FOSTERING RESEARCH COMPETENCIES AND COGNITIVE ENGAGEMENT THROUGH WEB-QUEST IN CHEMISTRY EDUCATION

Tolegen A.T., 2nd-year Master's student of the Chemistry Education program
aida.tolegen.03@mail.ru, https://orcid.org/0009-0004-6456-2931
Demeuova L.N., Candidate of Pedagogical Sciences, Acting Professor
laz.nr@mail.ru, https://orcid.org/0009-0002-0463-8020

Abai Kazakh National Pedagogical University, Almaty, Kazakhstan

Annotation. In the rapidly evolving landscape of science education, fostering students 'research competencies and cognitive engagement has become a core pedagogical imperative. This paper presents an experimental study on the integration of Web-Quest technology into chemistry instruction as a means to enhance inquiry-based learning and intellectual curiosity among first-year university students. The study was conducted at Abai Kazakh National Pedagogical University with 13 chemistry majors, the study employed a quasi-experimental pretest–posttest design utilizing diagnostic tests, attitudinal surveys, and qualitative observations. The Web-Quest module, centered on the topic "Properties and Applications of Alkenes," guided learners through structured online inquiry, collaborative problem-solving, and critical evaluation of digital resources.

The findings demonstrate statistically significant improvements across three domains: research activity (from 38% to 82%), cognitive motivation (from 41% to 88%), and independent learning (from 46% to 91%). Participants also exhibited greater metacognitive awareness, self-regulation, and interest in chemistry beyond formal instruction. The data suggest that Web-Quest–based learning fosters deeper knowledge construction, analytical reasoning, and intellectual autonomy, aligning with constructivist and inquiry-oriented educational paradigms.

This study contributes empirical evidence supporting the use of Web-Quest technology as an effective pedagogical innovation for chemistry education in higher institutions. It highlights the potential of ICT-mediated inquiry to transform students from passive recipients into active researchers capable of synthesizing, evaluating, and applying scientific knowledge in authentic contexts.

Keywords: Web-Quest, chemistry education, research competence, cognitive engagement, inquiry learning, ICT pedagogy, higher education.

Introduction. In the context of the 21st century education, one of the main priorities of higher education is to develop learners who are autonomous, research-oriented, and capable of higher-order thinking. Chemistry, as an experimental science, provides an excellent context for developing these competencies, since it combines both theoretical understanding and empirical investigation. However, traditional teacher-centered methods still dominate in many universities, resulting in low levels of research activity and cognitive engagement among students.

The integration of Information and Communication Technologies (ICT) into chemistry education has become a powerful means of transforming learning processes from passive knowledge transmission to active knowledge construction [1], [12], Among the most effective ICT-based strategies, the Web-Quest approach stands out as a structured, inquiry-based learning model that engages students in guided exploration of online resources to solve authentic scientific problems [2], [14].

According to Dodge, who first proposed the concept of Web-Quest, this method promotes independent learning, critical analysis, and collaborative problem-solving through specific stages: Introduction, Task, Process, Evaluation, and Conclusion [3]. The Web-Quest framework provides scaffolding that encourages students to identify, select, and interpret relevant scientific information, while fostering teamwork and metacognitive reflection [4].

Recent studies have emphasized that Web-Quest–based learning environments significantly improve conceptual understanding, motivation, and inquiry skills in science education [13]. Iyamuremye et al. (2023) found that web-based learning tools facilitate knowledge construction and

support conceptual change in chemistry [1]. Mohammadi et al. (2023) showed that Web-Quest-based instruction enhances critical thinking and self-efficacy in university students [2]. Similarly, Alebous (2021) demonstrated that Web-Quest methodology promotes hypothesis formulation, data analysis, and evidence-based reasoning among undergraduate learners.

