

# Opportunities for Using Mobile Applications in Chemistry Lessons

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## ABSTRACT

This article analyzes the possibilities of using digital technologies, in particular mobile software applications, in the educational process. The pedagogical significance of teaching educational materials on the natural resources of the territory of Karakalpakstan through mobile applications is highlighted in chemistry lessons. With the help of mobile technologies, the possibilities of increasing students' interest in the subject, effective assimilation of educational materials, and organizing lessons based on interactive and game technologies are shown. The main functional capabilities of mobile applications in the educational process and their role in increasing the effectiveness of training sessions are also analyzed.

**Keywords:** Digital technology, innovative programs, natural resources, mobile software applications, chemistry education, principles.

## INTRODUCTION

Research is being conducted worldwide aimed at improving the quality of chemical education, introducing innovative and digital technologies into the educational process, introducing them into teaching practice, and using the possibilities of blended learning. These efforts are aimed at creating modern methodological foundations that develop students' intellectual potential and creative abilities [1].

Today, the organization of the educational process using digital technologies is of great importance. In the educational process, much attention is paid to the effective organization of the educational process using various software tools, Web platforms, and mobile software applications, which are considered digital technologies. Increasing students' interest in the subject using mobile technologies in the modern educational process, improving the content of educational materials increases the possibility of more effective learning and expands the possibilities of conducting lessons in an interactive manner using game technologies [2]. When providing educational materials on the natural resources of Karakalpakstan in

accordance with the educational materials given in the textbook in chemistry lessons, the organization of classes using mobile applications ensures that the lessons are more interesting and effective. Let us briefly dwell on the content of the functional capabilities of using mobile applications in lessons.

The main functionalities of the mobile application are:

- 1. 3D modeling of mineral resources.** Three-dimensional models of the main mineral resources (salts, phosphorites, oil and gas deposits) of the territory of Karakalpakstan, the possibility of viewing them from different angles, studying their structure.
- 2. Interactive chemical reactions.** Students have the opportunity to conduct chemical reactions based on various local raw materials (for example, table salt, magnesium salts, phosphorites) virtually. Show the reactions step by step, explain the reaction mechanism.
- 3. Geolocation and maps.** Using GPS technology, provide students with information about the natural resources of

their territory, information about the location of nearby natural resources.

**4. Augmented Reality (Augmented Reality).** Displaying data on the composition, properties, and use of natural reserves (table salt, Glauber's salt, phosphorite) in augmented reality format by scanning samples.

**5. Virtual laboratory.** Students can conduct various laboratory experiments in a virtual environment. For example:

- Dissolution and crystallization of salts
- Ion exchange reactions

Obtaining substances of practical importance (sodium hydroxide, chlorine, hydrogen).

**6. "Chemist" Simulator.** The student, playing the role of a "chemist," participates in the process of processing the natural resources of Karakalpakstan, manages various chemical processes, and receives products.

**7. Environmental monitoring.** Students can observe the environmental situation in their area, enter data into the application, and analyze it. For example:

- Study of soil sample composition
- Water sample inspection
- Identification of environmental problems

**8. Project Activity.** Students have the opportunity to create their own projects in the application and develop them together with other students. For example:

"Salt Deposits in Our Territory";

- "Processing of petroleum products";
- "Production of mineral fertilizers."

Today, many mobile software applications have been created by specialists in the field and researchers for use in chemistry lessons, which are currently being effectively used in the educational process [3].

When creating a mobile application, the implementation of the following technical solutions is required.

### **1. Programming Platform**

- React Native / Flutter - cross-platform solution (Android and iOS)
- Local platforms (Java/Kotlin for Android, Swift for iOS)

### **2. Data storage**

- SQLite - local database
- Firebase - cloud database
- Opportunity to work offline

### **3. Interactive elements**

- Unity 3D - for 3D models and games
- AR Core / AR Kit - for augmented reality
- Chemistry JS - library for modeling chemical reactions

### **4. Design standards**

- Material Design (Android)
- Human Interface Guidelines (for iOS)
- Thematic design (with elements characteristic of Karakalpakstan)

The issue of developing and presenting mobile software applications to the public is one of the current pressing issues in the education market [116; 12-b.]. In the process of observations and research, the goal was set to develop a mobile application intended for use in chemistry lessons. The difference between this mobile application and other applications is that it takes into account the use of educational materials on the natural resources of Karakalpakstan in lessons. The mobile application consists of 4 sections, and each section contains sub-sections. It consists of a chemistry section, a geography section, settings, and profile sections. The chemistry section consists of subdivisions on chemical elements, the periodic table, chemical formulas, and lessons. When entering a program installed on a mobile phone, the main window of the program appears.

