

The Pilot Study on the Application of Interactive Apps for Teaching Inorganic Chemistry

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Abstract. This pilot study investigated the impact of the interactive applications on learning outcomes and student opinion for teaching inorganic chemistry. This study was conducted at Karaganda University's Chemistry Department with the participation of students from groups ChB-32r-21, ChB-24-1K, and ChS-24-1K. Results from tests conducted on interactive platforms, such as Quizizz, Kahoot, and Quizlet, were analysed. Group ChB-32r-21 achieved an average score of 17.6 out of 20, indicating a high level of engagement and success. Similarly, groups ChB-24-1k and ChS-24-1k achieved consistent results, confirming the effectiveness of interactive methods. A survey of students revealed a positive attitude towards the use of interactive applications: 85-90% of students noted their engaging nature and clarity of presentation. However, the study also identified issues such as a lack of digital literacy and limited access to devices or the internet among some students, which can create learning inequalities.

Keywords: higher education, interactive learning, online platforms, interactive applications, inorganic chemistry, students, survey.

Introduction

The application of interactive technologies is particularly significant when teaching complex and abstract subjects, such as inorganic chemistry. This field of chemical science requires students to think abstractly, manipulate chemical equations, comprehend structural models of substances and understand the fundamental laws governing chemical processes. Traditional teaching methods often fail to convey complex theoretical concepts effectively or sustain students' motivation to engage with the subject matter. When developed in accordance with didactic principles, interactive applications can serve as effective tools for visualisation, platforms for enhancing problem-solving skills, and instruments for organising independent and research-based learning activities. However, despite the availability of various digital solutions, their actual effectiveness remains to be determined and requires comprehensive scientific investigation [1]. Key elements of interactive learning include group discussions, project-based activities, role-playing exercises and multimedia technology. These methods

significantly enhance students' understanding and retention of material by encouraging the practical application of previously acquired knowledge [2].

Interactive programs are specialised software tools or web applications designed to facilitate interactive teaching methods. A key feature of such programmes is the feedback loop between learner and application, enabling educational content to be acquired through visual and hands-on experiences. Furthermore, they allow for personalisation and adaptation of the learning process. The content of interactive programmes usually incorporates multimedia elements, such as video, animation, audio and graphics. The effective presentation of these materials helps to focus students' attention and enhances memory retention. Additionally, interactive features enable students to actively participate in the learning process by encouraging them to make decisions, work through mistakes and gain practical experience [3].

Examples of widely used interactive platforms for remote and traditional education in-

clude Kahoot, Quizlet, PhET Simulations, Moodle and Google Classroom. These platforms not only deliver content but also support assessment, testing, game-based learning and reflection, thereby enriching the overall learning experience.

Nikolopoulou et al. [4], Sadykov et al. [5] have identified several key areas in which interactive programmes contribute to educational effectiveness:

- enhancing student motivation;
- enabling the development of personalised learning trajectories;
- increasing both cognitive and emotional engagement in the learning process;
- improving overall learning outcomes.

Through interactive programs, students learn to express their opinions, engage in logical reasoning, and justify their viewpoints. The widely used educational platforms Kahoot, Quizlet, Padlet and Quizizz [6]. In chemistry education, for example, they help students

to understand complex theoretical material, boost their motivation and provide teachers with flexible tools for organising diverse learning activities, assessing knowledge and supporting collaborative work [7].

Here is an example of a practical lesson on the topic: «Elements of the 15th group of chemical elements» (figure 1).

The pilot study examined the impact of the interactive applications on learning outcomes and student opinion for teaching inorganic chemistry.

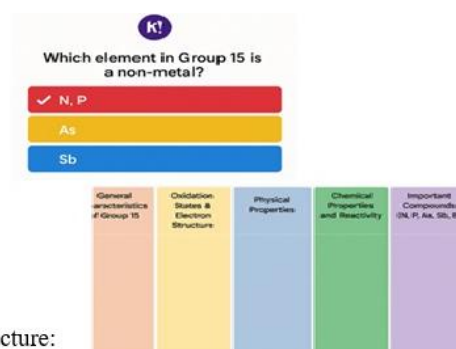
Research methods

The verification was carried out in the from February to March 2025 at Buketov Karaganda National Research University (Faculty of Chemistry). There are several important reasons to do pedagogical research at the Karaganda Buketov University (Faculty of Chemistry). First, chemistry involves learning both from practice and theory. This area of study can directly help to increase the effectiveness

Stage 1: Warm-up and baseline assessment (Kahoot, 10 minutes).