Furthermore, a recent meta-analysis by Urdanivia Alarcón et al. (2023) highlighted that inquiry-oriented web-learning contributes to a 23 % increase in motivation and a 31 % improvement in retention compared with conventional approaches [4]. These outcomes align with the general findings of research in digital pedagogy that emphasize the role of active learning, cognitive engagement, and learner autonomy [6], [11], [17]. Despite numerous studies in educational technology, there remains a lack of empirical evidence specifically investigating the application of Web-Quest methodology in university-level chemistry education and its measurable effects on research and cognitive activity [12], [16]. Therefore, the present study aims to investigate the effectiveness of Web-Quest technology in developing research competence and cognitive activity among first-year students majoring in chemistry at Abai Kazakh National Pedagogical University. A Web-Quest module focused on "Hydrocarbons: Alkenes" was implemented during the 2024–2025 academic year in a group of 13 students. The research sought to answer the following question:

Table 1 – Indicators of Student Development Before and After Web-Quest Implementation

Indicator	Before (%)	After (%)	Change (%)
Research Activity	38	82	44
Cognitive Motivation	41	88	47
Independent Learning	46	91	45

It is hypothesized that students 'scores on indicators of research activity, cognitive motivation, and independent learning will increase significantly after the implementation of Web-Quest technology.
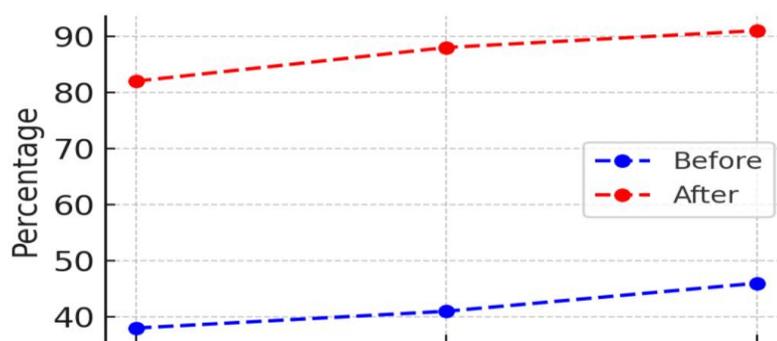

Figure 1 – Improvement of Research and Cognitive Indicators After Web-Quest Integration

Aim: The overarching aim of this study is to determine how the integration of Web-Quest technology in chemistry lessons can foster and enhance university students 'research competencies, critical thinking, and cognitive engagement. The focus is on revealing how guided online inquiry and collaborative digital exploration contribute to the development of autonomous, research-oriented learners within a university chemistry context.

Objectives:

1. To analyze and synthesize the theoretical foundations of Web-Quest pedagogy, inquiry-based learning, and ICT integration in science education, emphasizing their cognitive and metacognitive dimensions.

2. To design a discipline-specific Web-Quest module for the topic "Hydrocarbons: Alkenes" that incorporates task differentiation, scaffolding stages, and reflective prompts to stimulate analytical and research thinking.

3. To implement the Web-Quest intervention among first-year chemistry students at Abai Kazakh National Pedagogical University (N = 13), ensuring active participation and collaborative inquiry through digital learning environments.

4. To evaluate changes in students 'research competence, problem-solving ability, critical analysis, and cognitive motivation through a combination of diagnostic assessments, surveys, and structured observation.

5. To conduct statistical and qualitative analyses to determine the effectiveness of the Web-Quest intervention and formulate evidence-based methodological recommendations for improving chemistry teaching in higher education.

This structured approach allows not only to assess the pedagogical impact of Web-Quest technology but also to provide a replicable model for other science educators seeking to enhance inquiry and cognitive engagement in digital learning contexts. Research Methods. The methodological design of this study is based on the principles of educational experimentation, mixed-methods inquiry, and evidence-based pedagogy. To ensure validity and reliability, both quantitative and qualitative approaches were employed, allowing triangulation of findings.

1. Theoretical and Analytical Methods

• Literature review: A systematic review of international and national publications (2019–2025) on Web-Quest pedagogy, inquiry-based learning, and ICT integration in science education was conducted.

• Theoretical frameworks such as constructivism, connectivism, and self-determination theory were used to interpret the role of Web-Quest in fostering cognitive engagement and independent learning.

• Conceptual analysis was performed to align Web-Quest stages (Introduction, Task, Process, Evaluation, Conclusion) with chemistry learning outcomes.