The mobile application is intended for all Android devices and is intended for use by users in classroom and

extracurricular educational processes (Fig. 1.8).

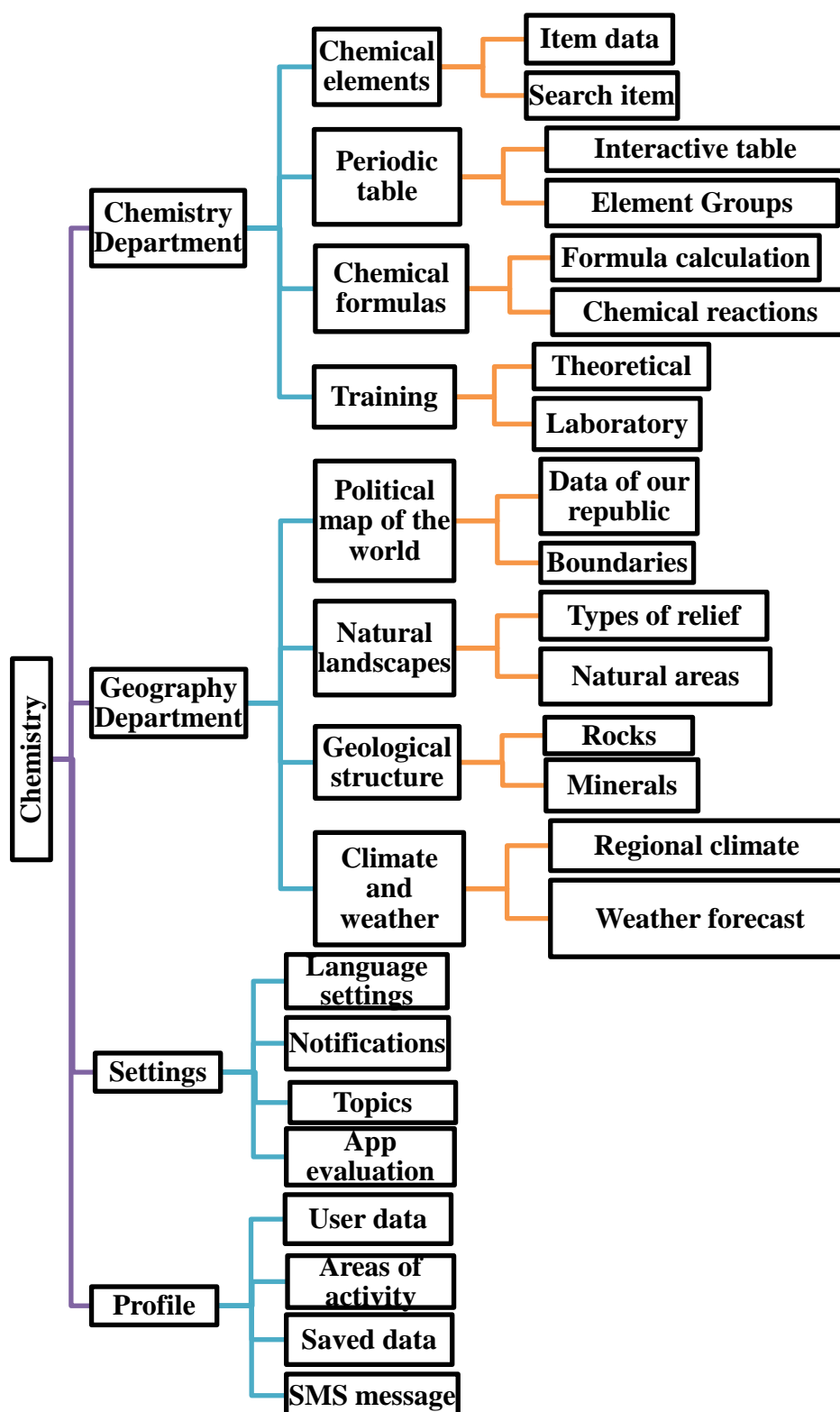


Figure 1.8: Schematic view of the "Chemistry" mobile application

The mobile application differs from other mobile applications in its ease of installation, simplicity, coverage of all necessary information, interesting tasks on each topic in order to independently improve the user's knowledge and skills, examples of the use of innovative technologies, and data on the physical geography of the regions [144; 45-b.].

The mobile application consists of a database, 3D models and images, video lessons, interactive tests, games and related educational materials that play an important role in conducting classes (Table 1.3).

Mobile app content

Content type	Description
Database	Metal reserves of Karakalpakstan, properties and uses of each metal.
3D models and images	3D views of metal ores from local deposits.
Video lessons	Interviews about the local metal industry, clips from the mines.
Interactive tests	Questions for monitoring student comprehension.
Games (Gamification)	For example: mini-games such as "Metal Find," "Build a Factory," "Separate Metals."

Through this application, we will familiarize ourselves with the process of using chemistry in classes. From the content of classes in the Chemistry section of the mobile application, we will familiarize ourselves with the content of educational materials on the topic "Use of the Most Important Salts" given in theoretical classes.

Topic: Use of the most important salts

**1. Scientific (knowledge-oriented) goal:**

The student will learn about the use of the most important salts: sodium chloride, calcium carbonate, ammonium nitrate, the natural reserves of salts used for various purposes in the national economy of our republic, and their use in the production of metals, sulfur, and various chemical compounds [3; P. 24].

**2. Educational goal:**

The student develops an ecological culture by observing safety regulations when working with sodium chloride, calcium carbonate, and ammonium nitrate, understanding their widespread use as means of controlling certain pests, increasing germination and yield, and promoting growth,

