Multidisciplinary International Journal of Research and Development

Volume: 05 / Issue: 02 / 2025 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

# An Assessment of the Readiness of Grade 8 Students for Arduino-Based Projects in Rizal National High School

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**Abstract—** This study assesses the readiness of Grade 8 students at Rizal National High School for Arduino-based projects, responding to the integration of robotics into the K-12 curriculum. Utilizing a descriptive-quantitative research design, the study evaluates readiness across five distinct domains: Technical, Cognitive, Affective, Resource, and Support Readiness. Data were collected from 124 respondents using a researcher-designed instrument comprising a Likert-scale survey and a 10-item subject proficiency quiz. The findings reveal a balanced demographic profile (51.16% female, 48.84% male), challenging gender stereotypes in technical fields. Results indicate that students possess High Affective Readiness, demonstrating a strong interest and willingness to practice despite perceived difficulties. However, specific deficiencies were identified in Technical Readiness (Weighted Mean: 2.53) and Cognitive Readiness (Weighted Mean: 2.77), particularly in programming logic and IDE utilization. This self-assessment was corroborated by the Knowledge Quiz, where the class achieved a mean score of 3.93 out of 10, indicating a "Low Proficiency" level. The study concludes that while students exhibit a "High Interest" profile, they are functionally underprepared for the software aspects of Arduino. Recommendations include implementing scaffolded coding exercises and visual programming tools to bridge the gap between student motivation and technical capability.

**Keywords—** Arduino, Junior High School, Student Readiness, Robotics Education, Technical-Vocational Education.

## I. INTRODUCTION

The advent of the Fourth Industrial Revolution (4IR) has fundamentally altered the global economic landscape, necessitating a paradigm shift in education systems to prioritize digital literacy, computational thinking, and complex problem-solving (Schwab, 2016). In response to these demands, educational institutions worldwide have increasingly integrated robotics and physical computing into their curricula. These tools are rooted in the theory of Constructionism, which posits that learning occurs most effectively when students are actively engaged in building tangible objects in the real world (Papert, 1980). Specifically, the Arduino microcontroller platform has emerged as a standard tool in secondary education due to its open-source nature and accessibility, effectively democratizing access to electronics and programming (Banzi & Shiloh, 2014).

In the Philippines, the Department of Education (DepEd) has aligned the K-12 curriculum with these global standards, embedding Technical-Vocational-Livelihood (TVL) tracks and Information and Communications Technology (ICT) skills to prepare students for the modern workforce (DepEd, 2013). However, the transition from theoretical science to hands-on engineering is fraught with challenges. While the curriculum mandates the

 

Volume: 05 / Issue: 02 / 2025 - Open Access - Website: www.mijrd.com - ISSN: 2583-0406

inclusion of technology, successful implementation hinges on the students' actual preparedness to engage with these complex tools. Existing literature suggests that without adequate scaffolding, the cognitive load of learning electronics and coding simultaneously can overwhelm novice learners (Sweller, 1988). Therefore, this research, titled "An Assessment of the Readiness of Grade 8 Students for Arduino-Based Projects in Rizal National High School," aims to evaluate the specific readiness profile of students as they enter this technical domain. The concept of "Student Readiness" in this study is operationalized not as a single metric, but as a multidimensional construct encompassing five distinct domains: Technical, Cognitive, Affective, Resource, and Support Readiness.

Technical Readiness (TR) and Cognitive Readiness (CR) represent the hard skills required for execution. Technical readiness involves the psychomotor skills necessary to manipulate hardware, such as the ability to "connect simple electronic components following a diagram" and "troubleshoot basic issues such as loose wires". Concurrently, cognitive readiness addresses the abstract logic needed for programming. This includes the mathematical comfort to handle concepts like voltage and current, and the computational thinking required to "follow logic statements such as if/else and loops". These indicators align with Blikstein's (2013) assertion that digital fabrication requires a fusion of manual dexterity and abstract debugging skills.

