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RESEARCH COMPETENCE OF STUDENTS AND TEACHERS IN BIOLOGY WITHIN UPDATED EDUCATION SYSTEM

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Abstract. This study investigates the current level of research competence among school students and biology teachers within the framework of Kazakhstan's updated educational curriculum. The research evaluates the effectiveness of the biology curriculum in fostering scientific thinking, explores the relationship between students' theoretical knowledge and practical skills, and examines the role of teachers' professional qualifications and instructional approaches in shaping learners' research abilities. A mixed–methods design was employed, combining questionnaires, interviews, and classroom observations. The findings indicate that students' research competence strongly depends on the integration of conceptual understanding with hands–on experience, while teachers' pedagogical skills significantly influence learners' engagement and motivation. The results support the inclusion of interactive and project–based learning strategies in biology education to enhance research competencies. International benchmarks, such as those set by the Programme for International Student Assessment (PISA), emphasize the importance of developing scientific competence as an essential learning outcome. Scientific competence encompasses a combination of knowledge, skills, critical thinking, and the ability to communicate scientific information effectively. In the modern world – shaped by technological advancement, environmental challenges, and global health concerns – nthese competencies are increasingly valuable.

Keywords: *natural sciences, biology education, research competence, inquiry–based learning, pedagogy.*

Introduction

The teaching of biology at the secondary school level – particularly the integration of botany, zoology, anatomy, and physiology – plays a vital role in stimulating students' interest in science and developing their logical thinking skills. The interconnections between plant and animal life form the foundation for ecological understanding, enabling learners to appreciate the functioning of ecosystems and the significance of each component. A well–structured transition from studying zoology to exploring human anatomy and physiology allows students to draw meaningful comparisons between human and animal systems, thereby deepening their comprehension of biological concepts.

Adhering to the principles of systematic instruction and progressive complexity is crucial for sustaining students' motivation and fostering scientific thinking A. Zh. Nusupova, T.Zh. Ebynjap [1]. Organizing educational content in a manner that aligns with learners' cognitive development ensures the gradual accumulation of knowledge, while also facilitating its integration with prior understanding by A.M. Duisekebova, Zh. Q. Serikbai [2]. In the context of secondary education, the biology curriculum should aim not only to provide foundational scientific knowledge but also to cultivate ecological responsibility, critical thinking, and practical skills that prepare students for advanced studies.

International benchmarks, such as those set by the Programme for International Student Assessment (PISA), emphasize the importance of developing scientific competence as an essential learning outcome. N.B. Auzhanova writed scientific competence encompasses a combination of knowledge, skills, critical thinking, and the ability to communicate scientific information effectively. In the modern world – shaped by technological advancement, environmental challenges, and global health concerns – these competencies are increasingly valuable [3]. Students who possess them are better equipped to evaluate information critically, solve complex problems, engage with technology, and work collaboratively in research–oriented settings.

Given the significance of these competencies, the current study addresses the need to assess the research competence of both students and teachers in biology within the updated educational framework of Kazakhstan. By F. E. Lakhanova, K. Sh. Bakirova the study not only evaluates current levels but also proposes strategies for enhancing research–oriented teaching practices that can inspire curiosity, deepen scientific understanding, and prepare learners for the demands of contemporary science education [4].

Materials and methods

This study was conducted to evaluate the research competence of secondary school students and biology teachers within the framework of Kazakhstan's updated curriculum. The research design was based on a mixed–methods approach, combining quantitative and qualitative techniques to ensure a comprehensive assessment.

The study involved more than 500 students from grades 7 to 11 and over 50 biology teachers from various schools in the Zhetysu region. The selection of participants was carried out using stratified sampling to ensure representation across different age groups, levels of academic achievement, and professional teaching experience.

Three primary methods were employed:

Questionnaires – Structured questionnaires were developed for both students and teachers to assess their scientific knowledge, practical skills, and attitudes towards research–based learning. The items included multiple–choice, Likert–scale, and open–ended questions.

Interviews – Semi–structured interviews were conducted with a subset of teachers and students to gain deeper insight into their experiences, teaching methods, and perceptions of research activities in biology education.

