

Robotics and Automation Outreach Program (RAOP 2026)

T2 Virtual Lab Checkpoint Form

Fillable PDF - Virtual Digital-Twin Evidence, Guided Inquiry, and Classroom Translation

Due Date: Thursday, July 16, 2026, at 11:59 p.m.

Participant instructions

Purpose: This form collects evidence from the virtual RAOP activities only. It documents whether each educator can access and operate the digital-twin environment, run the assigned Simulink/QLabs activity, explain input-output behavior, use guided inquiry, and translate the experience into a feasible Grades 6-12 student learning activity. Complete one required introductory activity and one required advanced activity. Optional activities are enrichment only.

What to write

Use check boxes for quick evidence, then write short but meaningful explanations. The most important narrative sections are Section 4 Lesson Learned and Section 5 Classroom Translation. Write enough detail for the RAOP team to understand what you learned, what students could do, and what support you still need.

Project and Form Information

Participant ID		Date submitted	
Educator name		Email	
School / institution		Virtual week	
Grade band / subject		Platform used	
Group number		Group partner	
Role	☐ Pre-service ☐ In-service ☐ Other		

T2 - Virtual Lab Checkpoint Form

Confidentiality and NSF reporting:

Names, emails, and school-specific details are collected for internal coordination only. NSF reporting and external summaries will use Participant ID numbers and aggregated results; personally identifying information will be hidden or removed.

RAOP Outcomes Supported by T2

Outcome	What this form measures	Evidence collected
O1. Virtual access	Educator can access MATLAB/Simulink, QLABs, and assigned virtual experiment.	Access checklist, model/path, support needs
O2. Digital-twin operation	Educator can open and run one required introductory and one required advanced activity.	Completion status, evidence notes
O3. Input-output reasoning	Educator can identify command/input, measurement/output, sensor/actuator, and model behavior.	Signal table, technical explanation
O4. Guided inquiry	Educator uses assessment questions, predicts, observes, explains, and revises before relying on solutions.	Inquiry checklist/reflection
O5. Classroom translation	Educator can adapt the virtual activity into a feasible Grades 6-12 learning activity.	Lesson learned and translation template

T2 Research / Evaluation Questions

1. Can educators operate the virtual digital-twin environment and complete the required virtual activities?
2. Can educators explain the relationship among inputs, outputs, sensors, actuators, controller blocks, and observed behavior?
3. Can educators use guided inquiry and evidence before reviewing provided solutions?
4. Can educators translate the virtual robotics/control activity into a practical Grades 6-12 student-facing activity?

Activity Workload: Required and Optional

Workload guidance

Complete Introductory 1 and Advanced 1. Introductory 2 and Advanced 2 are optional enrichment. Optional activities can strengthen evidence but are not required for T2 completion or success coding.

Level	Status	Platform / virtual twin	Simulink model or workspace name	Purpose / function	Completed?
Introductory 1	Required			Open and run model; observe basic input-output behavior.	☐ Yes ☐ Partial ☐ No
Introductory 2	Optional			Repeat or extend with a second simple task if time allows.	☐ Yes ☐ Partial ☐ No ☐ N/A
Advanced 1	Required			Change one command, parameter, configuration, or controller/gain setting; compare response.	☐ Yes ☐ Partial ☐ No
Advanced 2	Optional			Extend advanced task if time allows.	☐ Yes ☐ Partial ☐ No ☐ N/A

Single File / Model Location Entry

Write the main path, workspace, or model name used for your required virtual activity. One clear entry is enough; do not list every folder or assessment file.

Evidence reminder

The fillable PDF captures structured responses. Please submit it together with the Word Evidence Report, where you can paste QLABs screenshots, Simulink model screenshots, run/status images, output plots, scope responses, assessment evidence, lessons learned, and classroom translation details.

Platform-Specific Technical Framework for Virtual Activities

Accuracy note

Use only the row that matches your assigned platform. Exact available signals depend on the assigned Instructor Resources Simulink model and Q Labs activity. Do not force a signal or component if it was not present.