However, skill proficiency is often moderated by psychological factors. Affective Readiness (AR) assesses students' self-efficacy—their confidence in their own ability to succeed. This study measures if students are "interested in building projects" and if they possess the resilience to believe they "can learn Arduino even if it seems hard at first". Bandura (1997) argues that high self-efficacy is a strong predictor of persistence in difficult STEM tasks. Furthermore, the study examines the external environment through Resource Readiness (RR) and Support Readiness (SR), assessing the availability of "reliable internet access" and a "safe workspace," as well as the presence of "guidance and clear steps" from teachers.

To validate these self-perceived readiness levels, the study correlates them with an actual Arduino Knowledge Quiz. By testing specific competencies—such as identifying that "Analog input" pins are for continuous variables or knowing that the function runs only once the research aims to pinpoint the specific gaps between student interest and student capability. This data-driven approach will provide the necessary baseline for designing effective, scaffolded instructional interventions for Grade 8 students at Rizal National High School.

## II. METHODOLOGY

This section presents the research design, respondents, instruments used, data collection procedures, and the statistical analysis employed in the study.

- ***Research Design.*** The study utilizes a Descriptive-Quantitative research design. This method is appropriate as the study aims to describe the current status of student readiness by quantifying variables such as technical skills, cognitive understanding, and affective attitudes. It assesses the "what is" of the students' preparedness without manipulating any variables.
- ***Respondents of the Study.*** The respondents of this study are the Grade 8 students of Rizal National High School. The participants were selected from the section that had a background in electronics. Based on the data gathering, a total of 124 students participated in the assessment.

 

MIJRD Multidisciplinary International Journal of Research and Development

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- ***Research Instrument.*** The primary data gathering tool used was a researcher-made instrument titled "An Assessment of the Readiness of Grade 8 Students for Arduino-Based Projects". The instrument is divided into three distinct parts:

1. ***Part I: Socio-Demographic Profile:*** This section collects basic demographic information, including sex.
2. ***Part II: Student Readiness Assessment:*** This section consists of a 25-item survey divided into five domains, with 5 indicators per domain:
    - Technical Readiness (TR): Skills in connecting components, using the IDE, and troubleshooting.
    - Cognitive Readiness (CR): Competency in logic (loops/conditionals), math, and breaking down problems.
    - Affective Readiness (AR): Interest, confidence, and willingness to practice.
    - Resource Readiness (RR): Access to devices, internet, and safe workspaces.
    - Support Readiness (SR): Availability of teacher guidance and peer support.
    - The items were measured using a 4-point Likert scale: 4 (Strongly Agree), 3 (Agree), 2 (Disagree), and 1 (Strongly Disagree).
3. ***Part III: Arduino Knowledge Quiz:*** To measure actual proficiency, a 10-item multiple-choice test was administered. The quiz covers fundamental concepts, including pin functions (Analog/Digital), programming syntax (loops, setup, variables), and basic electronics components (resistors, LEDs).

***Data Gathering Procedure.*** The researcher secured necessary approval from the school administration to conduct the study. The instrument was distributed to the Grade 8 students during their scheduled class time to ensure a controlled environment. The researchers explained the purpose of the study and clarified that the quiz scores would be used for assessment purposes only. Data was collected, tallied, and tabulated for statistical analysis.

***Statistical Treatment of Data.*** The following statistical tools were used to analyze the data:

- ***Frequency and Percentage:*** Used to describe the demographic profile and the distribution of scores in the Knowledge Quiz.
- ***Weighted Mean:*** Used to determine the level of readiness in the Likert-scale survey (Part II).
- ***Mean and Standard Deviation:*** Used to analyze the overall performance of the students in the specific readiness domains and the knowledge quiz.

To interpret the Weighted Mean for Part II (Readiness), the following scale was adopted based on the 4-point system:

**Table 1. Likert Scale Interpretation Guide**

| Scale Range | Verbal Description | Verbal Interpretation |
|---|---|---|
| **3.26 – 4.00** | Strongly Agree | High Readiness |
| **2.51 – 3.25** | Agree | Moderate Readiness |
| **1.76 – 2.50** | Disagree | Low Readiness |
| **1.00 – 1.75** | Strongly Disagree | Very Low Readiness |

 

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## III. RESULTS AND DISCUSSION

This section presents the data gathered, analyzed, and interpreted in relation to the specific objectives of the study.

### *1. Socio-Demographic Profile*

This section presents the distribution of respondents based on sex, providing a baseline for the demographic composition of the study group.