as well as explaining educational materials related to the natural reserves of salts used for various purposes in the national economy of our Republic.

**3. Developmental Goal:**

Students compare the properties of sodium chloride, calcium carbonate, ammonium nitrate salts, analyze what substances are formed using salts, understand the reaction equations, draw conclusions, develop independent thinking and problem-solving skills based on practical assignments.

**Homework.** Students can ask various questions on the covered topic and complete tests on the topic.

**New topic:** Use of the most important salts

Plan:

1. The importance of salts in human life, their role in the body.
2. Salts of sodium chloride, calcium carbonate, ammonium nitrate

3. Use of salts in the national economy. Natural reserves of salts in our republic.

Among complex substances, the most widespread and widely used in the national economy are inorganic substances - salts, which are of great importance for the normal course of life processes on Earth [97; p. 6].

The human body constantly needs to maintain salt balance, and 5.5% of the total body mass consists of various salts. For example, when calcium salts decrease in the body, there is a desire to consume calcium-containing products to restore balance. Or, when the body rapidly loses fluid for various reasons, salt is excreted with the fluid, therefore in such cases, various physiological salt solutions are given. Salts containing calcium, iron, potassium, sodium, and many other metals are used in medicine as medicines

against various diseases [65; P. 7].

Salts containing a group of metals known as nitrogen, phosphorus, potassium, sulfur, calcium, sodium, and trace elements are widely used in agriculture as fertilizers, pest control agents, and growth stimulants that increase germination and yield [113; 12-b.].

Sodium chloride - NaCl. We all know very well for what purposes table salt is used in everyday life. Table salt is used in industry for obtaining chlorine, alkali, and sodium metal, and in medicine for preparing physiological solutions [147; p. 13]. Information from the infographic in Figure 1.9 can also be used to provide information on the areas of application of table salt. This helps students remember information about the use of table salt for a long time.