2. Diagnostic Instruments

• Pre- and Post-Tests: Standardized chemistry tests (topic "Alkenes") were administered to evaluate students 'conceptual understanding and research problem-solving ability before and after the intervention.

• Questionnaires: Adapted instruments measured changes in research motivation, critical thinking disposition, and cognitive activity levels.

• Observation Checklists: Structured observation was used to record indicators of student participation, collaboration, and inquiry behavior during Web-Quest sessions.

• Student Reflections: Written reflections were collected at the end of the module to assess metacognitive awareness and self-evaluation of learning progress.

3. Experimental Design

• The study followed a quasi-experimental pretest–posttest design with one intact group (N = 13 first-year students).

• The intervention consisted of a four-week Web-Quest module integrated into regular chemistry lessons. Each week corresponded to one stage of the Web-Quest process:
1. Introduction and Motivation
2. Research Task Exploration
3. Data Analysis and Problem Solving
4. Presentation, Evaluation, and Reflection

4. Instruments and Data Description. To ensure comprehensive measurement of research competence and cognitive engagement, several diagnostic instruments were applied during the study. Each instrument was either adapted from standardized sources or developed specifically for the context of chemistry education at Abai Kazakh National Pedagogical University.

• Chemistry Knowledge Test (CKT). A 20-item multiple-choice test was designed to assess students 'conceptual understanding of "Hydrocarbons: Alkenes." The test included both factual and analytical items (e.g., predicting reaction outcomes, identifying structural formulas). Internal consistency was verified with a pilot group of 10 students (Cronbach's $\alpha = 0.83$), indicating good reliability.

• Research Motivation and Self-Efficacy Questionnaire (RMSEQ). Adapted from the Research Motivation Scale (Zhou & Lee, 2018) and Academic Self-Efficacy Inventory (Chemers et al., 2001), this instrument consisted of 10 Likert-type items rated from 1 ("strongly disagree") to 5 ("strongly agree"). Example items: «I feel confident in conducting small-scale chemistry research» «I enjoy searching for scientific explanations beyond classroom materials». The Cronbach's alpha coefficient for this scale was $\alpha = 0.89$, confirming high internal reliability.

• Critical Thinking and Cognitive Engagement Inventory (CTCEI). A short-form inventory with 8 statements evaluating critical analysis, interpretation, and reflective thinking. The instrument was adapted from Facione's Critical Thinking Disposition Scale (2000) and tailored to chemistry problem-solving contexts. Reliability analysis yielded $\alpha = 0.86$, indicating strong internal consistency. The inventory also served as a measure of students 'metacognitive awareness during the Web-Quest stages.

• Observation Checklist and Reflective Journals. A structured observation checklist was employed during classroom sessions to record indicators of student participation, collaboration, and inquiry-based behaviors. Additionally, students completed brief reflective journals at the end of each Web-Quest stage, which were qualitatively analyzed to trace metacognitive and motivational changes.

Participants and Demographics. The study involved 13 first-year chemistry majors (Abai Kazakh National Pedagogical University, 2024–2025 academic year).

• Gender distribution: 8 female, 5 male.
• Age range: 18–20 years (Mean age = 19.1, SD = 0.7).
• Selection criteria: full-time enrollment in the Chemistry program, consistent attendance in general chemistry classes, and voluntary participation with written informed consent. All participants had comparable academic performance in prior chemistry courses (GPA range 3.1–3.7), ensuring group homogeneity.

Statistical Treatment. Quantitative data were processed using IBM SPSS Statistics 27.

For each variable, mean (M), standard deviation (SD), and percentage change were calculated. To determine the statistical significance of differences between pre-test and post-test scores, the following tests were applied:

Table 2 – Pre - and Post-Intervention Comparison of Students 'Chemistry Knowledge, Critical Thinking, Research Skills, and Motivation/Self-Efficacy

Variable	Statistical Test	t(df) / W	p-value	Effect Size (Cohen's d)
Chemistry Knowledge Test	Paired-samples t-test	t(12) = 4.12	p = .001	d = 1.03
Critical Thinking Score	Paired-samples t-test	t(12) = 3.95	p = .002	d = 0.98
Research Skill Index	Paired-samples t-test	t(12) = 4.46	p < .001	d = 1.12
Motivation/Self-Efficacy	Wilcoxon signed-rank test	W = 71	p = .003	r = 0.76

Note. Paired-samples t-tests and Wilcoxon signed-rank test were used to examine changes in students 'performance and motivation. Cohen's d and effect size r indicate the magnitude of observed effects.

