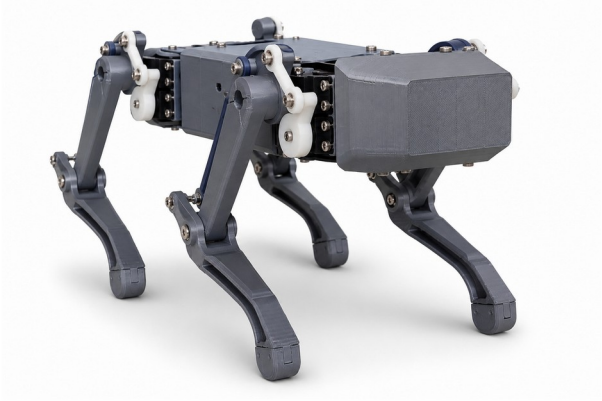
EDU Mini

Quadruped Robotics Teacher's Guide

28-Lesson Teaching Guide | 50 Minutes per Lesson

DIY Kit • Ready Kit

ESP32 / MicroPython



Version V0.2 | Teacher's Edition

QADIR Corporation

www.qadircorp.com

QADIR EDU Mini

Teacher's Guide | Companion to the 28-Lesson Curriculum

Based on: QADIR EDU Mini Student Workbook V5.5 (proofread Chinese edition)

Draft V0.2 | For QADIR teaching and engineering review | November 2026

This guide provides lesson arrangements, observation points, and assessment recommendations for teachers. It does not replace the student workbook or official QADIR engineering documentation. Technical specifications, code, and operating instructions in the student workbook have not been rewritten or modified here.

1. Teaching Principles and How to Use This Guide

- Course duration: 28 lessons × 50 minutes. Each lesson matches the same lesson number in the student workbook; use both materials together.
- The DIY Kit requires full assembly. The Ready Kit comes with the main body preassembled, and students attach the four legs. Learning objectives are identical, but teachers should plan different activities for Lessons 3–4.
- Follow this sequence for each lesson: preparation → teacher guidance → student practice → evidence recording → safety and learning checks.
- Encourage students to predict before operating and retain records of errors, corrections, and tests. Do not grade solely on whether the robot moves.

2. Robot Safety and Engineering Boundaries

- Servo angles are calibrated before shipment. Students do not need to reset the zero position and must not force joints or change calibration settings without authorization.
- Before applying power, check that screws are secure, joints are free of interference, cables are not pinched, and the battery appears normal. The teacher must complete mechanical acceptance checks.
- The app's Stop button is an operating control; it must not be treated as a safety-rated emergency-stop device.
- Flashing firmware is different from uploading a .py program. Do not overwrite factory code with generic firmware unless QADIR has provided the correct firmware and backup/recovery procedures.

- For control APIs, GPIO pinouts, actual supply voltages, safe motion-angle limits, and firmware versions, consult official QADIR engineering documentation. Simulation ranges in the student workbook are not physical robot limits.
- Use low-risk, step-by-step verification for robot tests. If safety or version compatibility cannot be confirmed, use written analysis or software simulation instead.

3. Suggested Assessment Framework

Assessment Area	Suggested Weight (Teacher May Adjust)
Safe Operation and Compliance	25%
Hands-On Work and Technical Understanding	30%
Documentation, Analysis, and Correction	25%
Teamwork, Presentation, and Reflection	20%

These weightings are suggestions in this teacher's guide, not fixed requirements of the student workbook.

4. Lesson-by-Lesson Teaching Guidance (28 Lessons)

Lesson 01 | Getting to Know EDU Mini, Learning Goals, and Operational Safety

Student Workbook Objective | Explain the quadruped platform and the differences between DIY and Ready kits

Main Student Activity | Identify risks involving the battery, pinch points, unexpected startup, and falls from a table; draw a safe work area

Before-Class Preparation | Safety-zone markings, battery-condition photographs, a low workbench, and group worksheets

Teacher Guidance and Demonstration

Show quadruped movement and joint pinch points first. Have students identify at least three hazards, then inspect the work area together.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may mention collisions but overlook falls or unexpected startup. Ask what could happen if the connection is lost or the battery develops a fault.

