

The Relevance Of 4C Competencies In Teaching Mathematics In The 21st Century

Obidov Elyor

Mathematics subject methodologist at Methodological Service Department at Namangan Regional Center for Pedagogical Mastery (PMM), Uzbekistan

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Abstract: This article highlights the importance of the 4C (4K) skills—creativity, critical thinking, communication, and collaboration, which are core requirements of 21st-century education—in the teaching of mathematics. The study analyzes how developing these competencies can enhance students' logical reasoning, independent thinking, problem analysis, and creative problem-solving abilities. It also outlines ways to implement the 4C skills in mathematics lessons through interactive methods, digital technologies, and project-based learning elements. The results provide a methodological basis for mathematics teachers to organize effective, modern lessons.

Keywords: 4C skills; creativity; critical thinking; communication; collaboration; mathematics education; 21st-century skills; interactive methods; digital technologies.

Introduction: At a time when digitalization and innovative technologies occupy a central place in all areas of modern society, the education system must also not remain on the sidelines of this process. In particular, one of the most pressing issues in teaching mathematics today is developing students' logical thinking, analytical abilities, and problem-solving skills through modern approaches.

While traditional methods have been aimed primarily at delivering knowledge, modern teaching strategies focus on enhancing students' personal activity, curiosity, and ability to think independently. The use of contemporary pedagogical approaches and technologies makes learning mathematics not only more effective but also more engaging. For teachers, continuous research, the adoption of innovations, and organizing the educational process with consideration for students' individual development all contribute to improving the quality of education.

The 21st century has witnessed remarkable progress in mathematics education, with new, distinctive approaches and techniques emerging in the teaching of the subject. For teachers, it is crucial to study and apply specific methodologies that help deepen students' intelligence and comprehension. Firstly, the use of technology has revolutionized mathematics education in the 21st century. Teachers can now use various

software and online platforms that engage students in interactive activities and simulations. These tools not only make the learning process more interesting but also help students visualize complex mathematical concepts, thereby improving understanding and retention.

Moreover, integrating real-life applications into mathematics lessons has proven highly effective. By linking mathematical concepts to real-world scenarios, students can achieve a deeper understanding of the subject. For example, teaching algebra through the analysis of geometric or architectural projects, or studying economic data through statistics, allows students to see the practical relevance of mathematics and strengthens their cognitive engagement with the discipline.

Collaborative learning strategies have also become an essential part of 21st-century mathematics education. Group work and discussions encourage students to exchange ideas and solve problems collectively. This approach enhances critical thinking skills and fosters deeper understanding as learners explore each other's perspectives and strategies.

Overall, 21st-century mathematics education incorporates diverse methods and approaches that strengthen students' intellectual and cognitive development. The integration of technologies, real-

world applications, collaborative learning, individualized instruction, practical experiences, flexible classroom models, formative assessment, project-based learning, cultural relevance, and professional teacher development all contribute to students' comprehensive growth.

Starting from the new academic year, students will learn from a new generation of textbooks. One of the main features of these textbooks is that they are designed based on the 4C principle. This principle goes beyond rote memorization or simple reading and writing; it focuses on teaching students not only academic subjects but also the essential life skills required in the 21st century.

The 4C approach (also known as the 4K approach) encompasses four fundamental principles:

Collaboration.

The textbooks are structured to help students develop their ability to work effectively in teams. This approach teaches students to cooperate, exchange ideas efficiently, and provide mutual support.

Communication.

Students learn to express their thoughts clearly and coherently, listen to and understand their interlocutors, and use language effectively to convey information.

Creative Thinking.

Students are taught to apply new approaches to achieve their goals, develop innovative solutions, and acquire the ability to solve creative problems.

Critical Thinking.

This methodology helps students develop skills in critically evaluating information and forming their own opinions and judgments. Students learn to approach problems analytically and shape their perspectives based on logical reasoning.