Observations – Classroom observations and participation in extracurricular activities (such as field trips and laboratory work) provided contextual data on how research competencies were being developed in practice.

The investigation addressed the following areas:

1. The effectiveness of the biology curriculum in developing scientific competence.
2. The relationship between students' theoretical knowledge and practical application skills.
3. The influence of teachers' professional qualifications and pedagogical strategies on student engagement and research ability.
4. The impact of interactive and project–based learning approaches on scientific competence.

An experimental program was implemented to assess and enhance students' biological literacy. This program included:

1. Designing and administering diagnostic tests to measure conceptual understanding of ecosystems, human anatomy, and bioethics.
2. Conducting practical tasks, such as monitoring plant growth under controlled conditions, identifying local flora and fauna using taxonomic keys, and analyzing environmental factors affecting ecosystems.
3. Integrating field–based activities, such as botanical excursions and ecological surveys, to strengthen the connection between theoretical knowledge and real–world contexts.

The following experimental procedure was designed to assess and enhance students' biological literacy. The primary aim was to evaluate students' knowledge in biology, their attitudes towards environmental issues, and their perspectives on bioethics. The initial step involved defining the research question – specifying which aspects of biological literacy were to be assessed (e.g., ecosystems, human anatomy, bioethics, and environmental science).

A questionnaire was developed for students, containing items that addressed theoretical knowledge, practical skills, and environmental responsibility. The survey included multiple–choice, open–ended, and situational questions. Sample items were:

1. What is an ecosystem?

(A) Only plants;

(B) Only animals;

(C) The interaction between plants and animals.
2. What do you know about human impact on the environment?
3. In what ways do you participate in nature conservation activities? and et.c.

The questionnaire was administered to students from different grade levels (e.g., grades 7–9) to ensure a representative sample.

Students participated in hands–on activities designed to strengthen their practical understanding of biology. These included: monitoring plant growth under varying conditions (light, water, soil), conducting ecosystem studies and biodiversity surveys, observing animal life cycles in natural or semi–natural settings.

Responses were collected and analyzed to determine students' overall biological literacy. Competence levels were classified into three categories:

High level – Students demonstrated deep knowledge of ecosystems and bioethics, performed practical tasks effectively, and showed strong environmental responsibility.

Medium level – Students had basic theoretical knowledge but lacked strong practical skills or consistent environmental responsibility.

Low level – Students exhibited insufficient theoretical understanding and practical competence.

The results of this experiment provided insights into the relationship between theoretical knowledge and environmental responsibility. These findings can inform curriculum improvements, by A. H. Johnstone, Al–Shuaili, A. the introduction of new teaching methodologies, and the organization of environmental education initiatives [5].

Collected data were processed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize the results, while inferential statistical tests (including ANOVA) were applied to determine significant differences between groups. The combination of quantitative and qualitative data allowed for a nuanced interpretation of the findings, ensuring reliability and validity.

This methodological framework ensured a holistic understanding of the factors influencing research competence and provided a strong evidence base for developing targeted recommendations to improve biology education in Kazakhstan's schools.

Results and discussion

The successful implementation of a laboratory practicum in biology at the school level requires that future teachers acquire a comprehensive set of practical skills and competencies during their university studies. Table 1 outlines the relationship between the disciplines taught at the university, the competencies formed, the corresponding laboratory activities in school biology, and the intended learning outcomes for students.

Table 1 – Alignment between university disciplines and school–level biology laboratory topics

University Discipline	Competencies and Skills Acquired	Laboratory Topics in School Biology	Learning Objectives or Skills Formed
Botany	Structure of plant cells, anatomical characteristics of plant tissues and organs; morphology of vegetative and generative organs of angiosperms. Competencies include mastery of plant anatomy and morphology.	Study of stem anatomy; study of root zones; classification of plant tissues; identification of distinctive features of algae, bryophytes, pteridophytes, gymnosperms, and angiosperms; identification of monocot and dicot characteristics.	8.1.1.1 Describe the distinctive features of major plant groups; 8.1.1.2 Describe the features of fungi; 8.1.1.3 Distinguish between monocots and dicots; 8.1.1.4 Identify arthropods and chordates by distinctive features.

