Effective Robotics Team Communication

Description
Working with robotics often involves working in teams, with team members holding different roles and responsibilities in order to accomplish a given task. Effective communication between team members is critical in reducing wasted time and energy and accomplishing the task to the highest possible standards.

This activity builds team communication as a core competency while working with robots and highlights the importance of specificity in team communication.

Students work in teams of three with strict parameters around what each student can do and who they can communicate with.

Each student may choose from the following three roles:

**Technician**
Works on the robot. Can only communicate with the coordinator.

**Programmer**
Works on the programming of the robot. No one else is permitted to use the computer to change the program. Can only communicate with the coordinator.

**Coordinator**
Works as an intermediary between the technician and the programmer. The coordinator is the conduit for the group’s communication.

Depending on class size and group size you may choose to have multiple students fulfilling each role; these small teams must also learn to communicate and collaborate together for optimal task accomplishment.

The roles can be maintained throughout the duration of the activity or they can be changed every 30 or 60 minutes.

The task for this lesson may vary depending on the abilities of the class. Potential tasks might include:

- Drive your robot a predefined distance.
- Navigate your robot around the legs of a table or chair in a predetermined pattern.
- Perform a task that incorporates a sensor (e.g., use the touch sensor to bump into an object and then turn around).
Lesson Outcomes
Students will be able to:
• Communicate effectively and efficiently with team members, highlighting the importance of specificity in their language
• Work as a team to achieve a goal
• Program a robot to solve a problem

Assumptions
It is also assumed that students:
• Know how to use and program robots
• Know how to build robots and implement sensors
• Can communicate using technical language
• Can work in teams with specific roles and responsibilities

Key Terminology
Bumper switch: allows a robot to detect an obstacle or limit the movement of a component.
Colour sensor: allows a robot to measure colours.
Distance sensor: allows a robot to measure distance using ultrasonic waves.
Encoder: allows a robot to monitor the position of a shaft or axle by monitoring pulses triggered by the rotation of the shaft. The software required to use an encoder is typically more complex than that used for a potentiometer, but the ability to monitor the position of continuously rotating shafts (such as axles) makes it a very useful sensor for tracking robot speed and position using dead reckoning.
Gyro sensor: allows a robot to measure turn rate and angles.
Limit switch: similar to a bumper switch but with a flexible lever arm triggering the switch. It allows for more flexible mounting options than the bumper switch.
Potentiometer: allows a robot to determine the position and direction of rotation of a shaft.
Reflective object sensor: similar to a colour sensor, but includes a light source and detects the presence or absence of a reflective object at very short range (typically < 5 mm). An arrangement of two or more reflective object sensors can form a line tracker.
Robot controller: the brain of a robot that can be programmed using software. A robot controller sends instructions to the components of a robot and receives input from sensors.

Estimated Time
2–3 hours, depending on chosen robot task
Recommended Number of Students
1 robot per 3 students but can be adjusted to suit class size and availability of robots

Facilities
This lesson ought to use two rooms to keep the programmer and the robot technician separate. Alternatively, workbenches and robots could be on one side of the lab and computers on the other.

Tools
• Appropriate sensors for assigned task/problem
• Computer with access to programming software

Materials
Paper for notes and diagrams
An assembled robot from a previous project or activity

Resources
Below are some examples of possible tasks for teams to work toward:

Learning Aid: Technical Terms for Describing Drawings
Pipe inspector challenge
https://www.youtube.com/watch?v=CiBCAXetZuE

Line follow
https://www.youtube.com/watch?v=BvChC6J6bNE

Demonstration
This simple exercise can give students an idea of the importance of specificity when working in teams and in robotics.

First, have students self-select into their groups of three and co-determine their group roles. The programmer and technician are not to speak to each other and should ideally be in separate rooms or on opposite sides of the classroom.

The technician is tasked with drawing a stick man or something quite simple but can ONLY take instructions from the coordinator. The coordinator is being instructed by the programmer. The coordinator can have some input as well, but ultimately they are listening to the programmer. After many interactions between the members, they will begin to see how critical clear and concise instructions are to succeeding in their task.
**Procedure**

1. Decide on the task that the teams will be performing with their robot and communicate this to the class.

2. The groups will need some time to design or redesign their robots. The technician is the manager of this process while the other two are meant to be in a more supporting role.

3. Once the redesign phase is complete, the groups are to be separated as much as possible so that the importance of communication can be emphasized.

4. If you are opting for team members to switch roles at intervals, be sure to communicate this to the groups.

5. The teams can start testing out the robot’s task only once the members have been separated from each other. This way the major bugs and inadequacies can be worked out first before the fine-tuning can begin.

6. Once students feel that they have achieved the task to their satisfaction (or the allotted time has elapsed), they can begin the assessment process.
### Assessment

The evaluation of this lesson is based on the four outcomes outlined above.

Prior to teachers using the evaluation grid it is recommended that students should perform some form of peer-assessment and self-assessment.

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<thead>
<tr>
<th>Outcome To Be Assessed</th>
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<tbody>
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<td><strong>Outcome 1</strong> Communicate effectively and efficiently</td>
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<td>1.1 Values the importance of specificity.</td>
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<td>1.2 Clarity of verbal communication.</td>
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<td>1.3 Uses technical language.</td>
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<td><strong>Outcome 2</strong> Teamwork</td>
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<td>2.1 Division of work.</td>
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<td>2.2 Effort of each team member.</td>
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<td>2.3 Works as a team to achieve a goal.</td>
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<td><strong>Outcome 3</strong> Program a robot to solve a problem</td>
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<td>3.1 Understands and uses appropriate software.</td>
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<td>3.2 Applies terminology appropriately.</td>
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**Total Points:**

- 6 Completed successfully at the exceptional level Exemplary
- 5 Completed successfully at higher than the expected level Accomplished
- 4 Completed successfully to the expected level Emerging
- 3 Attempted successfully at the minimum level Developing
- 2 Attempted - Unsuccessful - Close to Successful Beginning
- 1 Attempted - Unsuccessful Basic
- 0 Not Attempted N/A

**Comments:**