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IMPROVING METHODS FOR DEVELOPING FIRST-GRADE STUDENTS' IMAGINATION THROUGH THE VISUALIZATION OF LETTERS IN THE SCRATCH PROGRAMMING ENVIRONMENT

Annotation (Abstract). This article analyzes the potential of using the Scratch programming environment to create an effective model for enhancing imagination and visual thinking among first-grade students during the process of learning letters. The psychological, pedagogical, and technological aspects of digital visualization are examined, and the educational effectiveness of interactive letter animations developed in Scratch is evaluated based on the results of experimental trials conducted with first-grade learners. The study demonstrates that a multimedia (audio–visual–kinesthetic) approach increases students' speed of letter perception, strengthens their imaginative activity, and significantly facilitates the early literacy learning process. Regular use of the letter visualization module in Scratch reinforces phoneme–grapheme connections, improves students' ability to distinguish differences between letters, and increases their interest in the lesson.

Keywords: Scratch, imagination, visualization, letter animation, digital education, primary education, interactive technologies.

Introduction. In contemporary educational practice, the use of interactive technologies to activate learners and strengthen connections between letters, symbols, shapes, and sounds in their cognition is becoming increasingly essential. The integration of digital tools—particularly the Scratch programming environment, which enables the creation of multimodal learning settings—into primary education has gained growing attention in both scientific research and classroom practice [1]. The capabilities of Scratch play a significant role in

enhancing young learners' imagination, helping them associate symbols with visual images, and facilitating the process of mastering new concepts.

First-grade students typically exhibit highly active imaginative processes. However, because graphic symbols—letters—are abstract in nature, their accurate perception depends largely on the presence of visual, motor, and auditory stimuli [3]. Therefore, demonstrating letters through animation, presenting the step-by-step drawing process of their shapes, creating object-based animations corresponding to each letter, and producing the relevant phonetic sound when a letter is clicked serve as highly effective instructional techniques for young learners [9].

International research highlights that Scratch significantly contributes to the development of creative thinking, visual perception, compositional understanding, and algorithmic reasoning in young children [2]. However, within Uzbekistan, scientific studies dedicated to the use of Scratch in early literacy instruction remain limited. The relevance of this topic stems from the fact that the current literacy-teaching process makes insufficient use of digital visualization tools, while many students struggle to perceive abstract letter forms effectively [6].

The main goal of this research is to develop and experimentally validate an effective model for enhancing first-grade students' imagination through the visualization of letters using the Scratch programming environment.

2. Methodology. The study was conducted with first-grade students from general education schools located in the Kashkadarya and Bukhara regions, as well as the city of Tashkent. The participants were divided into experimental and control groups across several schools, as shown in Table 1.

№	Educational Institution	Experimental Group	Control Group
1.	School No. 2, Shahrisabz city	31	33
2.	School No. 4, Shahrisabz city	30	29
3.	School No. 3, Shahrisabz district	31	32
4.	School No. 6, Shahrisabz district	35	35
5.	School No. 8, Bukhara city	33	34

6.	School No. 34, Bukhara city	34	31
7.	School No. 242, Olmazor district	30	30
8.	School No. 152, Yashnabod district	39	39
Jami		**263**	**263**

Table 1. Distribution of Participants Across Schools

Total: 263 (experimental group) + 263 (control group) = **526 students**

A total of **526 first-grade students** participated in the study:

- **Experimental group:** 263 students
- **Control group:** 263 students

All participants were selected from classes with homogeneous characteristics in terms of age (7 years old) and similar levels of academic readiness [7].

Figure 1. Dynamics of Imagination Development

Development of Instructional Modules. Several pedagogical–informational modules were developed in the Scratch environment as part of the study:

1) Letter Animation Module. The animation of letter shapes—including their movement, coloring, and transformation—enhances learners’ imagination and strengthens their ability to form mental images of abstract symbols [4].

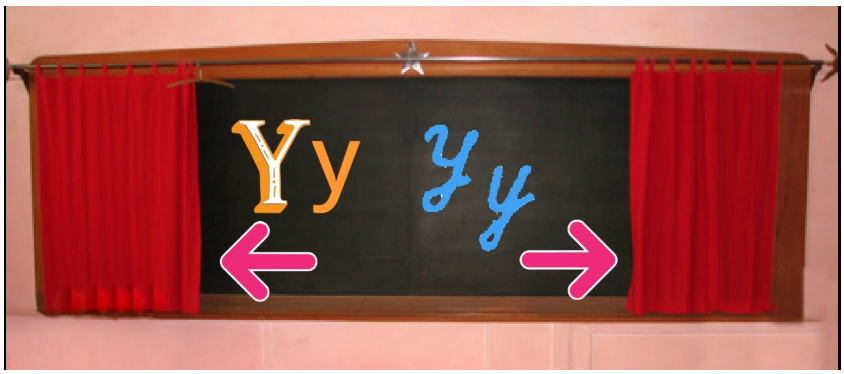

Figure 2. Scene for Teaching Letter Shapes and Writing

2) Phoneme–Grapheme Connection Module. When the learner clicks on a letter, its corresponding sound is played. For example, clicking on the uppercase letter “B” produces the audio “capital b—b—b…”, while clicking on the lowercase “b” plays “small b—b—b” [11]. This feature reinforces the auditory–visual linkage essential for early literacy development.