Purpose: activate prior knowledge and introduce key concepts.

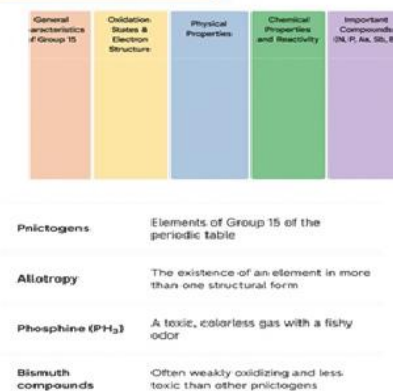
Activity: Students join a Kahoot quiz titled 'Meet the Group 15 Family!'.



Stage 2. Exploration & Concept Building (Padlet, 10 minutes)

Purpose: Systematize properties and trends using collaborative digital tools.

Activity: Students work in small groups to fill a shared Padlet board with the structure:



Stage 3. Key Concepts Reinforcement (Quizlet, 8 minutes)

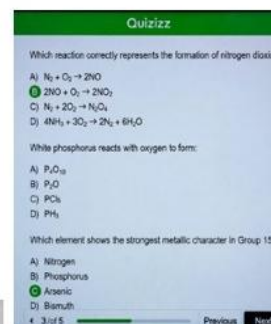
Purpose: Strengthen terminology and element recognition.

Activity: Students use a Quizlet set titled “Group 15 Elements: Terms & Definitions”. Flashcard examples:

Stage 4. Practice & Application (Quizizz, 15 minutes)

Purpose: Apply knowledge by solving chemical problems in an interactive game format.

Activity: Launch a Quizizz session titled “Reactions and Trends of Group 15 Elements”.



Stage 5. Reflection & Summary (3–5 minutes)

Students return to the Padlet board and add short reflection notes:

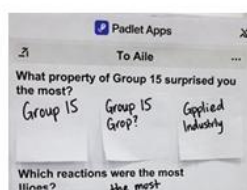


Figure 1 – A practical lesson on the topic: «Elements of the 15th group of chemical elements»

of education by helping students grasp the topic and develop suitable abilities. Secondly, the faculty offers the opportunity to compare the effectiveness of traditional and interactive teaching methods, assessing their impact on students' knowledge and motivation levels. Such research can help to identify shortcomings in the learning process, improve teaching technologies and enhance instructors' professional skills.

The study was carried out with the following groups: ChB-32r-21, ChB-24-1k and ChS-24-1k, in total 24 respondents participated (19 female students and 5 male students). It was aimed to investigate the use of interactive applications in the teaching of inorganic chemistry during six practical classes. The tests covered the following topics: "Chemical elements of the fifth group and their properties", "Chemical elements of the sixth group and their properties", and "Chemical elements of the seventh group and their properties".

To determine the attitude of students towards interactive apps, a questionnaire was conducted after the experiment. The questionnaire developed for this study consisted of eight questions. We used a three-point response scale: "yes" (1), "neutral" (2) and "no" (3).

Question:

1. Do you like lessons with the use of interactive apps?
2. Do you think that lessons with the application of interactive apps are more interesting than traditional lessons?
3. Was the explanation in the interactive apps clear enough to understand the topic well?
4. Do you think that the interactive apps had too much information, diagrams and images, so you found it difficult?
5. Was knowledge gained in an interactive app applied in real life?
6. Would you like it if interactive apps like these could be carried out more often?
7. Do you like the Kahoot game? Is it quick and interesting and does it help you to check

your knowledge?

8. Do you think that solving the interactive tasks in this way is more interesting than with the traditional method?

Results

1. Test results for students

A) Group: ChB-32R-21

The entrance test consisted of 15 questions. A test was conducted with group ChB-32r-21 using the interactive Quizizz platform. Grading scale: 13-15 points: good (excellent performance); 10-12 points: satisfactory (average result); 6-9 points: unsatisfactory (additional support required); 0-5 points: low (insufficient or incorrect work). The average score of 13.6 out of 15 (90.7%) reflects a very high level of academic achievement (figure 2). Out of 5 students, 4 (80%) achieved a "good" score (13-15 points), while 1 student (20%) attained a "satisfactory" result (10-12 points).

After the final test the ChB-32r-21 group demonstrates strong academic potential and a high level of engagement with inorganic chemistry. The test results confirm that the majority of students are on a trajectory of independent learning and academic success. With additional individualized support and opportunities for advanced study, this group is well-positioned to achieve even higher levels of performance.