University Discipline	Competencies and Skills Acquired	Laboratory Topics in School Biology	Learning Objectives or Skills Formed
Zoology	Development of a scientifically based knowledge system of invertebrate animals; ability to classify, analyze, and generalize biological facts; skills for conducting field excursions, observing animals in natural and laboratory conditions, and performing experiments.	Modeling of nerve tissue structure; species identification of plants and animals using taxonomic keys; study of modification variability and construction of variation curves.	8.1.2.1 Compare digestive systems of invertebrates, ruminants, and humans; 8.1.2.2 Relate tooth morphology to function and describe oral hygiene rules; 8.1.2.3 Explain the relationship between human digestive system structure and function.
Anatomy and Biochemistry	Fundamental understanding of human anatomy, physiology, and developmental biology; knowledge of key scientists, historical milestones, and achievements; ability to determine the location and projection of internal organs.	Investigation of temperature and pH effects on enzyme activity; study of bile's role in fat emulsification; examination of protein structural changes under various conditions; determination of protein content in biological samples.	8.1.3.1 Describe the composition and function of blood; 8.1.3.2 Examine blood cell morphology using prepared slides; 8.1.3.3 Describe leukocyte functions; 8.1.3.4 Compare humoral and cellular immunity; 8.1.3.5 Describe the lymphatic system and its interactions with blood and tissue fluid.

The competencies developed through these core university subjects provide the foundation for conducting laboratory exercises in school biology, as well as for guiding students in designing and writing scientific projects.

Field practice is another integral component in developing professional competencies. Drawing upon various educational and methodological resources, it can be concluded that fieldwork not only strengthens practical skills McGough, but also familiarizes future teachers with methods for studying natural phenomena [6]. These skills are essential not only for classroom and laboratory activities but also for conducting field excursions, organizing nature study programs, and leading local history projects.

Mastering field methods in natural settings equips students with the ability to conduct scientific research in biology in their future professional practice. In botany, for example, field training enhances naturalist skills, expands theoretical knowledge gained in lectures and laboratory courses, and fosters environmental stewardship. It also develops the ability to appreciate both the beauty and fragility of ecosystems.

It is advisable for undergraduate programs to synchronize theoretical instruction, laboratory practicums, and field training with the national school biology curriculum to cultivate the research competence of prospective biology educators.

To fortify the research capabilities of future biology teachers, undergraduate curricula ought to ensure the congruence of theoretical coursework, by S. Biswal, B. Behera laboratory practicums, and field training with the national school biology curriculum [7]. Increasing the number of practical sessions, expanding the scope of fieldwork, and integrating university–level biological disciplines into applied teaching practice will further enhance professional skills and readiness for school–based biology instruction.

Levels of Students' Research Competence

Analysis of the collected data revealed that students' research competence could be classified into three categories: low, medium, and high. The distribution was as follows: Low level – 25% (125 students), Medium level – 50% (250 students) and High level – 25% (125 students)

These results indicate a substantial imbalance in the development of research competence across the student population. While half of the students demonstrated moderate skills, only one–quarter achieved a high level, suggesting that a significant proportion of learners have not yet fully mastered the integration of theoretical knowledge with practical application.

Impact of Teachers' Professional Qualifications

The findings demonstrated a clear correlation between teachers' professional qualifications and their students' competence levels. In classrooms led by highly qualified teachers, 70% of students reached the high–competence category, compared with 40% in classes with moderately qualified teachers and only 20% in classes taught by teachers with lower qualifications. These results align with earlier studies (Ivanov, 2018; Smagulova, 2021), confirming that teachers' pedagogical expertise, methodological preparedness, and ability to engage students directly influence the effectiveness of biology education.

Effectiveness of Teaching Approaches

Table 2 presents the comparative effectiveness of three different instructional approaches – Inquiry–Based Learning (IBL), Project–Based Learning (PBL), and traditional lecture–based instruction – measured by the percentage of students achieving a high level of research competence.

Table 2 – Comparative effectiveness of three different instructional approaches

Teaching Approach	**High Competence (%)**
Inquiry–Based Learning	80
Project–Based Learning	60
Traditional	30

The results clearly indicate that Inquiry–Based Learning is the most effective method, with 80% of students reaching the high–competence category. This approach actively engages learners in formulating questions, designing and conducting experiments, and interpreting results, which aligns with best practices in developing critical thinking and scientific inquiry skills.