Platform	Virtual-lab focus	Signals/components to look for	Behavior to observe
Qube-Servo 3	DC motor with inertia disk and/or inverted pendulum modules.	Motor command; rotary encoder measurements; pendulum angle when used; motor speed/tachometer estimate; current sense or RGB LED only when included.	Step response, tracking, overshoot, settling time, steady-state error, stability, and effect of P/PI/PID or other gain changes when used.
Aero 2	Dual-rotor aerospace experiment. Q Labs supports 1-DOF attitude, 2-DOF helicopter, and half-quadrotor configurations.	Pitch/yaw measurements; motor/rotor commands; encoder/IMU-related measurements when included; selected configuration.	Attitude response, pitch/yaw coupling, response speed, overshoot, settling time, and effect of controller/gain/configuration changes.
QArm	4-DOF serial robotic manipulator with a two-stage gripper and RGBD camera.	Joint command; joint position; joint velocity; joint PWM/current when included; gripper open/close command; RGBD data when included.	Commanded versus measured joint motion, gripper behavior, simple trajectory/path behavior, and how block connections map to robot motion.
QBot Platform	Differential-drive autonomous ground robot with virtual mobile-robotics sensing.	Wheel/velocity command; odometry or state measurement; inertial, visual, or ranging signals when included; LiDAR/RGBD/downward camera data when included.	Mobile motion, navigation/path behavior, obstacle or sensor-response behavior, and how command signals produce robot movement.

Component and configuration notes

Use your platform user manual, Q Labs workspace, and assigned Simulink model to identify the components you actually used. Examples: QBot LiDAR/RGBD/downward camera; QArm joints, gripper, RGBD camera; Aero 2 pitch/yaw/rotor configuration; Qube motor/encoder/inertia disk or pendulum. Write exact names in later sections when possible.

Section 1. Virtual Access and Model Operation

Quick checklist

Mark what you were able to complete during the virtual activity. Add short notes only when useful. This section helps measure basic readiness and operation success.

Indicator	Yes	Partial	No	Notes / evidence
Accessed MATLAB/Simulink and QLABs successfully.	☐	☐	☐	
Opened the assigned virtual twin / QLABs activity.	☐	☐	☐	
Opened the assigned Simulink model.	☐	☐	☐	
Ran the model and observed a response in QLABs and/or scopes/displays.	☐	☐	☐	
Located main interface/configuration or I/O blocks when present (for example: QLABs configuration, HIL Initialize, HIL Read/Write, scope/sink, switch).	☐	☐	☐	
Located the main input/command signal.	☐	☐	☐	
Located the main output/measurement signal.	☐	☐	☐	
Submitted at least one piece of evidence: screenshot, scope plot, table, or short observation.	☐	☐	☐	

Brief Evidence / Notes for Section 1

Optional: Explain any access issue, model-running issue, or evidence you submitted. Keep this short unless the issue affected your activity completion.

Section 2. Input-Output and System Behavior Evidence

What counts as evidence

Focus on the connection between what you changed and what you observed. Examples: a reference input changes a motor angle, a joint command changes a QArm joint position, a gripper command changes gripper state, or a velocity command changes QBot motion.

Selected platform:

☐

Qube-Servo 3

☐

Aero 2

☐

QArm

☐

QBot Platform

Command/input changed	Measurement/output observed	Sensor/actuator connection identified	What changed in the response?

Short Technical Explanation

Explain the most important input-output connection you observed. What command did you change? What measurement changed? Which sensor, actuator, or model block helped you see the behavior?

Advanced Activity Observation

For the advanced activity, describe one change you made or observed. Examples may include changing a gain, command, configuration, reference signal, robot joint command, gripper command, or mobile-robot command. Use simple response terms when appropriate: faster/slower response, overshoot, settling time, tracking, steady-state error, or stability.

Section 3. Guided Inquiry-Based Learning Process

Guided inquiry prompt

Use the student-style assessment questions as a starting point before reviewing the provided solution. The goal is to predict, observe, test, explain, and revise - not simply to copy a completed solution. This section helps RAOP measure evidence-based inquiry.

Guided inquiry step	Completed?	Brief evidence
Reviewed the assessment questions before checking the solution.	☐ Yes ☐ Partial ☐ No	
Made a prediction or wrote what you expected to happen.	☐ Yes ☐ Partial ☐ No	
Ran the model and collected an observation or output.	☐ Yes ☐ Partial ☐ No	
Compared the observation with the expected or solution behavior.	☐ Yes ☐ Partial ☐ No	
Re-ran or revised the model/input/parameter after reviewing the solution.	☐ Yes ☐ Partial ☐ No	

Guided Inquiry Reflection

What question did you investigate? What did you observe? What did you learn from comparing your observation with the solution or expected response? Describe one revision you would make if you ran the activity again.