Overall group results: 17.6 points of 20.

The overall group performance is very good, with many students demonstrating strong knowledge in inorganic chemistry.

B) ChB (chemistry-biology)-24-1k

Figure 3 presents the test results of a student group across three different dates. Throughout these assessment periods, interactive learning programs were incorporated to enhance students' engagement and improve their understanding of the subject.

As a result, the use of interaction in teaching caused most students to understand the subject much better. Student № 1 was able to go from 18 points on the first try to 30 points on the final exam. Likewise, student № 3 and student № 8 did very well in the final review,

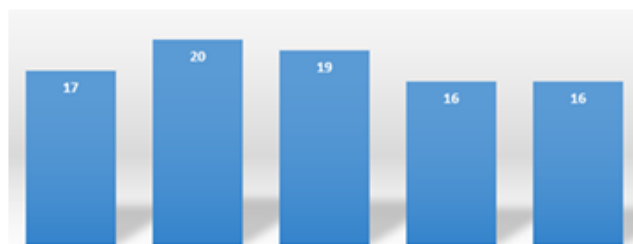
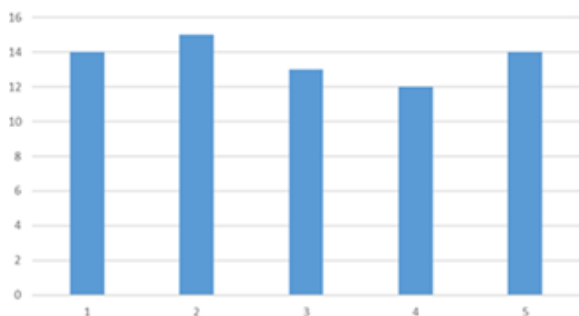


Figure 2 – The entrance and final knowledge assessment of the ChB-32r-21 group

suggesting they learned a lot and the approach was beneficial for studying. Some students showed patterns where their test results would change from one attempt to another. On 23 February, student № 6 had a score of 15 points which climbed to 21 points on 9 March, showing better academic progress for her. Similarly, while student № 9 scored 27 points first, he decreased to 15 points in the final test, pointing out that he could use further support. Hence, using interactive programmes increases student motivation and ambition to learn. Positive results from the group are noticeable, but some students still benefit from extra help

and additional resources.

C) ChS (Chemistry in science)-24-1k

Figure 4 presents the test results of a student group across three different dates: 10.02.2025, 11.02.2025 and 17.02.2025. The group's overall academic achievement is at a good level.

There were three key stages in how the project was evaluated:

- Stage 1. There are 30 points given to questions. The scores of all students were between 17 and 20 points. The similar results mean the group has a similar understanding of the idea.