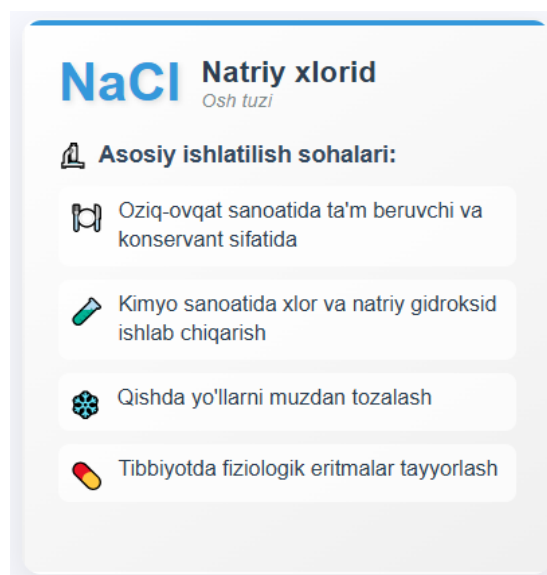


Figure 1.9: Applications of NaCl

Calcium carbonate -  $\text{CaCO}_3$ . Salt used in construction as marble, limestone. Marble is most often used for decorating buildings. It adds to the beauty of the Tashkent metro stations [155; p. 16]. When providing information on the areas of application of calcium carbonate salt, it may

be even more interesting to use the information in the infographic in Figure 1.10. This plays an important role in providing students with sufficient information about the use of calcium carbonate in the national economy, and also plays an important role in students' mastery of educational materials on natural reserves.

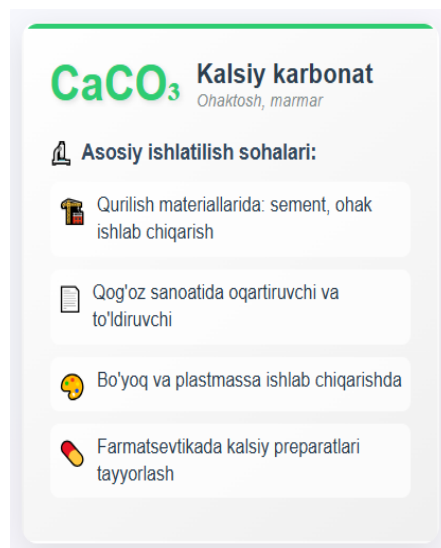


Figure 1.10: Applications of CaCO3

Ammonium nitrate - NH<sub>4</sub>NO<sub>3</sub>. It is used in agriculture under the name ammonium nitrate. It is produced artificially at the Fergana Nitrogen Fertilizer Plant and Navoiyazot JSC. In industry, salts are also widely used in

the production of various metals and other salts. For example, cast iron and steel are obtained from sulfide iron salts. In the territory of our republic, natural reserves of salts used for various purposes in the national economy have been identified [125; 11-b.].