**Table 2. Socio-Demographic Profile of Respondents (Sex)**

| Sex | Frequency | Percentage |
|---|---|---|
| **Male** | 21 | 48.84% |
| **Female** | 22 | 51.16% |
| **Total** | 43 | 100.00% |

The demographic data reveal a near-even split in gender distribution, with female students comprising 51.16% and male students 48.84% of the respondents. This balanced composition challenges common stereotypes about male dominance in technical and vocational fields. It implies that the interest in robotics and electronics at Rizal National High School transcends gender lines, creating an inclusive environment for implementing STEM-based projects.

### *2. Student Readiness Assessment*

The following series of tables details the self-assessment of students across five key domains—Technical, Cognitive, Affective, Resource, and Support Readiness—to determine their perceived preparedness for Arduino-based projects.

**Table 3. Technical Readiness (TR)**

| Indicator | Mean | SD | Verbal Description | Verbal Interpretation |
|---|---|---|---|---|
| **1. I can connect simple electronic components following a diagram.** | 2.79 | 0.80 | Agree | Moderate Readiness |
| **2. I can open or install an IDE like Arduino IDE and locate basic functions.** | 2.23 | 0.43 | Disagree | Low Readiness |
| **3. I can upload a sample code to a microcontroller with minimal help.** | 2.44 | 0.73 | Disagree | Low Readiness |
| **4. I can read simple wiring diagrams such as breadboard layouts and pin labels.** | 2.67 | 0.64 | Agree | Moderate Readiness |
| **5. I can troubleshoot basic issues such as loose wires or wrong port/board.** | 2.53 | 0.85 | Agree | Moderate Readiness |
| **Weighted Mean** | 2.53 | 0.69 | Agree | Moderate Readiness |

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The results in Table 3 highlight a distinct gap between physical manipulation and software skills. Students reported Moderate Readiness (Weighted Mean: 2.79) in connecting electronic components, suggesting they are comfortable with the tactile aspect of wiring. However, they assessed themselves as having Low Readiness in software-based tasks, specifically in opening/installing the IDE (Weighted Mean: 2.23) and uploading code (Weighted Mean: 2.44). This indicates that while students can follow a wiring diagram, the technical barrier of operating the programming environment remains a significant hurdle.

**Table 4. Cognitive Readiness (CR)**

| Indicator | Mean | SD | Verbal Description | Verbal Interpretation |
|---|---|---|---|---|
| **1. I am comfortable with basic math used in electronics (voltage/current/resistance).** | 2.79 | 0.71 | Agree | Moderate Readiness |
| **2. I can follow logic statements such as if/else and loops in simple code.** | 2.81 | 0.73 | Agree | Moderate Readiness |
| **3. I can break a problem into steps to design a solution.** | 2.65 | 0.65 | Agree | Moderate Readiness |
| **4. I can read and understand short technical instructions.** | 3.12 | 0.73 | Agree | Moderate Readiness |
| **5. I can interpret simple error messages to find the cause.** | 2.47 | 0.91 | Disagree | Low Readiness |
| **Weighted Mean** | 2.77 | 0.75 | Agree | Moderate Readiness |

Table 4 indicates that students generally perceive themselves as having Moderate Readiness in cognitive tasks (Composite Mean: 2.77). While they are reasonably confident in following logic statements and reading instructions, the lowest-rated indicator was the ability to "interpret simple error messages" (Weighted Mean: 2.47), which fell under Low Readiness. This suggests that while students can follow a "happy path" of instructions, they lack the computational thinking skills required for debugging and problem-solving when errors occur.