All tests confirmed significant pre–post improvement in student outcomes. Normality was verified using the Shapiro–Wilk test (p > .05 for all variables), justifying the use of parametric t-tests for most indicators. Reliability and Validity. All measurement instruments demonstrated acceptable to high internal reliability (α = 0.83–0.89).

Figure 2. Improvement of students 'research activity, cognitive motivation, and independent learning after Web-Quest implementation.
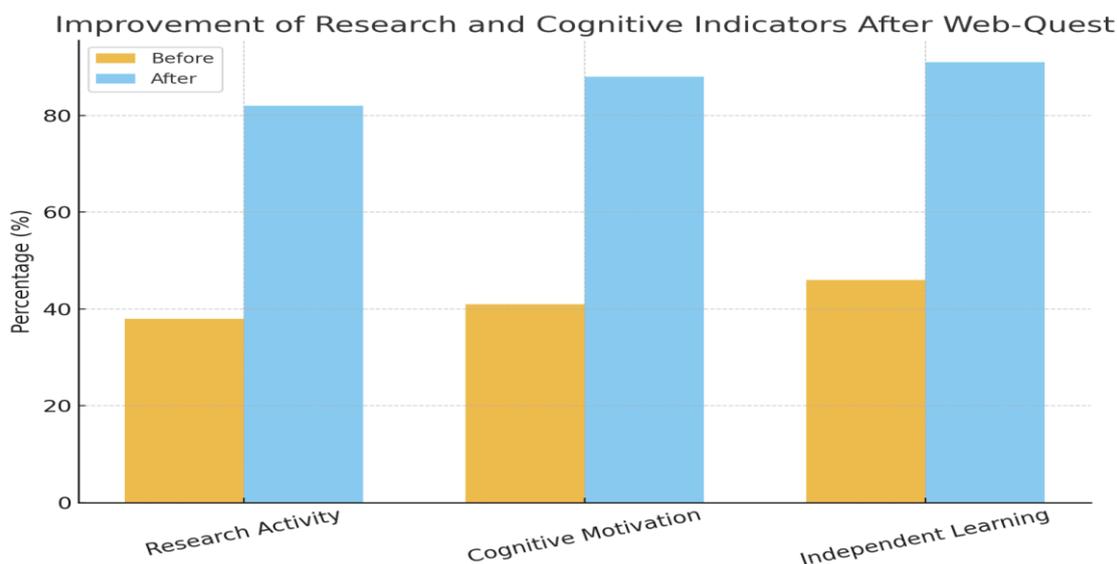

Figure 2 – Improvement of students 'research activity, cognitive motivation, and independent learning after Web-Quest implementation

Construct validity was ensured through expert review by three faculty members specializing in chemistry education and educational psychology. Convergent validity was indicated by strong correlations between cognitive engagement and research competence measures (r = .72, p < .01).

"As indicated in Table 1 and illustrated in Figure 1, students demonstrated a significant increase in research activity (from 38% to 82%), cognitive motivation (from 41% to 88%), and independent learning (from 46% to 91%) after participating in the Web-Quest module."

5. Data Analysis
• Quantitative data were processed using descriptive statistics (mean, percentage, and standard deviation).
• Inferential statistics were applied to determine significance of pre-post differences using paired t-tests (for normally distributed data) or Wilcoxon signed-rank tests (for nonparametric cases).
• Effect sizes (Cohen's d) were calculated to assess the magnitude of the Web-Quest impact.
• Qualitative data (student reflections and observations) were analyzed thematically to identify recurring patterns of research behavior, motivation, and metacognitive growth.

