Рекомендуемая структура исследовательских работ

Рекомендуемый объем исследовательского отчета — не более 2000 слов

Секция	Описание
Автор	Kurmangaliyeva Aimira, Nursultanova Karakozaiym, Jacobs Selwyn
Тема	*Interdisciplinary Approaches to Teaching Analytical Skills: Evaluating the Impact of Targeted Strategies on Scientific Experimentation Proficiency in Physics, Chemistry and Biology*
Аннотация (150–250 слов)	In 2024, the NIS Paper 3 science examination underwent a significant transformation, shifting from a practical, hands-on format to a written, paper-based assessment. This reform required a re-evaluation of how analytical and experimental skills are taught in Physics, Chemistry, and Biology. Recognizing that the new format emphasizes planning, data analysis, and evaluation over physical manipulation, three subject teachers collaboratively initiated a research project titled *"Interdisciplinary Approaches to Teaching Analytical Skills: Evaluating the Impact of Targeted Strategies on Scientific Experimentation Proficiency in Physics, Chemistry and Biology."* The study aimed to design and evaluate an interdisciplinary teaching strategy to strengthen students' analytical and evaluative skills in alignment with the revised Paper 3 requirements. An initial analysis of the 2024 exam results revealed subject-specific weaknesses associated with the new structure. In response, a tailored intervention was implemented, integrating digital tools, interactive simulations, inquiry-based activities, structured response templates, and collaborative assessment methods, including rubrics, peer review, and self-assessment. This interdisciplinary framework fostered consistency in skill development across all three sciences while accounting for their distinct content demands. Post-intervention assessments demonstrated notable improvements in students' ability to plan, analyze, and evaluate scientific investigations. Statistical analysis confirmed measurable gains, while qualitative feedback from surveys and interviews highlighted increased clarity of expectations, greater autonomy, and stronger engagement. Students particularly valued the diversified, student-centered approaches, which encouraged transferable skills applicable across scientific disciplines. The study concludes that a differentiated, multi-method, and interdisciplinary strategy substantially enhances students' proficiency in addressing the analytical demands of the restructured Paper 3. The findings support ongoing cross-disciplinary collaboration among science educators, the integration of formative assessment tools, and professional development focused on designing engaging analytical tasks. This research contributes to the growing body of evidence advocating for interdisciplinary and active learning approaches within science education reform.
Актуальность и обоснование проблемы	The development of analytical reasoning in experimental contexts is a core objective of upper-secondary science education. Modern assessment frameworks increasingly emphasize planning, data interpretation, error evaluation, and justification rather than purely procedural laboratory skills.

	However, classroom evidence indicates that students often approach analytical tasks differently across subjects. While similar cognitive processes are required in Physics, Chemistry, and Biology, instruction frequently remains subject-specific, limiting transfer of analytical skills. Comparative analysis of examination data revealed variation in student performance in the third analytical component across the three sciences. These differences raise important questions regarding instructional alignment and the potential benefits of interdisciplinary strategies. Given the growing emphasis on transferable scientific reasoning, there is a need to explore whether coordinated instructional approaches across subjects can strengthen students' experimental data evaluation skills.
Цель и исследовательские вопросы	Aim To examine how an interdisciplinary instructional strategy influences students' analytical data evaluation skills across Physics, Chemistry, and Biology. Research Questions 1. What differences exist in students' performance in the analytical component across the three science subjects? 2. How does the implementation of interdisciplinary analytical scaffolding affect students' reasoning structure and evaluation accuracy? 3. Which aspects of experimental data analysis show the greatest improvement following the intervention?
Теоретическая основа (кратко)	The study draws upon: • **Experimental reasoning theory** - emphasizing variable control, uncertainty evaluation, and justification. • **Assessment literacy** - understanding quality criteria and evaluation standards. • **Interdisciplinary learning theory** - promoting transfer of cognitive skills across domains. • **Cognitive scaffolding principles** -structured support through analytical checklists and guided reasoning frameworks. The integration of these theoretical perspectives supports a structured yet transferable model of analytical skill development.
Методология	The research was conducted using a comparative Action Research design. **Participants** 125 students: • Physics (62) • Chemistry (32) • Biology (31) Data Collection Methods • Examination performance data (Component 3) • Statistical analysis (mean, median, distribution curves, letter-grade frequency) • Comparative cross-subject analysis • Classroom observations • Student feedback surveys Research Phases 1. Baseline performance analysis across subjects 2. Design of interdisciplinary analytical scaffolding