**Table 5. Affective Readiness (AR)**

| Indicator | Mean | SD | Verbal Description | Verbal Interpretation |
|---|---|---|---|---|
| **1. I am interested in building projects that use sensors and code.** | 2.63 | 0.76 | Agree | Moderate Readiness |
| **2. I believe I can learn Arduino even if it seems hard at first.** | 3.09 | 0.75 | Agree | Moderate Readiness |
| **3. I enjoy working on open-ended projects and figuring things out.** | 3.00 | 0.76 | Agree | Moderate Readiness |
| **4. I feel confident presenting what my group built.** | 3.14 | 0.68 | Agree | Moderate Readiness |

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| | | | | |
|---|---|---|---|---|
| **5. I am willing to practice outside class to improve.** | 3.28 | 0.55 | Strongly Agree | High Readiness |
| **Weighted Mean** | 3.03 | 0.70 | Agree | Moderate Readiness |

Among all readiness domains, Affective Readiness showed the most promising results. The highest-rated indicator in the entire survey was found here: "I am willing to practice outside class to improve," which garnered a Strongly Agree rating (Weighted Mean: 3.28). This demonstrates that despite the technical difficulties identified in Table 3, the students possess a high level of growth mindset and motivation. They are psychologically prepared to learn, even if their current skill set is developing.

**Table 6. Resource Readiness (RR)**

| Indicator | Mean | SD | Verbal Description | Verbal Interpretation |
|---|---|---|---|---|
| **1. I have access to a device I can use for coding at home or school.** | 2.56 | 0.85 | Agree | Moderate Readiness |
| **2. I have reliable internet access when needed.** | 2.91 | 0.68 | Agree | Moderate Readiness |
| **3. Our class has enough basic components such as boards, wires, and sensors.** | 2.79 | 0.74 | Agree | Moderate Readiness |
| **4. We have a safe workspace for projects.** | 2.98 | 0.51 | Agree | Moderate Readiness |
| **5. I have enough time each week to practice.** | 2.93 | 0.82 | Agree | Moderate Readiness |
| **Weighted Mean** | 2.83 | 0.72 | Agree | Moderate Readiness |

Table 6 assesses the logistical support for the projects. Students rated the safety of their workspace highly (Weighted Mean: 2.98), indicating the school provides a conducive environment. However, the lowest indicator in this domain was access to a device for coding (Weighted Mean: 2.56). This proximity to the "Low Readiness" threshold suggests that a lack of personal computers or laptops may hinder the students' ability to practice coding outside of school hours, potentially slowing their technical development.

**Table 7. Support Readiness (SR)**

| Indicator | Mean | SD | Verbal Description | Verbal Interpretation |
|---|---|---|---|---|
| **1. My teacher provides guidance and clear steps for projects.** | 3.49 | 0.51 | Strongly Agree | High Readiness |

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| | | | | |
|---|---|---|---|---|
| **2. My classmates and I can work together effectively.** | 3.12 | 0.63 | Agree | Moderate Readiness |
| **3. I can ask for help when I get stuck.** | 3.26 | 0.54 | Strongly Agree | High Readiness |
| **4. Our school supports hands-on projects with schedule and materials.** | 3.21 | 0.47 | Agree | Moderate Readiness |
| **5. I receive feedback that helps me improve.** | 3.02 | 0.56 | Agree | Moderate Readiness |
| **Weighted Mean** | 3.22 | 0.54 | Agree | Moderate Readiness |

The data in Table 7 underscores the critical role of instructional scaffolding. The students rated teacher guidance ("My teacher provides guidance and clear steps") as High Readiness (Weighted Mean: 3.49).

Furthermore, they feel comfortable asking for help (Weighted Mean: 3.26). This strong support system is vital, as it compensates for the students' lower technical proficiency. The data suggests that the students are heavily reliant on the teacher's intervention to succeed in their projects.

***3. Arduino Knowledge Proficiency***

To validate the self-reported readiness levels, an objective assessment of the students' actual content knowledge was conducted through a 10-item proficiency quiz.

**Table 8. Performance in Arduino Knowledge Quiz**

| Score Range | Frequency | Percentage | Interpretation |
|---|---|---|---|
| **High (7–10)** | 2 | 4.65% | Proficient |
| **Average (4–6)** | 22 | 51.16% | Developing |
| **Low (0–3)** | 19 | 44.19% | Beginning |
| **Total** | 43 | 100.00% | |

Mean score: 3.93 SD: 1.50 Overall proficiency level: Low

Table 8 serves as the objective validation of the self-assessment survey. The overall mean score of 3.93 out of 10 indicates Low Proficiency across the class. A significant majority of students (95.35%) scored in the Average to Low range.