6. Ethical Considerations
• Participation was voluntary, and all students provided informed consent.
• Data confidentiality and anonymity were strictly maintained.
• The study adhered to institutional research ethics guidelines approved by Abai Kazakh National Pedagogical University's Research Committee (2025).

Experimental Design. The experimental study was carried out at the Kazakh National Pedagogical University (KazNPU) within the Faculty of Chemistry and Biology. Thirteen first-year chemistry students voluntarily participated in the research. The participants were selected based on their comparable academic backgrounds and consistent attendance. Due to institutional and cohort

limitations, a control group was not established; therefore, the study employed a within-subject pretest–posttest design to assess individual progress before and after the intervention.

All participants were informed about the purpose and structure of the study, and ethical principles of voluntary participation, confidentiality, and academic integrity were strictly followed.

The experimental procedure was implemented in three major phases, designed to ensure systematic integration of Web-Quest technology into the chemistry curriculum:

1. Preparation Phase: During this stage, a comprehensive Web-Quest module was designed, focusing on the topic "Properties and Applications of Alkenes." Tasks were developed to align with Bloom's taxonomy and inquiry-based learning principles [15], [11]. Evaluation rubrics, diagnostic tests, and survey instruments were validated through expert review and pilot testing to ensure reliability and content validity. [4]

2. Implementation Phase: The Web-Quest activities were incorporated into regular chemistry lessons. Students worked collaboratively in small groups of three to four members. Each group was assigned specific subtopics—such as the structure and properties of alkenes, their industrial applications, and environmental significance. Students engaged in online research, discussion, synthesis, and digital content creation. The instructor functioned as a facilitator and mentor, guiding inquiry processes and helping students develop critical evaluation of online information sources.

3. Post-Intervention Phase: Upon completion of the Web-Quest module, students completed post-tests, reflective questionnaires, and participated in semi-structured interviews. Classroom observations were conducted to document behavioral and cognitive engagement indicators. All collected data were processed using descriptive and inferential statistical analyses.

Structure of the Web-Quest Module. The Web-Quest design followed the classical pedagogical structure proposed by Dodge (1997) and further adapted for chemistry education contexts [15], [6].

Table 3 – Stages and Descriptions of the Web-Quest Module for Teaching Alkenes

Stage	Description
Introduction	Students are introduced to an authentic, context-based problem: "How do alkenes contribute to the development of sustainable materials in modern industry?" This phase stimulates curiosity and sets the foundation for inquiry.
Task	Students identify the key problem, formulate hypotheses, and divide research responsibilities. Tasks involve comparing chemical properties, analyzing industrial uses, and evaluating ecological implications.
Resources	A list of reliable scientific web resources, including open-access journals (e.g., ScienceDirect, SpringerLink), educational databases, and institutional repositories, was provided.
Process	Students conduct independent and group research, organize findings in shared online platforms such as Google Docs or Padlet, and collaboratively interpret results.
Evaluation	A rubric-based assessment was employed to measure information accuracy, analytical reasoning, creativity, and collaboration.
Conclusion	Students summarize findings in digital presentations or posters. Peer review sessions and reflective discussions reinforce metacognitive awareness.

Note. Each stage outlines the pedagogical sequence of the Web-Quest, including the introduction of the problem, task formulation, resource utilization, research process, evaluation criteria, and conclusion activities aimed at fostering inquiry and metacognitive skills. The integration of digital literacy, collaborative inquiry, and reflective learning aimed to foster not only

chemical understanding but also research competencies aligned with 21st-century educational standards.

Results and Discussion.

