USING THE DESIGN OF GAME DEVICES TO DEVELOP TECHNICAL CREATIVITY

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Abstract: This article presents practical examples for prospective technology education teachers on how to increase seventh-grade students' interest in robotics through technical creativity in Technology lessons. It discusses ways of encouraging creative thinking by using the Arduino platform and its components, which are already familiar to students.

Keywords: technology education, technical creativity, Arduino, educational process, technology, sensors, creative thinking, Simon game, software, music.

Today, robotics education is becoming an increasingly important component of general secondary education, as it provides students with opportunities to acquire fundamental technological knowledge while developing practical skills, technical creativity, logical reasoning, and problem-solving abilities. Integrating robotics into Technology lessons enables learners to move beyond theoretical explanations and engage in hands-on activities involving electronic components, programmable devices, and elementary automation systems. Such learning experiences encourage students to explore how technological systems operate, understand the relationships between hardware and software, and apply previously acquired knowledge to the design and construction of functional devices. Furthermore, robotics-based activities can promote independent learning, experimentation, collaborative problem-solving, and creative thinking, all of which are essential competencies in contemporary technology education. A practical example of this educational approach is presented in the Grade 7 Technology textbook (Figure 1). The fourth section of the textbook is specifically devoted to the fundamentals of robotics and includes six practical exercises and two project assignments intended to develop students' initial robotics-related knowledge and practical competencies [1]. Through these activities, students become familiar with various electronic components and learn their functions, operating principles, and potential applications in simple technological projects. In particular, students gain experience working with photoresistors, light-emitting diodes (LEDs), buzzers, MQ-5 gas sensors, FC-28 soil-moisture sensors, motor-shield drivers, water pumps, and Bluetooth communication modules. Each of these components introduces learners to different aspects of electronic control, environmental monitoring, signal processing, and automated device operation. For example, photoresistors can be used to demonstrate light-sensitive control systems, while soil-moisture sensors and water pumps provide opportunities to explore elementary automated irrigation systems. Similarly, LEDs and buzzers help students understand how programmable devices generate visual and auditory responses to predefined conditions.

It is important to emphasize that the Grade 7 curriculum does not represent students' first encounter with robotics and programming. The Technology textbooks for Grades 5 and 6 already introduce basic robotics concepts and provide preliminary explanations of the Arduino platform and its programming environment [2]. Consequently, robotics education at the Grade 7 level can be regarded

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as a continuation of a progressively structured learning process in which previously acquired knowledge is consolidated and applied to more complex practical tasks. This continuity creates favorable pedagogical conditions for moving from the identification and basic operation of individual electronic components toward their integration into functional systems.

From a pedagogical perspective, the significance of this progression lies in the opportunity to connect technical knowledge with creative design activities. Rather than limiting instruction to assembling predefined circuits or reproducing ready-made programs, teachers can encourage students to modify existing projects, compare alternative solutions, identify technical problems, and independently develop simple electronic devices. In this context, designing interactive game devices using familiar Arduino components represents a promising practical approach. Such projects bring together programming, circuit assembly, sensory feedback, and creative problem-solving within a single learning activity. They also provide a meaningful foundation for developing students' technical creativity by allowing them to transform previously learned concepts into tangible technological products. Therefore, the systematic integration of robotics projects into Technology education can support the gradual development of learners' practical competencies and strengthen the relationship between technological knowledge, independent experimentation, and creative application.



Figure 1. Technology textbooks for Grades 5, 6 and 7

The project assignments and practical exercises included in the textbooks help increase students' interest in robotics. Rather than repeating those tasks, this article presents another project that prospective technology education teachers can use to stimulate learners' interest through components encountered in earlier lessons. Considering students' age, electronic game devices may be especially appealing to them. Constructing such a device with their own hands can also make the learning experience more memorable.

One such device is the Simon game (Figure 2).



Figure 2. The Simon memory game

This game requires students to remember a sequence of musical tones and visual signals and then reproduce it using their visual and auditory perception. Because memory plays a central role in this task, the game can be used to exercise students' memory skills. Building a prototype also requires

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components studied in previous lessons. As a result, students have an opportunity both to develop their technical creativity and to review and consolidate material they have already learned.

