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FORMS AND METHODS OF IMPLEMENTING THE DIFFERENTIAL APPROACH IN ALGEBRA LESSONS

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Abstract

This article provides a systematic analysis of the theoretical foundations, practical forms, and methodological techniques for implementing a differentiated approach in algebra lessons. In modern education, the ineffectiveness of traditional algebra lessons conducted without considering differences in students' knowledge levels, cognitive styles, and learning rates is becoming increasingly evident. Based on Carol Ann Tomlinson's concept of differentiated instruction, the article examines the possibilities of adapting content, process, product, and environment to students' readiness levels, interests, and learning profiles. Strategies such as tiered assignments, flexible grouping, formative assessment, learning stations, choice boards, open tasks, and scaffolded questioning are described in the context of the conceptual complexity of algebra, symbolic manipulations, and abstract concepts. According to the research findings, the differentiated approach is a key tool for meeting students' individual needs, developing their mathematical thinking, and increasing the effectiveness of algebra lessons.

Keywords: differentiated approach, algebra, tiered assignments, flexible grouping, formative assessment, cognitive styles, mathematical thinking.

Introduction. Algebra is one of the fundamental branches of mathematics, forming the foundation not only of higher mathematics but also of many fields such as physics, economics, engineering, and information technology. In the process of teaching algebra in secondary schools and academic lyceums of Uzbekistan, the primary task is to develop students' logical thinking, abstract thinking abilities, and analytical problem-solving skills. However, in modern classrooms, students' level of knowledge, mathematical preparation, cognitive style, and learning speed differ significantly. It is precisely these differences that the traditional "one-dimensional" teaching method, which does not take into account, often leaves strong students bored and weak students behind [1, p. 10-15].

The differential (differentiated) approach serves as an effective pedagogical mechanism for solving this problem. Differentiated education is the process of adapting the content, process, product, and learning environment depending on the students' level of preparation, interests, and learning profile [2, p. 23-30]. Applying the differential approach in algebra classes serves to meet the individual needs of students when mastering complex topics such as working with equations, functions, inequalities, and algebraic expressions.

The purpose of the article is to theoretically substantiate the main forms and methods of implementing the differential approach in algebra lessons and to develop practical recommendations. Objectives: analysis of pedagogical theories of differential education, identification of its specific aspects in algebra, systematization of practical methods, and establishment of effectiveness criteria.

Body

1. Theoretical and methodological foundations of the differential approach

Carol Ann Tomlinson is considered one of the modern theoretical founders of differentiated education. He argues that a differentiated approach is a teacher's response to students' individual differences in a "proactive" rather than a "reactive" way. That is, at the lesson planning stage, students' different levels of preparation, interests, and learning styles are taken into account [2, p. 45-50]. Tomlinson showed that the four main elements of differentiated education - content, process, product, and environment - can be differentiated depending on the needs of students.

As noted in the works of Uzbek pedagogical scholars, including R.A. Mavlonova and others, a differentiated approach to teaching mathematics is an important factor in developing students' logical thinking, enhancing their independent work skills, and improving the quality of education [3, p. 56-60]. Additionally, the differentiated approach requires taking into account differences in students' cognitive styles (visual, auditory, kinesthetic, analytical, and intuitive). Research conducted at Al-Mustansiriya University shows that a differentiated approach based on cognitive methods significantly increases the efficiency of mastering mathematical concepts [4, p. 10-18].

2. Main forms of the differential approach in algebra lessons

A distinctive feature of algebra is its step-by-step and cumulative structure. A student who has not fully mastered one topic will face serious difficulties in subsequent topics. For this reason, the use of the following differential forms in algebra lessons is considered effective:

Tiered assignments: All students move toward the same learning goal, but the difficulty level of the assignment varies according to their level of preparation. For example, in the topic "Linear Equations with One Unknown," primary students solve equations of the form $2x + 3 = 7$, middle-level students solve equations with fractional coefficients ($2/3\ x + 1/4 = 5/6$), and high-level students solve equations with parameters [5, p. 30-35].

Flexible grouping: Students are grouped into temporary groups based on their level of preparation, interest, or learning style. The composition of the groups changes regularly. In algebra lessons, one group learns a new topic directly with a teacher, another group performs an independent exercise on a digital platform, and a third group works on a project.

Training stations and rotation models: A classroom is organized with 3-4 stations. For example, "Station 1 - small group with teacher," "Station 2 - visualization using Desmos or GeoGebra," "Station 3 - practical tasks," "Station 4 - independent written work." Students walk around the stations at designated intervals.

Choice boards: Students are given 9-12 different task options (for example, "graphing a function," "analyzing a system of equations," "composing an algebraic puzzle," etc.), and they select a certain number of tasks to complete. This method activates students' interests [6, p. 9-15].

3. Practical methods of the differential approach

The differential approach is implemented in algebra lessons through a number of specific methods:

Formative assessment: During the lesson, quick information is obtained about students' level of mastery through "exit cards," one-minute essays, and the "semaphore" method (green – understood, yellow – partially understood, red – did not understand). Based on this information, the next differential steps are determined [7, p. 12-14].

Concrete-representative-abstract (CRA) sequence: A new algebraic concept is first taught through physical models (concrete), then through drawings (representative), and then through

mathematical symbols (abstract). This method is especially effective for students who have difficulty with abstract thinking.