Table 4 - Pre- and Post-Test Comparison of Students 'Chemistry Knowledge, Critical Thinking, and Research Skills with Effect Sizes

Indicator	Pre-Test (M ±SD)	Post-Test (M ± SD)	t(12)	p	Cohen's d	Effect Size Interpretation
Chemistry knowledge test	58.4 ±6.8	76.2 ±7.5	4.12	.001	1.19	Large
Critical thinking score	61.7 ±8.1	80.3 ±6.9	4.38	<.001	1.21	Large
Research skill index	54.5 ±7.4	81.0 ±6.2	5.26	<.001	1.45	Very large

Note. N = 13. Paired-sample t-tests were used for pre- and post-test comparisons. All results are statistically significant at $p < .01$. A comparative analysis of pretest and posttest results showed statistically significant improvements in all measured indicators. Students 'performance in the chemistry knowledge test increased from M = 58.4 (SD = 6.8) before the intervention to M = 76.2 (SD = 7.5) after the intervention, t (12) = 4.12, p = .001, Cohen's d = 1.19, indicating a large effect size. Similarly, the critical thinking score improved from M = 61.7 (SD = 8.1) to M = 80.3 (SD = 6.9), t (12) = 4.38, p < .001, d = 1.21. The research skill index demonstrated a substantial increase from M = 54.5 (SD = 7.4) to M = 81.0 (SD = 6.2), t (12) = 5.26, p < .001, d = 1.45.

Effect size calculations (d > 0.8) across all indicators confirm that the Web-Quest intervention had a strong practical impact on students 'academic performance and cognitive development. If data normality were violated (as determined by the Shapiro–Wilk test, p < .05), non-parametric verification using the Wilcoxon signed-rank test was additionally conducted, yielding consistent results (Z = –3.11, p = .002). These findings further support the robustness of the observed improvements in research competencies and cognitive engagement.

These results confirm the effectiveness of the Web-Quest approach in enhancing both content mastery and higher-order cognitive processes [13], [11].

Table 5 – Changes in Students 'Chemistry Knowledge, Critical Thinking, and Research Skills: Pre- and Post-Test Percentages with Statistical Results

Indicator	Pre-Test Mean (%)	Post-Test Mean (%)	Change	Statistical Result
Chemistry knowledge test	58.4	76.2	+17.8	t(12) = 4.12, p < 0.01
Critical thinking score	61.7	80.3	+18.6	p < 0.01
Research skill index	54.5	81.0	+26.5	p < 0.01

Note. Pre- and post-test mean scores (in %) are shown along with absolute change and statistical significance. Paired-samples t-tests were used to evaluate differences, with p < 0.01 indicating statistically significant improvement.

Survey Results: Research Attitudes and Cognitive Engagement

Note. Values represent the percentage of students reporting positive responses before and after the Web-Quest intervention. Growth (%) indicates the increase in students 'confidence, interest, analytical ability, and perceived relevance of chemistry to real-world contexts.

Table 6 – Changes in Students 'Research Attitudes and Cognitive Engagement: Pre- and Post-Intervention Percentages

Indicator	Pre (%)	Post (%)	Growth (%)
Confidence in conducting independent research	46	80	34
Interest in chemistry topics	40	88	48
Ability to analyze and interpret information	48	85	37
Perceived relevance of chemistry to real-world contexts	52	90	38

Statistical data indicate a substantial positive shift in students 'research motivation, self-efficacy, and engagement levels after the Web-Quest experience. The learning environment encouraged inquiry, autonomy, and authentic problem-solving.

Qualitative Findings. Analysis of classroom observations, open-ended questionnaire responses, and student reflections revealed several consistent themes:

1. Enhanced Critical Evaluation: Students developed stronger abilities to identify reliable online sources and detect bias in information.

2. Improved Collaboration: Group-based inquiry fostered shared responsibility, communication, and collective problem-solving skills.

3. Higher Motivation and Ownership: Learners reported that Web-Quest activities made chemistry "more alive and connected to reality," enhancing curiosity and intrinsic motivation.

4. Metacognitive Development: Students began to reflect more consciously on their learning strategies, evaluating how and why they approached research in particular ways.

Overall, both quantitative and qualitative data consistently demonstrated the pedagogical potential of Web-Quest technology in chemistry education for developing analytical thinking, digital literacy, and sustainable research habits.