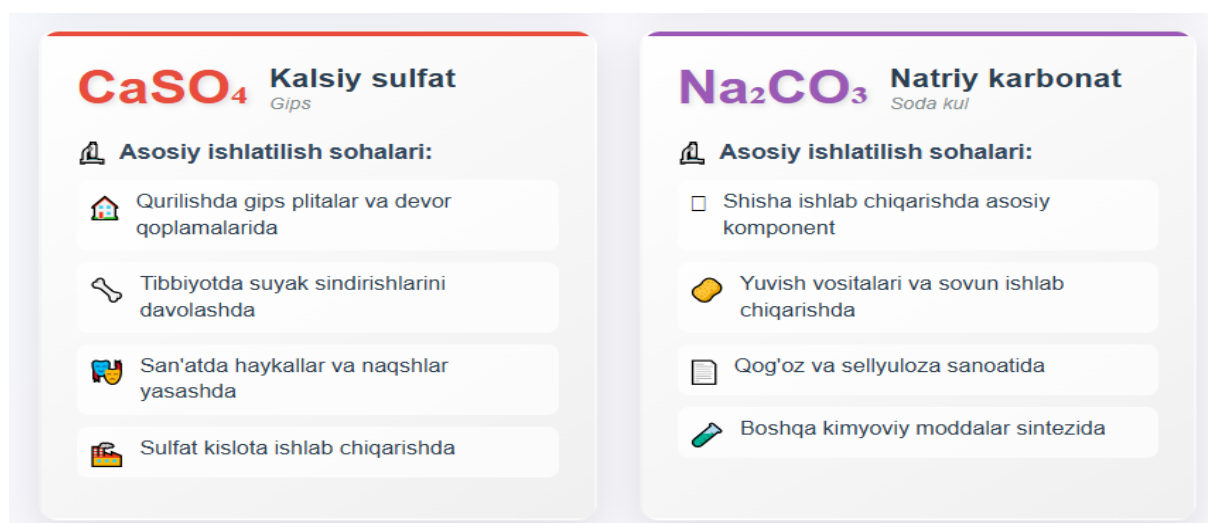


Figure 1.11: Application areas of CaSO<sub>4</sub> and Na<sub>2</sub>CO<sub>3</sub> salts.

Marble (CaCO<sub>3</sub>) is obtained from the Nurata and Gazgan deposits. Table salt (NaCl) and sylvinit (NaCl KCl) are extracted from the Khojaikon, Tubokat, Borsakelmas, Boybichakon, and Oqqal'a deposits. Phosphorite (Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>) is extracted from the Central Kyzylkum, Karakat, and Northern Jetitov deposits. Sulfide

salts of a number of non-ferrous metals are extracted from the Almalyk natural deposits. They are used in the production of metals, sulfur, and various chemical compounds. In addition, during the lesson, educational materials on the use of calcium sulfate, sodium carbonate, potassium chloride, and magnesium sulfate salts can be used (Figures 1.11 and 1.12).



**Figure 1.12: Applications of KCl and MgSO<sub>4</sub> salts laboratories.**

At the end of the lesson, students are asked questions on the covered topic. Students who actively participated in the lesson will be evaluated. Mobile software applications serve to make the lesson interesting and effective. Today, systematic work is being carried out on the creation of mobile software applications in the teaching of subjects [120; P. 28].

Based on the results of research conducted by specialists, it was shown that the use of mobile software applications in classes has the following advantages.

1. Easy and quick access to information - students can access educational materials at any time and in any place.
2. Interactivity - students become active participants, not passive observers.
3. Visualization - the ability to demonstrate complex concepts through animations, 3D models, and virtual

4. Flexibility - the material can be presented depending on the level of assimilation of each student.

5. Learning monitoring - creation of an automated system for assessing and analyzing students' knowledge.

In chemistry lessons, teaching educational materials on the natural resources of Karakalpakstan in accordance with the topics given in the textbook, using mobile applications, fully corresponds to the requirements of modern education. Organization of classes using mobile applications serves to effectively organize the educational process, to conduct classes in an interesting way, to increase the possibilities of organizing educational materials using various technologies, to form a scientific worldview of students, to master educational materials on the natural resources of the region in which they live, to increase their interest in professions in the field of chemistry, and to develop their research skills [127; 12-b.].

The use of a mobile application in lessons and extracurricular activities contributes to an increase in students' interest in the types of local natural resources, the raw materials obtained on their basis, professions in the field of chemistry, and the acquisition of information about their contribution to the economic and environmental development of the region [109; P. 24].

## CONCLUSION

The research results showed that the introduction of digital technologies, in particular mobile software applications, into the process of teaching chemistry is of great importance in increasing the effectiveness of the educational process. Mobile applications serve to organize lessons in an interactive, visual, and interesting way for students, allowing them to combine theoretical knowledge with practical activity.

The mobile application proposed in the article allows for the effective use of educational materials related to the natural resources of the regions in chemistry lessons. Functions such as 3D modeling, virtual laboratory, interactive reactions, and augmented reality in the application develop students' scientific thinking, independent thinking, and problem situation analysis skills.

Also, through the mobile application, it will be possible to visually and interactively study the natural reserves and areas of application of salts such as sodium chloride, calcium carbonate, and ammonium nitrate when teaching the topic "Use of the Most Important Salts." This serves to increase students' interest in science, form their ecological culture, and strengthen their knowledge of regional resources. In general, the use of mobile applications in chemistry lessons is an important pedagogical tool for modernizing the educational process and developing students' knowledge, skills, and competencies.

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