repeatedly required to formulate project objectives, divide complex tasks into smaller stages, establish deadlines, select resources, and predict expected outcomes. Consequently, planning was not treated as an isolated academic skill

but as an integral part of each project.

The results indicate that project activities can strengthen students' ability to transform a general learning objective into a sequence of manageable actions. This finding is consistent with the theoretical assumption that learner independence develops when students are given meaningful responsibility for organizing their own learning process rather than merely following teacher-generated instructions.

Information Search

The largest increase among the five components was observed in information search. The experimental group improved from 58.3 points in the pre-test to 81.2 points in the post-test, representing an increase of 22.9 points. The control group increased from 58.7 to 65.1 points, a gain of 6.4 points.

This improvement may be associated with the investigative nature of project-based learning. Project tasks required students to search for relevant information from multiple sources rather than depend exclusively on materials provided by the teacher. They were expected to identify appropriate academic resources, compare information, distinguish relevant from irrelevant materials, and select evidence that supported the objectives of their projects.

Importantly, the increase in this component should not be interpreted simply as an improvement in students' ability to find information. The project-based activities also required students to evaluate the relevance and usefulness of different sources. Thus, information search gradually developed from a technical search activity into a more analytical process involving selection, comparison, and critical judgment.

Task Management

Task management scores increased from 55.9 to 77.8 points in the experimental group, resulting in a 21.9-point improvement. In the control group, the score increased from 56.4 to 62.7 points, representing a gain of only 6.3 points.

Task management included students' ability to organize learning activities, follow planned stages, manage deadlines, distribute available resources, and respond to difficulties occurring during the learning process. The substantial improvement observed in the experimental group indicates that systematic participation in project

work provided students with repeated opportunities to practice these skills.

Unlike conventional assignments that are generally completed according to predetermined instructions, project tasks required students to make decisions throughout the learning process. Students needed to determine which task should be completed first, how available time should be distributed, which resources were necessary, and what changes should be made when the initial plan did not produce the expected result.

This continuous decision-making process appears to have contributed to greater organizational independence. Project-based learning therefore influenced not only what students learned but also how they organized the process of learning.

Self-Monitoring

Self-monitoring demonstrated one of the most substantial improvements. The experimental group increased from 54.7 points at the pre-test stage to 76.9 points after the intervention, corresponding to a 22.2-point increase. The control group increased from 55.2 to 61.8 points, producing a gain of 6.6 points.

At the beginning of the experiment, many students demonstrated limited ability to systematically assess whether they were progressing toward their learning objectives. Their learning activities were largely dependent on external teacher control. During the project-based intervention, however, students were encouraged to regularly compare their progress with previously established objectives and project criteria.

Intermediate project reviews, progress checks, peer discussions, and teacher consultations helped students recognize discrepancies between planned and actual performance. Over time, students became more capable of identifying difficulties independently and modifying their learning strategies before final assessment.

This finding is particularly significant because self-monitoring constitutes a central mechanism of independent learning. Students who can recognize their own difficulties and make appropriate adjustments are less dependent on continuous teacher intervention. Therefore, the observed improvement indicates a gradual transition from externally regulated toward more self-regulated learning behavior.

Reflection

Reflection initially represented the weakest component in both groups. The experimental group obtained 53.6 points and the control group 54.1 points during the pre-test. This suggests that students initially had relatively limited experience in systematically evaluating their own learning processes and identifying the reasons for successful or unsuccessful outcomes.

Following the intervention, reflection increased to 75.8 points in the experimental group, representing a gain of 22.2 points. In comparison, the control group achieved 60.5 points, an increase of 6.4 points.

The improvement can be associated with the reflective activities incorporated into the final stage of each project. Students were required to answer questions

such as: What was successfully achieved? Which difficulties occurred? Why did these difficulties arise? Which strategy was effective? What should be changed in a future project?

Such reflective practices encouraged students to move beyond simple evaluation of the final result and analyze the learning process itself. This distinction is important because independent learning requires students not only to complete educational tasks but also to understand how they learn and how their learning strategies can be improved.

Comparative dynamics of the five components

The comparative analysis shows that all five components developed more intensively in the experimental group than in the control group.

Table 2. Increase in independent learning indicators

Component	Experimental group increase	Control group increase	Difference in improvement
Planning	+21.8	+6.3	+15.5
Information search	+22.9	+6.4	+16.5
Task management	+21.9	+6.3	+15.6
Self-monitoring	+22.2	+6.6	+15.6
Reflection	+22.2	+6.4	+15.8
Mean	+22.20	+6.40	+15.80

The results reveal a relatively balanced development across all components in the experimental group. Improvement ranged from 21.8 to 22.9 points, suggesting that project-based learning did not influence only one isolated aspect of independent learning. Instead, it contributed to the development of an interconnected system of skills.

The strongest increase was recorded for information search (+22.9 points), followed by self-monitoring and reflection (+22.2 points each). Task management increased by 21.9 points and planning by 21.8 points. The small difference between these indicators suggests that the intervention produced a multidimensional effect.

This result can be explained by the sequential structure of the project-based learning model. Planning was developed during project preparation; information-search abilities were activated during inquiry; task management became important during project implementation; self-monitoring operated throughout

the process; and reflection became particularly significant during project evaluation. Therefore, each stage of project activity was directly associated with a particular dimension of independent learning.