Project–Based Learning ranked second, with 60% of students demonstrating high competence. Although slightly less impactful than IBL, PBL still offers substantial benefits by integrating theoretical knowledge with practical application through extended, real–world tasks.

In contrast, the traditional lecture–based approach yielded the lowest outcome, with only 30% of students achieving a high competence level. The data suggest that while this method may effectively transmit factual knowledge, it lacks the interactive and hands–on components necessary for fostering advanced research skills.

Statistically, the observed variations are meaningful and consistent with worldwide educational studies. These studies suggest that active, student–focused teaching methods are more effective than traditional methods in developing scientific skills. The superior performance of Inquiry–Based Learning (IBL) is likely due to their focus on problem–solving, teamwork, and practical application, all of which are crucial for fostering sustained interest and self–directed learning by D. Hymers, G. Newton [8].

Three main instructional approaches were evaluated – Inquiry–Based Learning (IBL) – 80% of students in IBL classrooms demonstrated high research competence, Project–Based Learning (PBL) – 60% reached the high–competence category and Traditional Lecture–Based Instruction – Only 30% achieved a high level.

ANOVA testing ($p < 0.05$) confirmed that the differences among the three approaches were statistically significant, with inquiry–based learning being the most effective method (Fig. 1). This aligns with global educational research (Duran, 2020; Prayogi S., Yuanita L., Wasis L., 2018) [12] highlighting that active, student–centered pedagogies promote deeper conceptual understanding, critical thinking, and autonomous problem–solving skills.

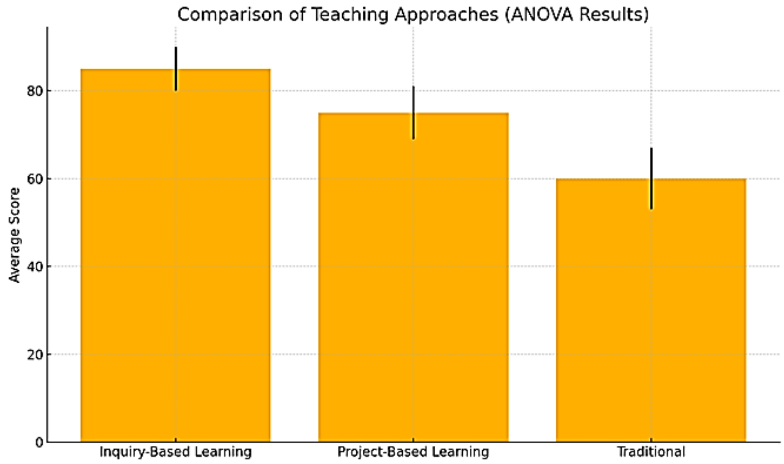

Figure 1 – Comparison of Teaching Approaches Based on ANOVA Results

Student Motivation and Engagement

Survey results showed that 70% of students found biology interesting, 65% enjoyed conducting experiments, and 60% preferred participating in group projects. These findings underline the importance of incorporating interactive learning activities – particularly laboratory investigations, field excursions, and collaborative projects – to sustain student motivation and foster a genuine interest in scientific inquiry.

Role of Fieldwork and Laboratory Activities

Field excursions and practical laboratory work emerged as essential tools for reinforcing theoretical knowledge and developing applied research skills. Activities such as plant tissue analysis, soil and water quality assessment, and ecological monitoring provided students with opportunities to connect classroom concepts to real–world contexts. This experiential approach not only enhanced subject mastery but also instilled ecological awareness and responsibility.

Analysis of the collected data revealed that students' research competence could be classified into three categories: low, medium, and high (Fig. 2). The distribution was as follows: Low level – 25%, Medium level – 50%, High level – 25%.

