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ANALYSIS OF SCIENTIFIC RESEARCH ON THE DEVELOPMENT OF SCIENTIFIC LITERACY IN GENERAL SECONDARY EDUCATION

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Abstract

This article scientifically and pedagogically analyzes modern methodological approaches aimed at developing students' scientific literacy in the general secondary education system. In particular, based on the analysis of scientific research conducted by scholars of our republic, effective methodological mechanisms for organizing the teaching process of natural sciences on an integrative, practice-oriented, and innovative basis are revealed. The article also substantiates the didactic opportunities for developing students' scientific thinking, problem-solving skills, evidence-based reasoning, and the ability to apply knowledge in practical situations.

Keywords: Scientific literacy, natural sciences, integrative approach, competency-based approach, scientific thinking, research competence, interdisciplinary integration, innovative educational technologies, problem-based learning, functional literacy, practical skills, international assessment programs.

Introduction

In the modern education system, the formation and development of students' natural-scientific literacy skills is considered one of the most important pedagogical tasks. In particular, during the teaching of natural sciences at the level of general secondary education, it is of special importance to develop students' abilities to explain natural phenomena on a scientific basis, conduct observations and experiments, analyze obtained results, and apply knowledge in practical situations.





In this process, organizing the educational content while taking into account students' age and psychological characteristics, integrating learning activities with research and practical work, and using effective methodological approaches are considered important factors. Therefore, improving the methodology of teaching natural sciences, developing students' scientific thinking, and conducting scientific research aimed at forming natural-scientific literacy skills are recognized as one of the key directions in pedagogical science. Below, scientific research conducted in this field and their results are analyzed. In the Republic, several scholars have conducted scientific research on the development of students' knowledge and skills in natural sciences. For instance, in her research titled "Methodology for Using Assessment Programs in Monitoring Students' Natural-Scientific Literacy (Based on PISA and TIMSS)", M.T.Ergasheva thoroughly examines the theoretical and pedagogical foundations of monitoring students' natural-scientific literacy based on international assessment programs, their methodological mechanisms, and the possibilities of integrating them into the educational process¹. The study scientifically investigates not only the assessment of students' knowledge through PISA and TIMSS tasks, but also the identification, analysis, and development of their functional competencies. The approaches proposed by the researcher emphasize teaching natural sciences on the basis of integrative "Science," using assessment as a monitoring tool, and developing students' functional literacy.

In our view, the scientific approaches proposed by M.T. Ergasheva demonstrate the necessity of fundamentally improving the assessment system in the development of students' natural-scientific literacy. In particular, it is important to organize the assessment process not only as a control tool, but also as a didactic mechanism for developing students' scientific thinking, to systematically integrate PISA and TIMSS tasks into the educational process, and to strengthen interdisciplinary connections.

Furthermore, in school practice, it is necessary to move away from relying solely on test-based results and to increase the proportion of tasks aimed at analysis

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and conclusion-making based on various forms of data presentation such as texts, tables, graphs, and experimental results. This enables students not only to acquire knowledge, but also to develop competencies in applying knowledge in different situations, solving problem-based tasks, and making scientifically grounded decisions.

In her research titled “Development of Teachers’ Methodological Preparation in Teaching Natural Sciences (Science)”, B.A. Amirullayeva scientifically addresses the improvement of teachers’ professional and methodological training based on interdisciplinary integration and a constructive approach. The study develops mechanisms for improving teachers’ methodological competencies through integrative “Science” teaching models, the 5E model, problem-based learning, and project-based educational technologies. The researcher proposes a didactic model, a practical-technological system, and integrated methodological approaches within the system of continuous professional development for teachers. In addition, based on the research findings, curricula, methodological manuals, and professional development course content were improved and implemented in practice. Olib borilgan tahlillar asosida qayd etish mumkinki, A.Amrullayeva tomonidan ilgari surilgan yondashuvlar tabiiy fanlarni o‘qitishda o‘qituvchilarning kasbiy kompetensiyalarini tizimli ravishda rivojlantirish, ta’lim jarayonini integrativ va amaliy yo‘naltirilgan asosda tashkil etish hamda o‘quvchilarda ilmiy tafakkur va funksional savodxonlikni shakllantirishning muhim metodik asosini tashkil etadi.