Section 4. Lesson Learned

Writing guidance

Write one detailed paragraph or several short paragraphs. This is not a test of perfect control theory. The goal is to document what you learned from the virtual activity, what evidence helped you learn it, what remains unclear, and how the experience prepares you to teach or demonstrate the idea to students.

Include, when applicable:

- one technical idea you understand better after using the virtual twin;
- one connection between a Simulink/QLabs input, output, sensor, actuator, or block;
- one observation from a plot, scope, visualization, or model response;
- one point of confusion or support need;
- one idea for how this could become a student learning activity.

Lesson Learned Response

Section 5. Classroom Translation Template

Translation guidance

Describe how you could adapt the virtual-twin activity into a Grades 6-12 student-facing learning activity. Since educators will have MATLAB/Simulink and QLABs access through RAOP, think about how students could observe, discuss, collect evidence, or answer a guided inquiry question using the virtual model.

Grade band and course/topic

Student-facing learning objective

How students would use, observe, or discuss the virtual twin

Data or evidence students would collect (screenshots, plots, measurements, observations)

Inquiry question or prompt students would answer

How you would assess student understanding

Implementation setting: course, robotics club, coding unit, after-school program, STEM club, Science Olympiad, capstone/project

What you need from RAOP to make this classroom activity feasible

Section 6. Support Needs and Readiness for On-Site Week

Support purpose

This section is not used to penalize educators. It helps the RAOP team plan follow-up support, refine the virtual sessions, and prepare for the on-site hardware week.

Readiness item	Ready	Need support	Notes
I can access and run the required virtual activity again independently.	☐	☐	
I can explain the basic input-output relationship from my selected activity.	☐	☐	
I can identify at least one sensor/measurement and one actuator/command in the model.	☐	☐	
I can discuss how this activity might be used with Grades 6-12 students.	☐	☐	
I am ready to connect this virtual experience to the on-site hardware week.	☐	☐	

Specific Support Requested

List any technical, instructional, or classroom-translation support you need before the next virtual session or before the on-site week. Examples: QLABs access, MATLAB/Simulink model, interpreting scope plots, identifying I/O blocks, developing a student activity, or aligning to a grade-level

Evidence Report Attachment Checklist

- ☐ QLABs / digital-twin screenshot
- ☐ Run/status evidence such as green LED/status when available
- ☐ Assessment or parameter-change evidence
- ☐ Simulink model screenshot
- ☐ Scope, plot, or output response screenshot
- ☐ Lesson learned and classroom translation plan

Educator Confirmation

- ☐ I completed this form based on my virtual RAOP activity experience and identified support needs honestly.

Name

Date

For RAOP Team Use Only: Coding Guide

Coding principle

This section converts educator responses into metrics for program improvement and annual reporting. Score based on submitted evidence, not perfection. Optional activities may strengthen evidence but are not required for success.

Code	Success indicator	0 = Not observed	1 = Emerging	2 = Meets expectation	3 = Exceeds expectation
T2-V1	Virtual access and operation	Could not access or run.	Access/run with major support.	Accessed and ran required activity with minor/no support.	Independently ran and documented activity clearly.
T2-V2	Required activity completion	No required activity completed.	Only partial completion.	Completed one intro and one advanced required activity.	Completed required activities plus useful optional evidence.
T2-V3	Input-output and signal understanding	No clear input/output identified.	Identified basic input/output with limited explanation.	Identified command, measurement, and basic relationship.	Explained command-measurement behavior with clear evidence.
T2-V4	Sensor/actuator and block reasoning	No component/block reasoning.	Named components but weak connection.	Connected sensor/actuator/block role to behavior.	Explained block/signal flow accurately and clearly.
T2-V5	Guided inquiry and evidence explanation	No inquiry/evidence process.	Observation only; little interpretation.	Prediction/observation/explanation present.	Strong compare-revise explanation using evidence.
T2-V6	Classroom translation quality	No classroom translation.	General idea only.	Feasible Grades 6-12 activity with objective/evidence/assessment.	Clear student-facing activity aligned to inquiry and assessment.

Individual Coding Summary

Participant ID	V1	V2	V3	V4	V5	V6	Total /18	Success?
								☐ Yes ☐ No
								☐ Yes ☐ No
								☐ Yes ☐ No
								☐ Yes ☐ No
								☐ Yes ☐ No
								☐ Yes ☐ No
								☐ Yes ☐ No
								☐ Yes ☐ No

Individual T2 success criterion: total score >= 13/18 and required Introductory 1 + Advanced 1 completed.

Program-level target: at least 70% minimum attainment; 80% or higher preferred for strong attainment.