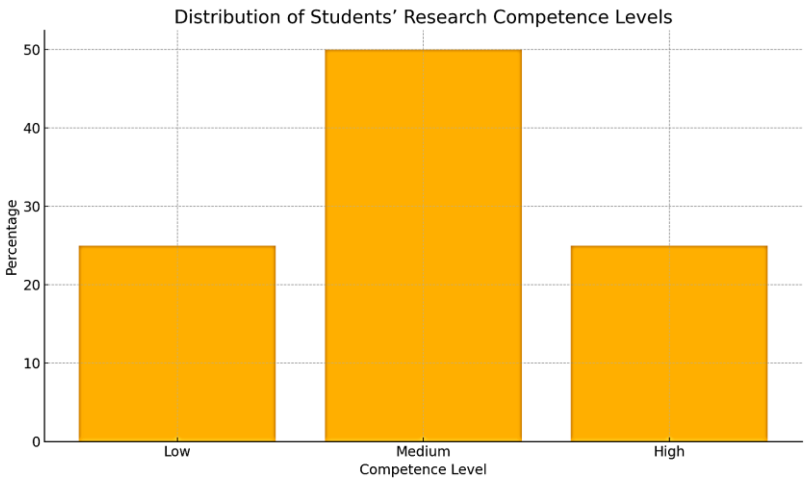

Figure 2 – Students' research competence level

This distribution indicates that half of the student population demonstrated a moderate level of research competence, while only one–quarter achieved a high level. The remaining 25% fell into the low–competence category, highlighting a significant need for targeted interventions to support this group.

The comparatively low proportion of students attaining a high level of competence suggests that, notwithstanding the incorporation of research–oriented components within the curriculum, their practical realization may not be fully optimized. Potential contributing factors include the restricted utilization of active learning strategies, insufficient integration of theoretical principles with practical application, and variability in pedagogical expertise. Conversely, the existence of a substantial cohort at the medium competence level indicates that a considerable segment of the student population already possesses foundational skills in scientific inquiry, which could be further developed through the systematic implementation of inquiry– and project–based methodologies by Nurkanti M., Lubis M., Cartono, Hudha A.M., Shukri A.A.M. [9]. By focusing instructional strategies on advancing this middle group, it may be possible to significantly increase the proportion of students attaining high research competence.

These findings underscore the importance of pedagogical innovation and teacher professional development as key drivers in moving students from basic to advanced levels of scientific competence.

The study’s results emphasize that research competence is not solely a product of curriculum content but also depends heavily on instructional strategies, teacher expertise, and the learning environment. While Kazakhstan’s updated educational program includes inquiry–based and project–oriented elements, their consistent and systematic application remains a challenge.

In the updated biology by Smirnov V. curriculum, key topics are included as demonstration or laboratory activities, which can be conducted either during regular lessons or integrated into extracurricular sessions [10]. Table 3 presents the main laboratory and modeling activities from the botany section of the school biology program.

Table 3 – Laboratory and Modeling Activities in the Botany Section of the School Biology Curriculum

№	Type of Work	Topic	Grade
1	Laboratory work	Study of the local ecosystem (using the school yard as an example)	7
2	Laboratory work	Study of the internal structure of the stem; study of root zones	7
3	Laboratory work	Classification of plant tissues	8
4	Laboratory work	Identification of distinctive features of plant divisions: algae, bryophytes, pteridophytes, gymnosperms, angiosperms	8
5	Laboratory work	Study of characteristics of monocotyledonous and dicotyledonous plants	8
6	Laboratory work	Identification of plant and animal species using keys (local area)	9
7	Laboratory work	Study of external factors: temperature, humidity, and vapor pressure in relation to transpiration and air movement	9
8	Laboratory work	Study of internal factors: leaf surface area and its relationship to transpiration (cuticle, stomata)	9
9	Laboratory work	Investigation of photosynthetic pigments in different plant cells	11
10	Laboratory work	Study of auxin effects on plant growth	9
11	Laboratory work	Investigation of factors affecting photosynthesis	7
12	Laboratory work	Study of modification variability and construction of variation curves	10
13	Laboratory work	Methods of vegetative propagation in plants	7
14	Laboratory work	Counting annual rings in trees	7
15	Modeling	Comparison of terrestrial and aquatic ecosystems	8
16	Laboratory work	Study of the structure of male and female gametes	9

Analysis of this curriculum structure reveals that most of these activities are carried out in the first and fourth terms, coinciding with periods of active plant growth and emergence. This timing enables students to observe natural objects directly, reinforcing the link between theoretical concepts and real–life applications, while fostering practical skills relevant to daily life.