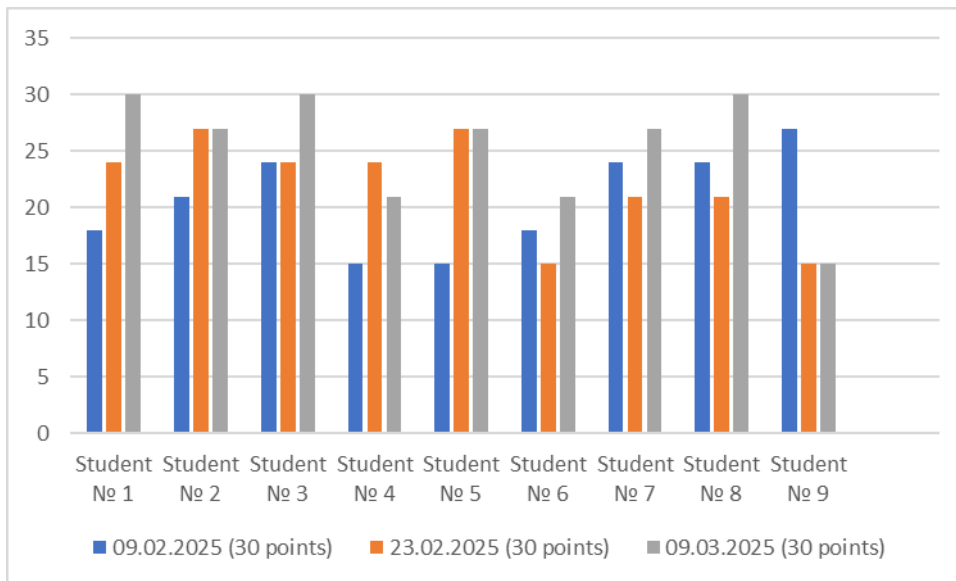


Figure 3 – The test results of ChB-24-1k

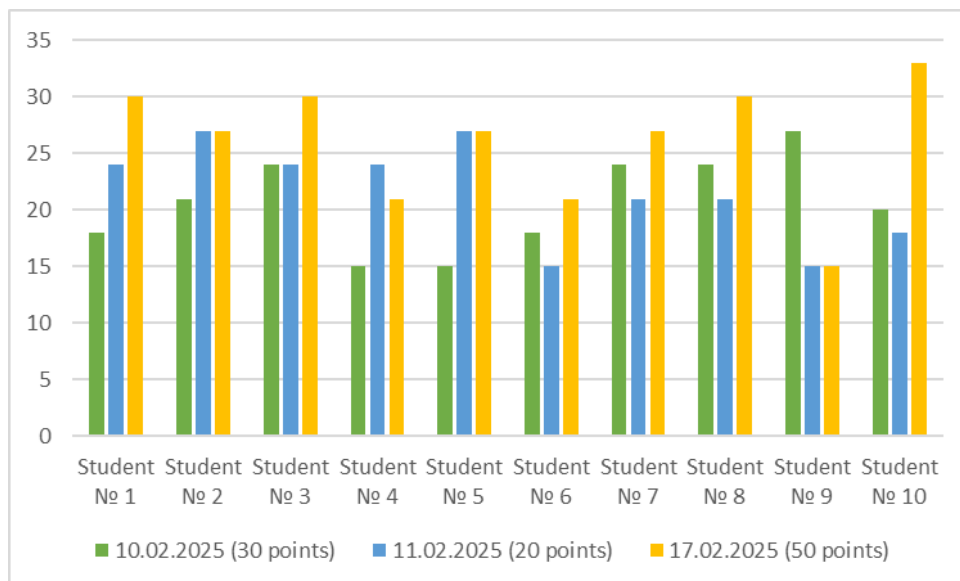


Figure 4 – The test results of ChS-24-1k

- Stage 2 (20 out of 50 points). Everyone marked 18 points, proving that the instruction was clear to everyone and that all students understood the material equally.

- Stage 3 (50 points). The scores were more varied (from 27 to 42 points) which could be because the tasks were more difficult and students prepared differently. General performance was still good, showing that the brand is in good standing.

The performance of ChS-24-1k demonstrates the effectiveness of interactive educational programmes:

- All students were actively involved in the learning process.

- Results were consistently high across the group.

- Interactive methods increased student engagement and enhanced their interest in the subject.

2. Analysis of the results to determine the attitude of students towards interactive apps

This questionnaire helps to gain a clear understanding of students' attitudes towards, and experiences of using interactive apps. It enables the evaluation of the group's response to teaching methods, their level of comprehension and the effectiveness of technology in the learning process. For instance, students who enjoy lessons involving apps (85-90%) and find interactive lessons more engaging than traditional ones are likely to be more motivated and enthusiastic about learning. The majority of students (85%) stated that they understood the topic well, which indicates that the teacher delivered the material in a visual and well-structured manner. Over 90% of students acknowledged that using Kahoot and mobile devices increased their interest and engagement during the lesson. Additionally, answers about the practical application of knowledge in

real life provide insight into students' practical attitude towards the subject (figure 5).

Conclusion

The study confirms the importance of using interactive applications such as Quizizz, Kahoot, and Quizlet in teaching inorganic chemistry in a digital educational environment. An analysis of test results among students in groups ChB-32r-21, ChB-24-1k, and ChS-24-1k at Buketov Karaganda National Research University revealed a significant improvement in material comprehension: average scores increased, with «good» and «excellent» grades becoming more common. This suggests that interactive methods can enhance student engagement and academic performance by facilitating the visualisation of complex concepts, such as the properties of elements in the periodic table, and encouraging independent study.

A survey of students revealed a predominantly positive attitude towards interactive applications. Between 85% and 90% of respondents noted their engaging nature, clarity of presentation, and usefulness in understanding the subject matter. They also expressed a desire to use such tools more often in their studies.

Overall, interactive applications can be a powerful tool for modernising the teaching of inorganic chemistry and promoting critical thinking, practical skills, and emotional engagement. To further improve effectiveness, adaptive programmes should be developed that take regional characteristics into account, and longitudinal studies should be conducted to assess the long-term impact on the professional training of chemistry specialists. These results could then be used to inform similar approaches in other natural science disciplines, thereby contributing to improvements in higher education in Kazakhstan and beyond.