Before implementing this innovative approach in Uzbek schools, foreign experiences were also studied. Countries with advanced education systems such as Singapore, China, England, Finland, and Estonia emphasize that the successful application of the 4C approach largely depends on teachers. Therefore, more than 300 trainer-teachers from across the country were recently trained in Tashkent. They will help improve the qualifications of other teachers

nationwide.

In international educational rankings such as PISA and PIRLS, countries that have achieved high results pay special attention to developing students' competencies in communication, inquiry, and creativity, which are integral to the 4C approach. This focus has enabled them to attain outstanding achievements in global education ratings.

An innovative approach based on the "4C model" does not require any special conditions for implementation in schools. For example, students' critical thinking skills can be developed through well-designed questions and tasks, while communication skills are strengthened through dialogue-based exercises and interactive activities. Therefore, it is incorrect to assume that schools lack the necessary conditions to apply these methods.

In the context of 21st-century education, preparing students for modern life—teaching them to think independently, work collaboratively, and adopt innovative approaches—is of vital importance. From this perspective, the 4C model plays a central role in developing the universal competencies essential for students' success in the future.

The 4C model not only helps students acquire knowledge but also teaches them how to apply it in practice, work effectively in teams, and develop the skills necessary for success in their future careers.

This raises the question: What methods of the 4C model can be used to develop these competencies? The following are some examples.

One of them is the "Corner of Thoughts" or Cameras Method. In this approach, four corners of the classroom are assigned to concepts related to a specific topic. Students move to the corner that best represents their opinion or understanding of the topic and then justify their reasoning.

Another example is the Frayer Model, which is a graphic organizer (Figure 1). It was created in 1969 and is widely used for learning vocabulary words. However, the Frayer Model is highly versatile and can be applied across all subjects. It not only helps students expand their vocabulary but also develops their ability to work with and understand different concepts.

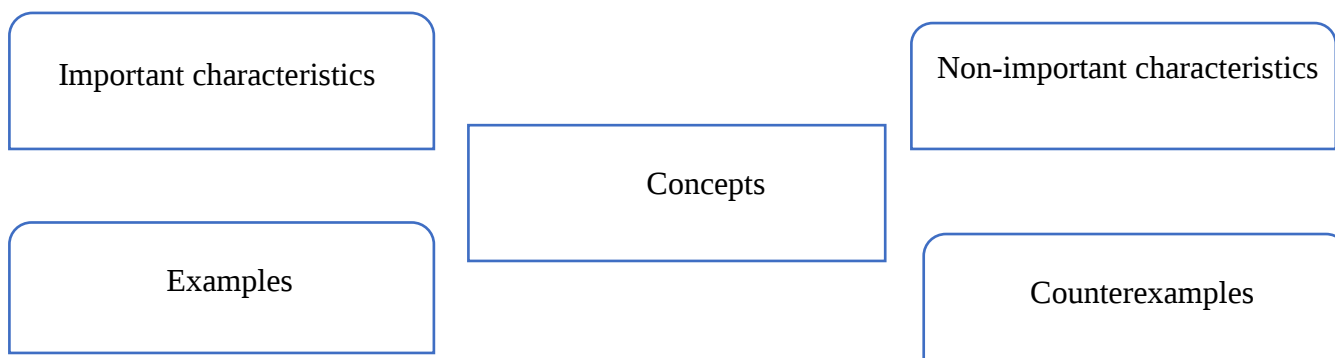


Figure 1. Frayer Model

For example: The Concept of the Indefinite Integral

Lesson duration: 45 minutes

Lesson type: New knowledge acquisition, interactive method

SMART Goals

Specific: Students will understand the concept, notation, and basic properties of the integral.

Measurable: Each student will be able to provide examples and counterexamples using the Frayer model.

Achievable: Students will master the topic through group work.

Relevant: The integral is applied in solving practical problems (area, volume, velocity, and distance).

Time-bound: The concept will be explained and examples completed within 45 minutes.

The Frayer model helps students develop a deeper understanding of mathematical concepts and use them correctly. This process directly promotes the development of 4C skills:

Creativity. Students learn to think creatively by independently generating definitions, characteristics, examples, and counterexamples of a concept.