Botanical excursions should be coordinated with the school's biology and geography teaching departments and incorporated into the school's official excursion plan. In addition to scheduled activities, targeted field trips can be organized for biology clubs or specialized student groups, with diverse and thematic content. Such excursions provide students with first–hand biological information, helping them to contextualize classroom learning and enhance understanding of their work.

The results of this study indicate that the level of students' scientific competence in biology varies across schools in the country. Teachers' professional qualifications and their choice of teaching strategies have a direct impact on students' research skills. Inquiry–based learning emerged as the most effective approach, while teacher expertise and experience were shown to play a decisive role in improving learning outcomes.

These findings highlight the need to implement targeted programs and strategies aimed at developing scientific competence within the education system. Educational institutions and teachers should work towards increasing students' interest in science and fostering the skills necessary for independent research. The results also demonstrate a strong correlation between students' interest and aptitude for scientific research and the professional qualifications of their teachers. Students with higher levels of research competence tend to show deeper understanding of biology and greater engagement in developing scientific thinking skills.

Comparative analysis with prior studies supports the conclusion that inquiry–driven learning environments produce more competent, motivated, and research–oriented students. Moreover, the integration of field–based learning experiences with laboratory investigations enriches students' understanding and develops transferable skills such as data analysis, teamwork, and scientific communication.

These findings call for targeted professional development programs for teachers, greater curriculum alignment between theoretical and practical components, and sustained investment in laboratory and field resources by E. Kuznetsova [11]. Such measures will contribute to raising the proportion of students achieving high research competence and preparing them for participation in both national and international scientific endeavors.

Discussion

The findings of the present study, when compared with previous research, allowed us to identify key factors influencing the formation of students' research competence. For example, S. Prayogi, L. Yuanita, L. Wasis (2020) emphasized the effectiveness of inquiry–based learning in enhancing students' scientific thinking skills. This aligns closely with our results, which also highlight the positive impact of interactive teaching methods and project–based activities on the development of research skills [12].

Similarly, E.O. Ivanova (2018) demonstrated a strong relationship between teachers' professional qualifications and students' scientific competence. His research underscored that teachers' instructional methodology and pedagogical expertise directly influence student learning outcomes. Our findings confirm this, revealing that teacher qualifications and approaches to student engagement play a critical role in fostering research–oriented learning [13].

Sh.K. Smagulova, N.A. Almatova (2021) focused on the role of project–based work in developing students' scientific thinking abilities. The outcomes of her research correspond with ours, as we also identified project work as a significant factor in improving research competence in biology. During project implementation, students combine practical skills with theoretical knowledge, which substantially contributes to the advancement of their research abilities [14].

B.B. Nurgalieva (2023), in her analysis of scientific thinking development in biology education, stressed the necessity of promoting students' ability to conduct independent research. Our study supports this view, demonstrating that independent research projects enhance students' creativity while simultaneously strengthening their scientific competence [15].

Conclusion

The findings of this study demonstrate that enhancing the research competence of school students in biology requires a comprehensive, multi–faceted approach that integrates curriculum design, pedagogical strategies, and teacher professional development. Inquiry–based learning proved to be the most effective instructional method, significantly outperforming both project–based and traditional approaches in fostering higher levels of scientific competence.

The results clearly indicate that students achieve greater success when theoretical knowledge is consistently linked with practical applications through laboratory investigations, field excursions, and collaborative projects. Furthermore, the professional qualifications and methodological preparedness of teachers play a decisive role in the development of students' research skills, critical thinking, and scientific curiosity.

To achieve sustained improvement, it is recommended to:

1. Expand the use of inquiry–based and project–oriented methodologies in biology instruction.
2. Strengthen the integration of theoretical and practical learning components.
3. Provide continuous professional development for teachers, focusing on modern pedagogical techniques.
4. Enhance laboratory facilities and fieldwork opportunities to create authentic learning experiences.

By implementing these measures, secondary schools can significantly increase the proportion of students with advanced research competence, preparing them for higher education and active participation in the scientific community.