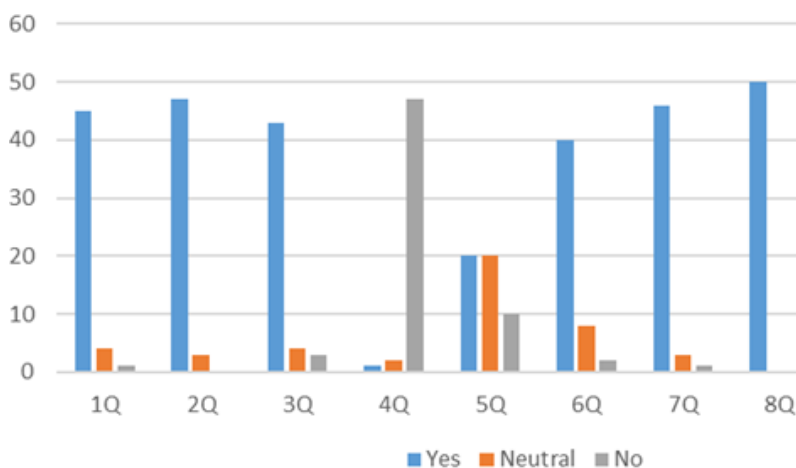


Figure 5 – The results to determine the attitude of students towards interactive apps

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Бейорганикалық химияны оқытуға арналған интерактивті қосымшаларды қолдану бойынша алдын ала зерттеу

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Аңдатпа. Бұл алдын ала (пилоттық) зерттеу интерактивті қосымшалардың бейорганикалық химияны оқытудағы білім сапасы мен оқушылардың пікіріне әсерін зерттеді. Зерттеу Е.А. Бөкетов атындағы Қарағанды университетінің химия факультетінде ХБ-32Р-21, ХБ-24-1к және ХЕ-24-1к топтарының студенттерінің қатысуымен жүргізілді. Quizizz, Kahoot, Quizlet және басқа интерактивті платформаларды пайдалану арқылы тестілеу нәтижелері талданды. ХБ-32Р-21 тобы орташа 20 баллдың ішінде 17,6 балл жинап, жоғары деңгейдегі қызығушылық пен табыстылықты көрсетті. Сол сияқты, ХБ-24-1к және ХЕ-24-1к топтары да тұрақты нәтижелерге қол жеткізді, бұл интерактивті әдістердің тиімділігін дәлелдейді. Студенттер арасында жүргізілген сауалнама интерактивті қосымшаларды қолдануға оң көзқарасты анықтады: студенттердің 85-90%-ы олардың қызықты әрі материалды түсіндіруде айқын екенін атап өтті. Алайда зерттеу барысында кейбір студенттердің цифрлық сауаттылығының жеткіліксіздігі және құрылғылар мен интернетке қолжетімділіктің шектеулілігі сияқты мәселелер анықталды, бұл білім алуда теңсіздік туғызуы мүмкін.

Кілт сөздері: жоғары білім, интерактивті оқыту, онлайн платформалар, интерактивті қосымшалар, бейорганикалық химия, студенттер, сауалнама.

Пилотное исследование по применению интерактивных приложений для преподавания неорганической химии

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Аннотация. В пилотном исследовании изучалось влияние интерактивных приложений на качество знаний и мнение учащихся в преподавании неорганической химии. Исследование проводилось на базе химического факультета Карагандинского университета имени Е.А. Букетова с участием студентов групп ХБ-32Р-21, ХБ-24-1к и ХЕ-24-1к. Были проанализированы результаты тестирований с использованием интерактивных платформ, таких как Quizizz, Kahoot, Quizlet и др. Группа ChB-32r-21 показала средний балл 17.6 из 20, демонстрируя высокий уровень вовлеченности и успешности. Аналогично, группы ChB-24-1k и ChS-24-1k продемонстрировали стабильные результаты, что подтверждает эффективность интерактивных методов. Опрос, проведенный среди студентов, выявил положительное отношение к использованию интерактивных приложений: 85-90% студентов отметили их увлекательность и ясность подачи материала. Однако исследование выявило и проблемы, такие как недостаточная цифровая грамотность некоторых студентов и ограниченный доступ к устройствам или интернету, что может создавать неравенство в обучении.

Ключевые слова: высшее образование, интерактивное обучение, онлайн-платформы, интерактивные приложения, неорганическая химия, студенты, анкетирование.

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