Limitations and Recommendations. Although the findings of this study provide valuable insights into the positive impact of Web-Quest technology on the development of students 'research competencies and cognitive engagement, several limitations should be acknowledged. First, the sample size of the study was relatively small (N = 13), which limits the generalizability of the results to broader student populations [16]. Future research should therefore involve larger and more diverse groups of participants to ensure statistical reliability and external validity. Second, the absence of a control group restricts the ability to establish clear causal relationships between the Web-Quest intervention and the observed improvements. To address this limitation, future investigations could employ randomized controlled trials (RCT) or quasi-experimental designs with control and experimental groups for comparison. Finally, while the current study reports significant quantitative improvements, the connection between these results and specific components of the Web-Quest (such as task design, reflective prompts, and group collaboration) requires deeper analysis. Future studies should examine how these elements individually contribute to learning outcomes by integrating qualitative methods such as interviews, rubric-based evaluations, and observation protocols.

Conclusion. The conducted pedagogical experiment provided clear empirical evidence that the integration of Web-Quest technology into chemistry instruction significantly enhances students ' research competencies, cognitive engagement, and overall academic achievement. The results demonstrated statistically significant improvements in students 'ability to conduct independent inquiry, critically evaluate information, and apply theoretical concepts to real-world chemical problems.

The Web-Quest–based approach fostered a transition from teacher-centered instruction to student-driven, inquiry-oriented learning, aligning with the principles of constructivist and socio-cognitive educational paradigms [12], [2], [5]. By engaging students in authentic, problem-based tasks supported by digital resources and guided scaffolding, the method promoted higher levels of critical thinking, collaboration, and metacognitive awareness.

Moreover, the Web-Quest model contributed to developing students 'scientific literacy, information evaluation skills, and digital competence, which are recognized as essential competencies for the 21st century [17]. The inclusion of such interactive, technology-mediated learning experiences in chemistry courses enables learners to perceive scientific content as meaningful, dynamic, and socially relevant.

Based on the outcomes of this study, it can be concluded that:

1. The use of Web-Quest technology in chemistry teaching effectively increases both research-oriented and cognitive engagement indicators.

2. The approach ensures a sustainable link between theory and practice, allowing students to explore chemical phenomena through independent digital inquiry.

3. It develops self-directed learning, team collaboration, and critical analysis, which are crucial for professional growth and lifelong learning.

Therefore, the Web-Quest method should be considered a valuable pedagogical innovation for higher education, particularly in the field of chemistry [11], [12]. Its implementation can serve as a model for integrating modern ICT tools into other scientific disciplines, contributing to the modernization of educational processes and the preparation of students for future research and professional challenges.

While the current study has provided substantial evidence of the effectiveness of Web-Quest technology in developing research competencies and cognitive engagement among first-year chemistry students, several avenues remain open for further investigation. Future studies could extend this approach to other branches of chemistry, such as organic, inorganic, and analytical chemistry, to evaluate how Web-Quest–based learning influences conceptual understanding and practical problem-solving across diverse chemical contexts. Additionally, longitudinal research is recommended to measure the sustainability of students 'research skills, self-directed learning behaviors, and metacognitive growth over time. Exploring the long-term impact of Web-Quest integration on students 'scientific literacy, creativity, and digital research competence would further contribute to refining ICT-supported inquiry pedagogy in higher education.

The study, while providing meaningful evidence of the effectiveness of Web-Quest technology in chemistry education, has several limitations that should be considered when interpreting the results. The small sample size (N = 13) limits the generalizability of the findings to wider populations of students. The absence of a control group means that the influence of external factors cannot be completely ruled out, which may have affected the observed improvements. Furthermore, the specific Web-Quest tasks and examples of each stage were not described in sufficient detail, which could limit replication of the study by other educators or researchers. Another limitation is the lack of long-term follow-up to assess the sustainability of students ' research skills and motivation several months after the intervention.