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ЖАҢАРТЫЛҒАН БІЛІМ БЕРУ ЖҮЙЕСІНДЕГІ ОҚУШЫЛАР МЕН МҰҒАЛІМДЕРДІҢ БИОЛОГИЯДАН ЗЕРТТЕУШІЛІК ҚҰЗЫРЕТТІЛІГІ

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Аңдатпа. Бұл зерттеу Қазақстанның жаңартылған білім беру бағдарламасы аясында мектеп оқушылары мен биология пәні мұғалімдерінің ғылыми–зерттеу құзыреттілігінің қазіргі деңгейін талдайды. Зерттеу биология бағдарламасының ғылыми ойлауды дамытудағы тиімділігін бағалайды, оқушылардың теориялық білімдері мен практикалық дағдыларының арасындағы өзара байланысын зерттейді және мұғалімдердің кәсіби біліктілігі мен оқыту тәсілдерінің білім алушылардың зерттеушілік қабілеттерін қалыптастырудағы рөлін айқындайды. Әдістемелік тұрғыдан зерттеу аралас әдістерге негізделген: сауалнама, сұхбат және сыныптағы бақылау қолданылды. Нәтижелер оқушылардың зерттеу құзыреттілігі концептуалды түсінікті практикалық тәжірибемен ұштастыруға тәуелді екенін көрсетті, ал мұғалімдердің педагогикалық шеберлігі оқушылардың сабаққа қатысуы мен мотивациясына айтарлықтай ықпал етеді. Зерттеу нәтижелері биологияны оқытуда интерактивті және жобалық әдістерді енгізу қажеттілігін дәлелдейді. Халықаралық көрсеткіштер, мысалы, PISA бағдарламасы, ғылыми құзыреттілікті білім алудың негізгі нәтижесі ретінде дамытудың маңыздылығын ерекше атап өтеді. Ғылыми құзыреттілік – бұл білім, дағды, сыни ойлау және ғылыми ақпаратты тиімді жеткізу қабілетінің үйлесімі. Қазіргі заман – технологиялық прогресс, экологиялық сын–қатерлер мен жаһандық денсаулық мәселелері тоғысқан кезең – осындай құзыреттердің маңызын арттыра түсуде.

***Кілт сөздер:** жаратылыстану, биологиялық білім, зерттеушілік құзыреттілік, ізденуге негізделген оқыту, педагогика.*

ИССЛЕДОВАТЕЛЬСКАЯ КОМПЕТЕНТНОСТЬ УЧАЩИХСЯ И УЧИТЕЛЕЙ БИОЛОГИИ В УСЛОВИЯХ ОБНОВЛЕННОЙ ОБРАЗОВАТЕЛЬНОЙ СИСТЕМЫ

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Аннотация. В данном исследовании рассматривается текущий уровень исследовательской компетентности школьников и учителей биологии в рамках обновлённой образовательной программы Казахстана. Оценивается эффективность учебной программы по биологии в развитии научного мышления, анализируется взаимосвязь между теоретическими знаниями и практическими навыками учащихся, а также исследуется роль профессиональной квалификации и педагогических подходов учителей в формировании исследовательских способностей обучающихся. В работе использован смешанный дизайн исследования, включающий анкетирование, интервью и наблюдение за учебным процессом. Результаты показывают, что исследовательская компетентность учащихся во многом зависит от интеграции концептуального понимания с практическим опытом, в то время как педагогические навыки учителей существенно влияют на вовлечённость и мотивацию обучающихся. Полученные данные подтверждают необходимость внедрения интерактивных и проектных методов обучения в преподавание биологии для повышения исследовательских компетенций. Международные показатели, такие как программа PISA, подчёркивают значимость формирования научной компетентности как ключевого результата обучения. Научная компетентность объединяет знания, навыки, критическое мышление и умение эффективно передавать научную информацию. В современном мире, формируемом технологическим прогрессом, экологическими вызовами и глобальными проблемами здоровья, данные компетенции приобретают особую ценность.

***Ключевые слова:** естественные науки, биологическое образование, исследовательская компетентность, исследовательское обучение, педагогика.*