This low performance correlates strongly with the findings in Table 3 (Technical Readiness), specifically the struggle with software. While students could answer questions related to hardware (e.g., pin functions), they struggled significantly with syntax-specific questions (e.g., loops and code structure).

This confirms that while students are motivated (Affective) and supported (Support), their actual content knowledge—particularly in programming logic—requires immediate and intensive remediation.

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## IV. CONCLUSION

Based on the findings of the study, the following conclusions are drawn:

The Grade 8 students of Rizal National High School exhibit a distinct "High Interest, Low Proficiency" readiness profile. While they possess a strong desire to learn and a positive attitude toward difficult tasks—evidenced by their high Affective Readiness—they currently lack the fundamental technical and cognitive skills required to execute Arduino projects independently.

Specifically, the study concludes that:

- ***Readiness is uneven across domains.*** Students are functionally ready to handle the physical aspects of the curriculum (wiring, connecting components) but are significantly underprepared for the software and programming aspects (IDE usage, syntax, debugging).
- ***There is a disconnect between perceived and actual skill.*** While students rated themselves as "Moderately Ready" in many areas, their actual performance in the Knowledge Quiz (Mean: 3.93/10) reveals a critical proficiency gap, particularly in programming logic.
- ***Instructional support is the primary enabler.*** The high Support Readiness scores indicate that students are heavily reliant on teacher guidance. Without this external scaffolding, the students' current technical deficiencies would likely lead to project failure.
- ***Gender is not a barrier.*** The balanced demographic profile suggests that female students are just as engaged and present in the robotics curriculum as their male counterparts, debunking gender stereotypes in this specific context.

## V. RECOMMENDATIONS

In light of the conclusions, the following recommendations are proposed to enhance the readiness and performance of the students:

Scaffold the Programming Curriculum. Since "opening the IDE" and "uploading code" were identified as the lowest technical skills, teachers should not begin with blank-slate coding. Instead, utilize "Fill-in-the-Blank" code exercises where the logic structure (loops/setup) is pre-written, and students only need to modify parameters (e.g., delay time, pin numbers). This reduces syntax anxiety while building confidence.

Bridge the Gap with Visual Programming. Given the low Cognitive Readiness regarding logic statements, the curriculum should temporarily incorporate Block-Based Coding (e.g., Tinkercad Circuits or mBlock) for the first 2–3 weeks. This allows students to understand the logic of loops and conditionals visually, before they struggle with C++ syntax errors.

Implement Strategic Peer Grouping. Teachers should structure project groups to balance the skills of their students. Since 4.65% of students scored as "Proficient" and others showed high manual dexterity, groups should be formed by pairing high-logic students with high-dexterity students. This encourages peer-to-peer knowledge transfer.

Maximize the "Safe Workspace" for After-School Practice. Since students expressed a strong willingness to practice outside class (Mean: 3.28) but reported lower access to devices (Mean: 2.56), the school should consider opening the computer laboratory for "Open Lab Hours" on a weekly basis. This capitalizes on their high motivation to learn.

Focus on Debugging Literacy. As students rated "interpreting error messages" very low, specific lessons should be dedicated to "The Art of Troubleshooting." Teachers should intentionally introduce errors into code (e.g., missing semicolons) and guide the class on how to read the error log to identify the fix.

## VI. ACKNOWLEDGEMENT

The researcher wishes to express her profound gratitude and appreciation to the following individuals whose support, guidance, and encouragement made this study possible: Dr. Filwyn P. Villanueva, Faculty Member of the Graduate School, NEUST, and Subject Teacher in Research Methodology, for his expert mentorship, constructive criticism, and patience throughout the writing process. His guidance was instrumental in shaping the direction of this research. Dr. Benilda S. Baluyan, Principal IV of RNHS, for her visionary leadership and for granting permission to conduct this study within the institution, allowing the researcher to gather the necessary data from the Grade 8 students. The Faculty of the TLE Department, for their professional camaraderie, encouragement, and support, which provided a motivating environment for the completion of this work. And to her husband and co-author, Dr. Joseph R. Del Carmen, for his unwavering love and patience, and for sharing his expertise as the Statistician of this study. His assistance in the statistical treatment of data was invaluable to the interpretation of the results.

To Almighty God, for the wisdom, strength, and grace to finish this undertaking.

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