A.A. Ismailovning “Tayanch o‘rta ta’lim sifatini baholashning tashkil etish mexanizmini PISA xalqaro dasturi talablari asosida takomillashtirish” deb nomlangan dissertasiya ishida tabiiy-ilmiy savodxonlikni baholashga qaratilgan ilmiy tadqiqotlari natijalari olim tomonidan olib borilgan ikki bosqichli tadqiqot doirasida o‘tkazilgan test natijalarining tahlili o‘quvchilarda tabiiy-ilmiy savodxonlik komponentlarining rivojlanishida turlicha dinamika mavjudligini ko‘rsatgan. Tadqiqotda PISA dasturining metodologik asoslari, kompetensiyaviy yondashuv hamda xalqaro baholash

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mexanizmlarini milliy ta'lim tizimiga integratsiya qilishning nazariy va tashkiliy jihatlari asoslab berilgan.²

Tadqiqot natijalarini tahlil qilish shuni ko'rsatadiki, mazkur yondashuv ta'lim sifatini baholash tizimini xalqaro standartlar bilan uyg'unlashtirish, o'quvchilarning funksional savodxonligini aniqlash va rivojlantirish hamda ta'lim jarayonini samarali boshqarishning muhim ilmiy-metodik asosini tashkil etadi.

Tadqiqotchi Z.M.Sangirovaning "Umumta'lim maktablarida STEAM yondashuvi asosida o'quv loyiha ishlarini tashkil etish metodikasi (tabiiy fanlarni o'qitish misolida)" nomli dissertatsiyasida umumta'lim maktablarida tabiiy fanlarni o'qitish jarayoniga zamonaviy pedagogik texnologiyalarni, xususan, STEAM yondashuvini joriy etish orqali o'quvchilarni amaliy hamda innovatsion faoliyatga yo'naltirish masalalari yoritilgan. Unda o'quvchilarda tanqidiy fikrlash, muammolarni hal etish va jamoaviy hamkorlikda ishlash ko'nikmalarini shakllantirishga qaratilgan metodik yondashuvlar ishlab chiqilgan. Muallif ta'kidlashicha, tabiiy fanlarni integrativ asosda o'qitish o'quvchilarda tabiiy-ilmiy, texnik, ekologik va iqtisodiy savodxonlikni shakllantirish bilan birga, tanqidiy hamda ijodiy fikrlashni rivojlantirishga xizmat qiladi. Shuningdek, fanlararo integratsiya orqali tabiatni yaxlit tizim sifatida anglash va o'quvchilar tafakkurida olamning yagona tabiiy-ilmiy manzarasini shakllantirish imkoniyati yuzaga keladi.³

Z.R.Xamidova tomonidan olib borilgan "STEAM ta'lim texnologiyalari vositasida 6-sinf tabiiy fanlarni o'qitish metodikasini takomillashtirish" mavzusidagi tadqiqot ishida tabiiy fanlarni o'qitishda STEAM yondashuvining nazariy-metodologik asoslari, fanlararo integratsiya hamda kompetensiyaviy yondashuv asosida metodik tizimi ishlab chiqilgan. Tadqiqotda 5E va 3C+2E modellari, loyiha asosida o'qitish hamda muammoli vaziyatlar orqali o'quvchilarning ilmiy tafakkuri va tabiiy-ilmiy savodxonligini rivojlantirish mexanizmlari asoslangan. Tadqiqot natijalari STEAM texnologiyalari asosida

² A.A. Ismailov "Tayanch o'rta ta'lim sifatini baholashning tashkil etish mexanizmini PISA xalqaro dasturi talablari asosida takomillashtirish" ped.fan. PhD diss. avtoreferat Toshkent 2022-53b

³ Z.M.Sangirova "Ummumta'lim maktablarida STEAM yondashuvi asosida o'quv loihalarini tashkil etish metodikasi". ped.fan. PhD diss. Chirchiq 2022-117-b



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tashkil etilgan ta'lim jarayonida o'quvchilarning fanlararo bilimlarni integratsiyalash, muammoni hal qilish, ilmiy fikrlash va amaliy faoliyatga yo'naltirilgan kompetensiyalarining sezilarli darajada rivojlanganligini ko'rsatadi.⁴