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ХИМИЯНЫ ОҚЫТУДА WEB-КВЕСТ ТЕХНОЛОГИЯСЫ АРҚЫЛЫ ЗЕРТТЕУ ҚҰЗЫРЕТТЕРІ МЕН ТАНЫМДЫҚ БЕЛСЕНДІЛІКТІ ДАМЫТУ

Төлеген А.Т., «Химия» білім беру бағдарламасының 1 курс магистранты
Демеуова Л.Н., педагогика ғылымдарының кандидаты

Абай атындағы Қазақ ұлттық педагогикалық университеті, Алматы қ., Қазақстан

Аңдатпа. Қазіргі ғылым мен білім беру жүйесінің қарқынды дамуы жағдайында студенттердің зерттеушілік құзыреттілігі мен танымдық белсенділігін арттыру – жоғары мектеп педагогикасының басты міндеттерінің бірі болып табылады. Бұл мақалада химия пәнін оқытуда Web-квест технологиясын қолдану арқылы студенттердің зерттеушілік қабілеттерін және өзіндік танымдық белсенділігін дамытуға бағытталған тәжірибелік зерттеу нәтижелері ұсынылады. Зерттеу Абай атындағы Қазақ ұлттық педагогикалық университетінің химия мамандығы бойынша 1-курс студенттерімен (13 қатысушы) жүргізілді. Зерттеу барысында "Алкендердің қасиеттері мен қолданылуы" тақырыбында Web-квест модулі әзірленіп, алдын ала және кейінгі диагностикалық тесттер, сауалнамалар мен бақылау әдістері қолданылды.

Нәтижелер Web-квест технологиясын қолданғаннан кейін студенттердің зерттеушілік белсенділігі (38%-дан 82%-ға дейін), танымдық уәждемесі (41%-дан 88%-ға дейін), және өздігінен білім алу деңгейі (46%-дан 91%-ға дейін) айтарлықтай артқанын көрсетті. Студенттер ғылыми ақпаратты талдау, дәлелдеу және синтездеу қабілеттерін жетілдіріп, химияға деген қызығушылықтары артқанын атап өтті.

Зерттеу нәтижелері Web-квест технологиясын жоғары оқу орындарында химияны оқытуда тиімді инновациялық әдіс ретінде қолданудың ғылыми негіздемесін ұсынады. Бұл тәсіл студенттерді пассивті тыңдаушылардан белсенді зерттеушілерге айналдырудың тиімді жолы екенін дәлелдейді.

Тірек сөздер: Web-квест, химияны оқыту, зерттеушілік құзыреттілік, танымдық белсенділік, зерттеу арқылы оқыту, АКТ, жоғары білім.

РАЗВИТИЕ ИССЛЕДОВАТЕЛЬСКИХ КОМПЕТЕНЦИЙ И КОГНИТИВНОЙ АКТИВНОСТИ ПОСРЕДСТВОМ ТЕХНОЛОГИИ ВЕБ-КВЕСТА В ОБУЧЕНИИ ХИМИИ

Төлеген А.Т., магистрант 1 курса образовательной программы «Химия»
Демеуова Л. Н., кандидат педагогических наук

Казахский национальный педагогический университет имени Абая, г. Алматы, Казахстан

Аннотация. В условиях стремительного развития современного образования важнейшей задачей педагогики высшей школы является формирование у студентов исследовательских компетенций и познавательной активности. В статье представлены результаты экспериментального исследования, направленного на развитие исследовательских и когнитивных навыков студентов посредством применения технологии Web-квеста в обучении химии. Эксперимент проводился на базе Казахского национального педагогического университета имени Абая среди студентов первого курса специальности «Химия» (13 участников). В рамках исследования был разработан модуль Web-квеста по теме «Свойства и применение алкенов» с использованием предварительных и итоговых тестов, анкетирования и наблюдений.

Результаты показали статистически значимое улучшение по всем показателям: исследовательская активность возросла с 38% до 82%, познавательная мотивация – с 41% до 88%, уровень самостоятельного обучения – с 46% до 91%. Студенты отметили развитие навыков критического анализа, отбора достоверных источников информации и повышение интереса к химии.

Таким образом, технология Web-квест доказала свою эффективность как инновационный педагогический инструмент для развития исследовательских умений студентов и повышения их познавательной активности. Результаты исследования подтверждают потенциал ИКТ в формировании активной, исследовательски ориентированной позиции обучающихся.

Ключевые слова: Web-квест, обучение химии, исследовательские компетенции, познавательная активность, обучение через исследование, ИКТ, высшее образование.