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The Role Of The STEAM Approach And Digital Technologies In Developing Mathematical Giftedness

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Abstract: This article analyzes the urgent issues of early identification and development of mathematically gifted students at the primary school stage. The psychological and pedagogical foundations of the concept of giftedness, as well as the criteria for identifying the general and specific characteristics of gifted learners, are examined. The article highlights the role of the teacher in working with mathematically gifted students, the significance of the learning environment, and ways of supporting them through modern technologies.

Keywords: Ability to abstract, giftedness, primary education, identification criteria, diagnostics, pedagogical approach, creativity, learner potential, analysis and synthesis, ingenuity, intuition, logic, intuitive hypothesis, perception.

Introduction: The primary school stage is one of the most important periods in the intellectual development of a child. Especially, interest and ability in mathematics begin to form precisely during this period. Early identification of mathematical giftedness not only creates a foundation for the learner's future achievements, but also enables the deep and logical development of thinking. In identifying mathematical giftedness, the teacher relies on the following criteria: logical reasoning, independent problem-solving, quick calculation, unconventional approaches, and sensitivity to mathematical terminology. In addition, student potential can be assessed through tests, observation,

interviews, and creative tasks.

Among modern methods, the STEAM approach, digital platforms, interactive games, and diagnostic tests play an important role. Through these methods, not only the learner's knowledge but also the quality of mathematical thinking can be assessed.

In research conducted to study mathematical giftedness among secondary school students and to direct them toward academic lyceums, experimental trials were carried out at the Academic Lyceum under Fergana State University and School No. 20 in the city of Quvasoy. At the initial stage of our graduation research work, we attempted to identify abilities characteristic of gifted students. For this purpose, through special subtests administered in the academic years 2023–2024, we identified 12 abilities associated with giftedness. Based on the main characteristics of mathematical thinking, the following hypothetical components of mathematical giftedness were derived.

We classified this ability, along with several others, into the hypothetical category of giftedness based on observations of students' problem-solving skills. For example, consider the following problem: "Prove that the number $2007^{2006} + 2005^{2007}$ is divisible by 2006 without remainder." Solution: Add 1 to the given number, then subtract 1: $2007^{2006} + 2005^{2007} = (2007^{2006} – 1) + (2005^{2007} + 1) – (2007 – 1)$ A + (2005 + 1) B = 2006 (A + B). It is clear that this number is divisible by 2006. A student's ability to perform such reasoning was generalized into the following categories.

An internal belief that motivates a person to study or achieve a particular goal. Self-confidence is a system of conscious and unique perceptions about oneself, based on which one demonstrates behavior and character. Self-confidence encompasses all positive traits beginning with "self," such as self-esteem, self-awareness, and self-reflection. It also includes the factor of "understanding one's place among others," which is one of the most important elements of personality formation. One of the important characteristics of a student's development during school years is the predominance of emotions forming the basis of self-confidence. That is, in lower grades, self-confidence is primarily unconscious, while in upper grades, conscious self-confidence increases significantly. Unconscious self-confidence manifests without full understanding of the difficulties involved, whereas conscious self-confidence is based on a clear perception of potential challenges. Therefore, tasks solved with conscious self-confidence are far more likely to be completed successfully. From this perspective, unconscious self-confidence is close to intuition. This may lead to the unexpected solution of highly complex mathematical problems that otherwise seem unrelated.

Intuition, ingenuity, resourcefulness. Intuition is a Latin term meaning "to look attentively," and refers to the ability to perceive truth without strict logical proof. Intuition is a unique concept that contradicts logic and strict reasoning. There are two types of intuition: intuitive judgment and intuitive hypothesis. Intuitive judgment directly perceives the objective relationship of objects or events without strict logical reasoning.Intuitive hypothesis refers to forming an assumption about a fact without logical proof, which is later confirmed through logical reasoning. Intuitive hypotheses arise unexpectedly, either consciously or unconsciously, appearing suddenly for a brief moment. Ingenuity is the intuitive hypothesis itself. Resourcefulness refers to the ability to solve extremely complex problems by transforming them into simpler ones with almost no modifications.

Motivation refers to the desire to perform a task, such as learning mathematics, solving problems, or creating something new. This psychological process ensures that the individual does not tire while working toward the intended goal and overcomes difficulties.

Carefulness refers to preventing possible errors or undesirable outcomes during work. It is one of the main factors enabling a person to overcome difficulties and perform tasks attentively.

Ability to analyze and synthesize. Analysis involves dividing a whole into parts and identifying the object's specific characteristics. Synthesis is the integration of the components obtained through analysis. These processes never occur in isolation. To perform an analytical process, one must have a complete understanding of the object, which corresponds to undifferentiated synthesis. Both real and ideal objects can be analyzed. When analyzing real objects, one directly sees them and can gather complete information about their properties, features, and structure through perception and imagination. For example, to find the volume of a clay pot of known dimensions, we observe it directly and gather sufficient information during the analysis.

After identifying the necessary characteristics of the object, synthesis begins, reconnecting the elements into a whole. The sequence of analysis and synthesis includes activating perception, memory, and imagination, identifying the properties of the object, dividing it into conceptual parts, studying the characteristics of each part, and finally returning to the whole through synthesis.

Ability to compare. Comparison is identifying the

similarities or differences between two objects based on their significant or insignificant features. Real objects, mathematical objects, their qualities, characteristics, as well as processes, events, and problem-solving methods may all serve as subjects for comparison. According to psychologists, comparison begins with activating memory and imagination to form clear perceptions of object features. Through verbal perception of objects, the main indicators of comparison are identified. Analysis and synthesis allow objects to be divided into parts based on their characteristics, leading to conclusions such as “equal–unequal,” “large–small,” “high–low,” “before–after,” “many–few,” “far–near,” “part–whole,” and “similar–not similar.”

CONCLUSION

In conclusion, early identification and support of gifted students in primary education play an essential role in improving the quality of education and developing young talent. Research findings indicate that giftedness manifests not only in high intellectual ability but also in creativity, independence of thought, and initiative. A multifaceted approach-such as pedagogical observation, diagnostic tests, questionnaires, and parental feedback- has proven to be effective in identifying gifted learners. In addition, a supportive socio-psychological environment created by both school and family is crucial for the development of giftedness, and the teacher’s role in this process is extremely significant.

In the future, to improve the system of identifying and supporting gifted learners, systematic methods must be developed and teachers' professional competencies should be enhanced. Identifying and developing giftedness at the primary school stage is one of the priority directions of modern education.

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