O'rganishlar natijasida quyidagi xulosaga kelish mumkin, Z.M.Sangirova va Z.R.Xamidova tomonidan ilgari surilgan yondashuvlar tabiiy fanlarni o'qitishda STEAM texnologiyalari asosida fanlararo integratsiyani ta'minlash, ta'lim jarayonini amaliy va kompetensiyaga yo'naltirilgan asosda tashkil etish hamda o'quvchilarda tanqidiy fikrlash, muammoni hal etish va ilmiy tafakkurni rivojlantirishning muhim metodik asosini tashkil etadi. Shu bilan birga, mazkur yondashuvlar o'quvchilarning tabiiy-ilmiy savodxonligini kompleks rivojlantirish va ta'lim jarayonining samaradorligini oshirishga yo'naltirilgan tizimli pedagogik mexanizm sifatida namoyon bo'ladi.

L.M. Qaraxonova tomonidan olib borilgan "Umumiy o'rta ta'lim maktablari biologiya darslarida o'quvchilarning tadqiqotchilik kompetensiyasini rivojlantirishning metodik asoslarini takomillashtirish" mavzusidagi tadqiqot ishida biologiya ta'limi jarayonida o'quvchilarning tadqiqotchilik kompetensiyasini shakllantirishning nazariy-metodologik asoslari, pedagogik-psixologik shart-sharoitlari hamda didaktik imkoniyatlari yoritilgan. Tadqiqotda kompetensiyaviy yondashuv asosida tadqiqotchilik faoliyatini tashkil etish, ilmiy izlanish va fanlararo integratsiya orqali o'quvchilarning ilmiy tafakkuri hamda amaliy ko'nikmalarini rivojlantirish mexanizmlari ishlab chiqilgan. Tadqiqot natijalari o'quvchilarning muammoni anglash, axborotni izlash va tahlil qilish, tajriba o'tkazish hamda natijalarni asoslab himoya qilish ko'nikmalari rivojlanganligini ko'rsatadi. Shuningdek, kichik tadqiqotlar va loyiha ishlari asosida tashkil etilgan ta'lim jarayoni tadqiqotchilik kompetensiyasini shakllantirishda samarali natija bergan.⁵

Tahliliy natijalar shuni ko'rsatadiki, mazkur yondashuv biologiya ta'limi jarayonida o'quvchilarning tadqiqotchilik kompetensiyasini rivojlantirish,

⁴ Z.R.Xamidova STEAM ta'lim texnologiyalari vositasida 6-sinf tabiiy fanlarni o'qitish metodikasini takomillashtirish ped.fan. PhD diss. avtoreferat Toshkent 2025-59b

⁵ L.M. Qaraxonova, "Umumiy o'rta ta'lim maktablari biologiya darslarida o'quvchilarning tadqiqotchilik kompetensiyasini rivojlantirishning metodik asoslarini takomillashtirish": ped. fan. bo'yicha falsafa doktori (PhD) dis. ... avtoref. – Toshkent, 2023. – 67 b.

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ularni mustaqil ilmiy tafakkurga yo‘naltirish hamda nazariya va amaliyot uyg‘unligini ta‘minlashda ustuvor metodik omil sifatida namoyon bo‘ladi.

K.T.Suyarovning “Fizik eksperimentlar asosida o‘quvchilarda o‘quv-tadqiqotchilik ko‘nikmalarini rivojlantirish” mavzusidagi dissertatsiyasida o‘quvchilarning mustaqil fikrlashini rivojlantirish, ilmiy izlanishga qiziqishini kuchaytirish hamda muammoni aniqlash va uni samarali hal etish ko‘nikmalarini shakllantirishga oid masalalar keng qamrovda tahlil etilgan⁶.