Critical Thinking. By comparing examples and counterexamples, students develop logical and analytical thinking skills.

Communication. Through group discussions and

presentations, students practice expressing their thoughts clearly and fluently.

Collaboration. Since the Frayer model is based on teamwork, students learn to listen to each other, share ideas, and find solutions collaboratively.

Thus, the Frayer model serves not only as an effective tool for mastering mathematical concepts but also as a means of developing the 4C skills essential for 21st-century education.

Lesson Stages

1. Organizational Stage (5 minutes)

- Greeting and checking attendance.
- Dividing students into groups of 3–4 people.

2. Introduction (5 minutes)

- Question: “What does a derivative represent? Does it have a reverse operation?”
- Based on students’ answers, the topic of the lesson is announced: Integral.

3. Main Part (25 minutes)

- Explaining the concept using the Frayer model.
- Students fill out the following table on A3-sized sheets:

Concept (Indefinite Integral)	Definition: $\int f(x) dx = F(x) + C$, where $F'(x) = f(x)$, C is an arbitrary constant.
Main Characteristics (Properties)	- The inverse operation of differentiation. - Symbol: $\int$ - There are specific rules for integration. - The constant C is always added.
Examples	$\int x^2 dx = x^3/3 + C$ $\int \cos x dx = \sin x + C$

Counterexamples	$f'(x) = 2x$ (this is a derivative, not an integral) Σa_i (this is a sum, not an integral)
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4. Reinforcement (7 minutes)

Mini-test questions:

1. $\int 2x \, dx = ?$
2. What does "C" mean in the integral notation?
3. Give a counterexample.

5. Final stage (3 minutes)

- Review the groups' Frayer model sheets.
- Question: "In what real-life problems can the integral be used?"
- Homework: Solve 5 simple integrals and complete a Frayer model.

Mix-Freeze-Group

In this method, students move around and mingle to music. When the music stops, everyone "freezes" in place, and the teacher asks a discussion question on the topic. Students form small groups according to their answers and, through various movements/activities, present their responses. The number of students in each group depends on the question posed by the teacher.

Stir-the-Class method

Students are asked to independently write down concepts on the topic in their notebooks. After finishing, they walk around the classroom, read their classmates' written concepts, and add to their own lists any concepts they do not have. They are given a chance to include as many peers' ideas as possible.

What these methods develop:

- Ability to express independent opinions
- Sharing ideas with others
- Teamwork
- Skill in organizing and structuring thoughts
- Fluent speech
- Ability to analyze
- Critical thinking
- Respect for others' opinions
- Creative thinking

CONCLUSION AND RECOMMENDATIONS

A new innovative approach can be observed in the growth of students' worldview and thinking. The portrait of a 21st-century learner must include 21st-century skills—that is the main purpose of applying innovative methods. Moreover, the primary goal of education is not only to impart knowledge, but to teach

students to apply what they have learned in real life.

Based on the analyses and practical observations presented above, it has been determined that the 4C model—creativity, critical thinking, collaboration, and effective communication—introduces a qualitatively new approach to the learning process in teaching mathematics. This model transforms students from passive recipients of knowledge into active creators of knowledge. The 4C model helps increase students' mathematical literacy, develop independent thinking, and become active in analyzing real-life problems and finding solutions. Working in groups strengthens socialization and fosters mutual respect, exchange of ideas, and leadership qualities. Notably, students' engagement, interest, and outcomes were observed to increase significantly during lessons. However, the successful implementation of the model is directly linked to the teacher's methodological proficiency, thorough lesson planning, and the learning environment. Therefore, to put the 4C model into practice, it is essential to provide teachers with ongoing professional development courses, methodological guides, and updated textbooks.

Overall, in mathematics education the 4C model not only heightens interest in the subject, but by cultivating 21st-century competencies it prepares students for life, professional activity, and independent decision-making. For this reason, widespread implementation of this model in all general-education schools is both timely and promising.

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