Step-by-step Q&A (scaffolding): The complex problem is broken down into smaller steps. At each stage, students are provided with the necessary assistance. For example, when analyzing the graph of a quadratic function: 1) the direction of the parabola; 2) axis of symmetry; 3) coordinates of the vertex; 4) zeros; 5) the largest/smallest value. At each stage, students at different levels are given different advice.

Use of digital technologies: Platforms such as Desmos, GeoGebra, Khan Academy, and DeltaMath allow for the provision of adaptive tasks. For example, Khan Academy's "Mastery Learning" system automatically changes the difficulty level of the next task based on the students' answers.

Open tasks: Tasks with multiple correct answers or multiple solutions. For example: "What kind of real process can the graph of this function represent?" or "Write two different word problems that match the given system of equations." Such assignments create a convenient entry point for students of different levels of preparation.

4. Stages of designing the differential approach in algebra lessons.

Designing an algebra lesson based on the differential approach includes the following stages:

1. Diagnostic stage: At the beginning of the topic, students' initial knowledge, interests, and learning styles are determined through a short test, interview, or observation.

2. Planning stage: Based on the identified data, tasks of different levels, various support tools, and various grouping models are developed to achieve the same learning goal.

3. Implementation stage: The lesson is organized based on stations, rotating groups, or selection panels. The teacher constantly monitors the students' activities and makes the necessary changes.

4. Evaluation and analysis stage: Based on the results of the formative and final assessment, the effectiveness of differentiated strategies is analyzed, and measures for improvement for subsequent lessons are determined.

Discussion

Despite the fact that the application of the differential approach in algebra lessons has yielded a number of positive results, there are several problems in practice. In particular, observations conducted in schools in Uzbekistan show that many algebra teachers limit the differential approach to dividing only into "strong" and "weak" groups. However, the composition of differentiated education groups should be constantly changing and should not divide students into "frozen" categories [8, p. 70-75].

The second major problem is the lack of time and resources. Preparing 2-3 different tasks and various supporting materials for one lesson requires additional time from the teacher. For this reason, many teachers do not want to abandon traditional methods [9, p. 40-45]. At the same time, digital technologies can partially solve this problem. Adaptive systems such as Khan Academy and UzEdPlatform automatically offer differentiated tasks.

The third problem is the complexity of the assessment system. How should the knowledge of students who have completed tasks of different levels be evaluated fairly? Researchers recommend a rubric (point table) and a criterion-based assessment. For example, a basic level student can get an "excellent" grade if they correctly solve 4 out of 5 equations, while a higher level student will only get an "excellent" grade if they correctly solve 4 out of 5 complex equations. Such an approach requires explaining the criteria to students in advance [10, p. 50-55].

Additionally, some researchers argue that the excessive use of the differential approach can negatively impact students' ability to think independently. If a student constantly receives assignments at their level and does not encounter somewhat more complex problems, their thinking may stop developing. Therefore, the differentiated approach should be based on the principle of the "proximal development zone" (Vygotsky) - tasks should be somewhat difficult for the student, but manageable with help [11, p. 30-35].

The following factors are important for the widespread implementation of a differentiated approach in the education system of Uzbekistan: paying special attention to differentiated educational strategies in teacher professional development courses, supporting the use of digital platforms, equipping classrooms, and enriching textbooks with differentiated assignments [12, p. 20-25].

Conclusions and suggestions

In conclusion, the implementation of the differential approach in algebra lessons is an important pedagogical tool that takes into account the individual differences of students, develops their mathematical thinking and increases the effectiveness of the lesson. Level tasks, flexible grouping, formative assessment, training stations, open tasks, and digital technologies are the primary tools of the differentiated approach, and their systematic application helps overcome the conceptual complexity of algebra.

At the same time, there are obstacles to the introduction of a differentiated approach, such as a lack of time and resources, the complexity of evaluation criteria, the qualification level of teachers and some methodological errors. To overcome these barriers, the following proposals have been developed:

Professional development of teachers: Implementation of special modules on a differentiated approach in pedagogical institutes and professional development centers. These modules should provide for practical sessions (stations, selection panels, preparation of level assignments) along with theoretical foundations [3, p. 90-95].

Creation of a bank of differential assignments: Creation of an electronic bank on the Republican Education Portal containing at least 3 levels (basic, intermediate, advanced) of assignments for each topic of the algebra course and their corresponding rubrics.

Encouraging the use of digital platforms: Creating technical conditions for using platforms such as Desmos, GeoGebra, and Khan Academy in schools and lyceums. Enriching the domestic "UzMath" platform with differentiated task functions.

Differentiated organization of assessment work: By abandoning the traditional "everyone writes the same work" system, provide students with several options (basic, intermediate, high level) for assessment work and establish separate evaluation criteria for each option. This reduces students' stress levels and allows for an objective assessment of their actual knowledge [7, p. 23-30].

Support for research work: Encouraging applied research on the effectiveness of the differential approach in algebra lessons in the fields of mathematics and pedagogy of higher education institutions. Discussion of the research results at scientific and practical conferences and dissemination of best practices.

The implementation of these proposals will significantly improve the quality of teaching algebra in secondary schools in Uzbekistan and serve to raise the mathematical training of students to the level of international standards.

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