Sh.T.Raxmonov tomonidan olib borilgan “Ixtisoslashtirilgan umumiy o‘rta ta‘lim maktablari 7-9-sinf o‘quvchilarini xalqaro PISA tadqiqotlariga tayyorlash (tabiiy fanlar misolida)” mavzusidagi tadqiqot ishida o‘quvchilarni PISA xalqaro baholash dasturlariga tayyorlashning nazariy-metodologik asoslari, pedagogik shart-sharoitlari hamda metodik mexanizmlari yoritilgan. Tadqiqotda o‘quvchilarning bilimlarini hayotiy vaziyatlarda qo‘llash, kimyoviy hodisalarni ilmiy tushuntirish, tahlil qilish va ijodiy fikrlash kompetensiyalarini shakllantirishga qaratilgan yondashuvlar ishlab chiqilgan. Tadqiqot natijalari o‘quvchilarning nostandart vaziyatlarda muammoni hal etish, dalillarni tahlil qilish, tajriba natijalarini izohlash hamda bilimlarini amaliyotda qo‘llash ko‘nikmalari rivojlanganligini ko‘rsatadi. Shuningdek, PISA topshiriqlari asosida ishlab chiqilgan variativ o‘quv-metodik materiallar hamda zamonaviy pedagogik texnologiyalarni qo‘llash ta‘lim samaradorligini oshirishda ijobiy natija bergan.⁷

Tahliliy natijalar shuni ko‘rsatadiki, eksperiment va PISAgga yo‘naltirilgan metodik yondashuvlar nafaqat o‘quvchilarning tabiiy-ilmiy savodxonligini oshiradi, balki ularning mustaqil fikrlashini rivojlantiradi, muammoni hal etish ko‘nikmalarini shakllantiradi hamda bilimlarni amaliy faoliyatda qo‘llash kompetensiyalarini kuchaytiradi. Shu nuqtai nazardan, umumta‘lim maktablarida dars jarayoniga eksperiment va xalqaro baholash topshiriqlari elementlarini keng joriy etish, o‘quv-metodik materiallar mazmunini boyitish

⁶ Suyarov K.T. Fizik eksperimentlar asosida o‘quvchilarda kuzatuvchanlik va tadqiqotchilik ko‘nikmalarini rivojlantirish: ped. fan. (PhD) diss. – Chirchiq, 2019. – 124 b.

⁷ Raxmonov, Sh.T. “Ixtisoslashtirilgan umumiy o‘rta ta‘lim maktablari 7–9-sinf o‘quvchilarini xalqaro PISA tadqiqotlariga tayyorlash (tabiiy fanlar misolida)”: pedagogika fanlari bo‘yicha falsafa doktori (PhD) dissertatsiyasi avtoreferati. – Samarqand: Islom Karimov nomidagi Toshkent davlat texnika universiteti, 2023. – 47 b.

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hamda baholash tizimini kompetensiyaga yo‘naltirilgan mezonlar asosida takomillashtirish zarur.

Xulosa qilib aytganda, umumiy o‘rta ta’lim tizimida o‘quvchilarning tabiiy-ilmiy savodxonligini rivojlantirish zamonaviy ta’limning ustuvor yo‘nalishlaridan biri hisoblanadi. Tahlil qilingan ilmiy tadqiqotlar natijalari shuni ko‘rsatadiki, tabiiy fanlarni o‘qitishda integrativ, kompetensiyaviy, STEAM hamda PISA talablari asosidagi metodik yondashuvlardan foydalanish o‘quvchilarning ilmiy tafakkuri, tadqiqotchilik ko‘nikmalari, muammoni hal etish hamda bilimlarni amaliyotda qo‘llash kompetensiyalarini samarali rivojlantirish imkonini beradi. Shu bilan birga, xalqaro baholash dasturlari asosida ishlab chiqilgan topshiriqlar, eksperiment va loyiha faoliyatiga yo‘naltirilgan ta’lim texnologiyalari o‘quvchilarning funksional savodxonligini shakllantirishda muhim didaktik vosita sifatida namoyon bo‘ladi.

Shu nuqtai nazardan, umumta’lim maktablarida tabiiy fanlarni o‘qitish jarayonini innovatsion pedagogik texnologiyalar asosida tashkil etish, fanlararo integratsiyani kuchaytirish, baholash tizimini kompetensiyaviy mezonlar asosida takomillashtirish hamda o‘quvchilarni mustaqil ilmiy faoliyatga yo‘naltirish tabiiy-ilmiy savodxonlikni rivojlantirishning muhim omili hisoblanadi.

Foydalanilgan adabiyotlar

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