	3. Implementation of cross-subject structured reasoning tasks 4. Post-intervention performance comparison 5. Reflection and refinement Ethical principles were maintained: anonymity, voluntary participation, and educational purpose.
Реализация (ход исследования)	The study began with statistical comparison of third-component results across Physics, Chemistry, and Biology. Distribution analysis revealed differing performance patterns, particularly in high-grade frequency and consistency of structured responses. An interdisciplinary intervention was then implemented. Teachers collaboratively designed: • Unified analytical checklists • Cross-subject case evaluation tasks • Explicit error-analysis prompts • Structured reasoning templates Students practiced applying identical analytical frameworks to subject-specific contexts. Classroom observations documented increasing coherence in reasoning patterns and improved justification depth.
Результаты и главные выводы	Statistical comparison showed: • Differences in grade distribution patterns across subjects. • Improvement in structured analytical reasoning following intervention. • Greater consistency in justification and uncertainty evaluation. • Increased student confidence in cross-disciplinary data analysis. Distribution curves demonstrated reduced variability and stronger clustering around higher analytical performance categories. The findings suggest that interdisciplinary alignment strengthens transfer of experimental reasoning skills.
Практические рекомендации	1. Implement unified analytical checklists across science subjects. 2. Integrate cross-subject case analysis tasks. 3. Explicitly teach assessment criteria for data quality evaluation. 4. Encourage collaborative teacher planning for analytical skill alignment. 5. Use comparative statistical feedback to inform instruction.
Заключение	This study confirms that analytical data evaluation skills benefit from coordinated interdisciplinary instruction. When teachers align reasoning frameworks across Physics, Chemistry, and Biology, students demonstrate stronger transfer of experimental thinking skills. The findings highlight the importance of structured scaffolding and cross-subject collaboration in strengthening analytical competencies required for modern science assessments.
Список литературы	*1. Gao, X., Riskowski, J. L., Todd, C. D., Wee, B., Dark, M., & Harbor, J. (2020).* Reviewing assessment of student learning in interdisciplinary reasoning and communication processes in science education. International Journal of Science Education. *2. Tripp, B. (2019).* A Framework to Guide Undergraduate Education in Interdisciplinary Science. CBE—Life Sciences Education. *3. Santiani, S., Fine Reffiane, F., & Winarto, (2024).* Science interdisciplinary learning approach: interdisciplinary thinking

	skills and literacy environment. Journal of Education and Learning. 4. *Handtke, K., (2019).* Self-efficacy beliefs of interdisciplinary science teaching: instrument development and validation. Education Sciences. 5. *National Research Council. (2012).* A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. *National Academies Press.* 6. *Sanders, M. E. (2012).* Integrative STEM education as "best practice". *In H. Middleton (Ed.),* Explorations of Best Practice in Technology, Design, & Engineering Education. 7. *You, H. S., Marshall, J. A., & Delgado, C. (2018).* Assessing students' disciplinary and interdisciplinary understanding of science topics. Journal of Research in Science Teaching. 8. *Gresnigt, N., et al. (2014).* Models of curriculum integration and interdisciplinary education pedagogy. *(Overview in* Interdisciplinary Education *literature)*
Приложения (при необходимости)	Показательные иллюстрации, диаграммы, таблицы, рисунки