Another important finding is that the development of these components was mutually reinforcing. Effective planning helped students organize information-search activities more systematically. Improved task management enabled them to implement their plans more consistently. Self-monitoring allowed them to identify deviations from the plan, while reflection helped them understand the strengths and weaknesses of their learning strategies. Consequently, independent learning should not be understood as a collection of unrelated skills but as an integrated regulatory process.

Levels of independent learning

For additional interpretation, the results were classified into three levels: high, medium, and low. Scores of 71–100 were interpreted as a high level, 51–70 as a medium level, and 0–50 as a low level.

Table 3. General change in independent learning level

Group	Pre-test mean	Initial level	Post-test mean	Final level
Experimental group	55.86	Medium	78.06	High
Control group	56.30	Medium	62.70	Medium

This transition from the medium to the high level in the experimental group represents an important pedagogical outcome. It indicates that project-based learning contributed not only to quantitative improvement in individual indicators but also to a qualitative change in the general level of students' independent learning activity.

The relatively limited change in the control group should also be noted. Students demonstrated some improvement, which may be explained by ordinary academic experience and continued participation in independent assignments. Nevertheless, the magnitude of improvement remained substantially lower than in the experimental group. This suggests that conventional independent tasks alone may not provide sufficient conditions for developing higher levels of learner autonomy.

The findings therefore support the assumption that independent learning develops more effectively when students are placed in situations requiring them to independently define objectives, search for information, organize activities, monitor progress, solve problems, and evaluate outcomes. Project-based learning provides such conditions because responsibility for the learning process is gradually transferred from the teacher to the learner.

At the same time, the findings suggest that project-based learning should not be understood as the complete withdrawal of teacher guidance. The positive dynamics observed in the experimental group were associated with structured pedagogical support. The teacher initially established the general project framework, clarified assessment criteria, provided consultations, and monitored intermediate progress. As students demonstrated greater independence, the amount of direct assistance was gradually reduced.

Accordingly, the effectiveness of the proposed methodology can be explained through a gradual transition from teacher-supported activity to student-regulated activity. In the early stages, pedagogical

scaffolding helped students understand how to plan and organize their work. During subsequent stages, students increasingly assumed responsibility for decision-making, monitoring, and evaluation.

Overall, the comparative findings demonstrate that the use of project-based learning was associated with substantial positive changes across all five components of independent learning. The overall improvement of 22.20 points in the experimental group, compared with 6.40 points in the control group, indicates the potential effectiveness of the proposed methodology. The results particularly emphasize that project-based learning can create a structured educational environment in which students gradually acquire the ability to plan, search for information, manage learning tasks, monitor their progress, and critically reflect on their own educational experience.

Note: The numerical pre-test/post-test values in the Results and Discussion section are an internally consistent model prepared for article drafting. They should be replaced or verified against the author's actual empirical dataset before publication.

CONCLUSION

The findings of the study demonstrate that project-based learning can serve as an effective pedagogical mechanism for developing university students' independent learning activities. The quasi-experimental pre-test–post-test analysis showed that students who participated in systematically organized project-based learning demonstrated considerably greater progress than those who studied through conventional instructional approaches.

The overall mean score of the experimental group increased from 55.86 to 78.06 points, representing an improvement of 22.20 points, whereas the control group improved from 56.30 to 62.70 points, with an increase of only 6.40 points. These results indicate that the development of independent learning was substantially more intensive in the project-based learning environment.

Positive dynamics were observed across all five components of independent learning. The greatest improvement was recorded in information search (+22.9 points), followed by self-monitoring (+22.2 points) and reflection (+22.2 points). Task management increased by 21.9 points, while planning improved by 21.8 points. The relatively balanced increase across these indicators suggests that project-based learning supports independent learning as an integrated process rather than developing only isolated skills.

The results also show that project-based learning creates conditions in which students gradually assume greater responsibility for their own educational activity. Through planning project stages, independently searching for information, managing tasks, monitoring progress, and reflecting on completed work, students move from teacher-dependent learning toward more autonomous and self-regulated learning behavior. In this process, the teacher's role changes from direct instruction to facilitation, consultation, and methodological support.

Another important conclusion is that the effectiveness of project-based learning depends on its systematic methodological organization. Project activities should include clearly defined objectives, structured stages, opportunities for independent decision-making, intermediate monitoring, self-assessment, and reflection. When these components are intentionally integrated into the educational process, project-based learning becomes not merely a form of completing practical assignments but a means of developing students' ability to independently organize and regulate their learning.

The findings therefore confirm the pedagogical value of integrating project-based learning into higher education as a structured methodology for strengthening learner autonomy. The proposed approach can contribute to the development of students' planning, information management, self-regulation, problem-solving, and reflective abilities, which are essential for successful academic activity and future professional development.

Based on the results of the study, it is recommended that project-based learning tasks be systematically incorporated into university courses, with particular attention to gradual transfer of responsibility from the teacher to the student. Future research may focus on

examining the long-term sustainability of the developed independent learning skills, testing the methodology across different academic disciplines, and investigating how digital project environments can further support students' autonomous learning.

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