The following components are required to build the prototype: an Arduino Uno board, a breadboard, a buzzer, four differently colored push buttons, four corresponding LEDs, and connecting wires. As noted above, students are already familiar with all of these components [1]. The elements are assembled according to the circuit diagram shown in Figure 3.

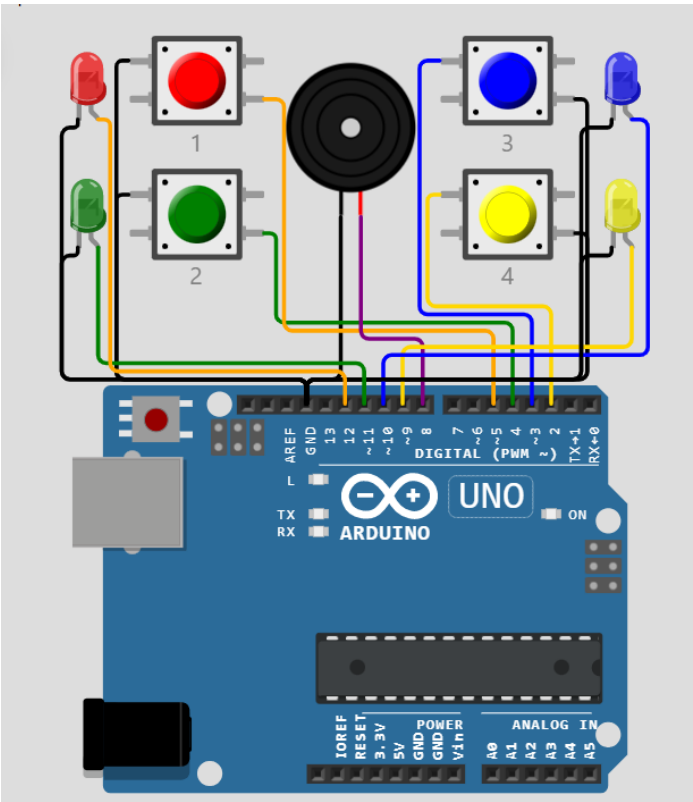


Figure 3. Wiring diagram of the Arduino-based Simon game prototype

After connecting all the components, the next major step is to write the program code. For this purpose, we use the freely available Arduino IDE (Integrated Development Environment). The required program code is entered into the editor window of the development environment.

Once the code has been entered, it is checked for errors, and the final program is uploaded to the Arduino board. The outcome can then be tested under practical conditions. A demonstration of the completed project is available at the following link: https://youtube.com/shorts/vRFyLZMiFq8?feature=share.

Designing, building, and using devices of this kind require considerable effort from both students and teachers. After the project is completed, its components can be assembled in an enclosure, as illustrated in Figure 2. This makes the device more visually appealing and convenient to use. The stages described above provide one example for prospective technology education teachers. More broadly, helping students acquire the skills needed to create unconventional devices through technical creativity in practical assignments and project work is closely related to teachers' professional expertise. In conclusion, alongside completing practical and project-based tasks, students should be encouraged to develop technical creativity and creative thinking. Approaches suited to their age and interests, such as the project described here, can help stimulate their interest in robotics.

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Furthermore, incorporating game-based device design into technology education creates opportunities for students to integrate theoretical knowledge with practical engineering experience. By independently assembling electronic components, programming Arduino microcontrollers, and testing the functionality of their projects, learners can develop analytical thinking, technical imagination, and problem-solving skills. Such activities also encourage experimentation, as students identify design limitations, correct programming errors, and explore alternative technological solutions. An important pedagogical consideration is the gradual increase in task complexity according to students' existing knowledge, individual abilities, and technological interests. Teachers should provide appropriate methodological guidance while allowing sufficient independence for creative decision-making. Collaborative projects can additionally strengthen communication, teamwork, and responsibility for achieving shared objectives. Therefore, integrating interactive electronic games into robotics education should be viewed not merely as an entertaining activity but as a purposeful pedagogical strategy for developing technical competence, independent learning, and sustained interest in engineering and technological innovation among school students.

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