3) Letter–Object Association Module. Animated objects corresponding to each letter are integrated to strengthen associative learning. Examples include: “T — Camel (Tuya),” “Y — Tiger (Yo‘lbars),” and “K — Deer (Kiyik).” This approach facilitates learning through concrete, recognizable images, making abstract symbols more accessible and meaningful for young learners [8].

Figure 3. Learning Letters Through Animated Objects

4) Letter-Placement Game. In Scratch, students assemble letter combinations to form simple names and place letters into their corresponding cells.

This game-based activity develops skills of selection, differentiation, and logical reasoning, thereby strengthening foundational literacy competencies [5].

Figure 4. Scene for Constructing Words Correctly

Stages of the Study

Diagnosis. Students' initial literacy indicators were assessed according to the following criteria:

- speed of letter recognition,
- ability to remember letter shapes,
- level of imagination (capacity to form mental images).

Experimental Intervention. The experimental group participated in classes conducted over a period of four months (September–December) using a Scratch-based electronic learning module specifically developed for this study. In the control group, traditional teaching methods were applied without digital visualization tools.

Stage 3: Final Assessment. The outcomes of both groups were compared using verification tests, mean-value calculations, and variational analysis techniques [2].

3. Results. The findings of the study demonstrated that visualisation through the Scratch programming environment has a high level of educational effectiveness.

Letter Recognition Speed. The letter recognition speed in the experimental group increased by an average of **40%**, whereas the control group showed an improvement of only **12%**. This significant difference confirms the strong impact of multimedia-based visualisation on early literacy development [1].

Development of Imagination. To assess imagination, the diagnostic test included tasks such as "Creating an image corresponding to a letter," "Reconstructing a letter in graphic form," and "Associating an object with a letter." The results revealed that the imagination development index increased by **32%** in the experimental group and by **11%** in the control group, proving an overall effectiveness rate of **21%** in favour of the Scratch-based intervention [10].

Phoneme–Grapheme Association. Sound-enhanced animations in Scratch were found to significantly strengthen the phoneme–grapheme connection. The experimental group outperformed the control group by a factor of **2.1** in correctly linking phonemes to their corresponding graphemes [4].

Letter Differentiation Skills. The letters most frequently confused by students included:

- **b–d**, **p–q**, **g–q**, **o‘–u**.
- With the help of Scratch animations, the ability to distinguish between these letters increased from **27% to 71%** in the experimental group [6].

Motivation and Engagement. During Scratch-based lessons:

- the frequency of raising hands increased **twofold**;
- the rate of completing tasks independently rose by **1.8 times**;
- both individual and group work skills showed notable improvement.

These outcomes confirm the motivational significance of interactive digital instruction for young learners [9].

Discussion. The results of this study align with both Uzbek and international scholars' theories on digital education, visualization, and multimedia learning environments.

Mayer's Multimedia Theory. The integration of audio, visual, and motion elements facilitates perception, and Scratch is built precisely on this model [2].

Vygotsky's Zone of Proximal Development (ZPD). Scratch allows learners to acquire skills that they cannot perform independently by providing interactive support, thereby promoting scaffolded learning [4].

Constructivist Approach. When students create letters themselves and control the drawing process, knowledge is actively constructed, deepening the learning experience [3].

National Research. Uzbek scholars have also emphasized the importance of visualization, ICT, and interactive methods in primary education [7], [8], [10]. This study demonstrates the practical potential of reinforcing these approaches through Scratch.

Overall, the study confirms that Scratch is not only a coding environment but also a rich didactic platform for teaching, explanation, and animation-based modeling, effectively enhancing early literacy and imaginative skills.

Conclusion. The study confirmed that using the Scratch programming environment for letter visualization significantly enhances first-grade students' imagination, figurative thinking skills, and abilities to recognize and differentiate letters. A multimedia interactive learning environment facilitates the literacy-teaching process, increases students' interest in lessons, and encourages active learning.

Recommendations:

1. Expand the implementation of the "Electronic Alphabet" created in Scratch.
2. Develop methodological guidelines for primary education teachers.
3. Systematically integrate digital tools into literacy teaching programs.

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