Lesson Acceptance and Assessment Evidence

Identify pinch points, battery hazards, and fall risks; draw a work area that distinguishes operators from bystanders.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 1.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 02 | Parts Identification, Tools, and Assembly Preparation

Student Workbook Objective | Identify components and use the appropriate tools

Main Student Activity | Use a parts inventory to count components in groups; mark left/right and front/rear parts, screws, and linkages; take photographs as evidence

Before-Class Preparation | Parts trays, basic tools, a parts list, and a camera

Teacher Guidance and Demonstration

Demonstrate how to align screws with holes. Have groups count parts and document quantities and missing items with photographs.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may mix up screws that look similar. Require checks against specifications and locations; never force a screw into place.

Lesson Acceptance and Assessment Evidence

A complete inventory with clear left/right and front/rear labels and traceable missing parts.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 2.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 03 | DIY Leg Assembly (Part 1) / Ready Structure Observation

Student Workbook Objective | Identify the structure of one leg and its assembly sequence

Main Student Activity | DIY: assemble the front portion of one leg using approved diagrams; Ready: observe a preassembled leg and draw the joint connections

Before-Class Preparation | QADIR-approved assembly drawings, single-leg components, and power-off confirmation cards

Teacher Guidance and Demonstration

Demonstrate initial single-leg assembly for DIY. Ready students observe the preassembled mechanism without disassembling the main body.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may assume mirrored left and right parts are identical. Check orientation before tightening.

Lesson Acceptance and Assessment Evidence

Explain the joint connection order and identify two possible points of interference.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 3.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 04 | DIY Leg Assembly (Part 2) / Ready Mechanism Analysis

Student Workbook Objective | Understand four-leg symmetry and mechanical interference

Main Student Activity | DIY: finish the remaining leg assemblies; Ready: compare mirrored parts and linkage travel

Before-Class Preparation | Completed sample leg, left/right comparison photographs, and approved drawings

Teacher Guidance and Demonstration

Use a sample to compare mirrored parts and free joint movement; complete the remaining DIY parts in stages.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may mistake intended joint motion for looseness. Examine the axis, travel stops, and fastening points.

Lesson Acceptance and Assessment Evidence

Correct left/right orientation, without forced fits or obvious interference.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 4.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 05 | Installing All Four Legs and Identifying Orientation

Student Workbook Objective | Correctly identify the installation position of each leg

Main Student Activity | With power off, install all four legs using the front/rear markings; check fasteners, clearances, and wiring one by one

Before-Class Preparation | Four legs, front/rear chassis markings, joining screws, and a wiring checklist

Teacher Guidance and Demonstration

With power disconnected, demonstrate the front/rear chassis directions and the four leg positions; have students assemble and cross-check each leg.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Wiring may be pinched or legs installed on the wrong side. Inspect visually before applying power.

Lesson Acceptance and Assessment Evidence

Verify all leg positions, fasteners, moving clearances, and cable routing.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 5.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 06 | Mechanical Inspection and Assembly Acceptance

Student Workbook Objective | Perform a mechanical assembly acceptance check

Main Student Activity | Record loose parts, interference, pinched wires, and reversed left/right components using a checklist; obtain teacher approval

Before-Class Preparation | Mechanical acceptance checklist, inspection lighting, and a teacher sign-off field

Teacher Guidance and Demonstration

Demonstrate a simulated defect using inspect–identify–record–correct–recheck, then arrange cross-group inspections.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may assume a robot is acceptable simply because it moves. Also inspect looseness, interference, and trapped wiring.

Lesson Acceptance and Assessment Evidence

Complete acceptance records; no first power-on until teacher approval.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 6.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 07 | EDU Mini Servos, Joints, and 12 DOF

Student Workbook Objective | Identify the 12 actuated joints

Main Student Activity | Number the three joints on each of four legs, and record expected motion and mechanical constraints

Before-Class Preparation | Diagram of the three joints on each leg and joint-numbering stickers

Teacher Guidance and Demonstration

With power disconnected, ask students to label three joints per leg and discuss the meaning of 12 DOF.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may confuse the number of linkages with the number of actuated degrees of freedom. Identify the servo-driven joints.

Lesson Acceptance and Assessment Evidence

All three actuated joints on each of the four legs are correctly labeled.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 7.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 08 | ESP32, Power Supply, and Signal Systems

Student Workbook Objective | Understand the respective roles of the ESP32 and power supply

Main Student Activity | Draw a battery → power supply → controller → motor block diagram without guessing pin assignments or supply voltage

Before-Class Preparation | ESP32 board and teaching diagrams of battery power and signals

Teacher Guidance and Demonstration

Draw only functional power and control-signal relationships, clearly separating verified information from unconfirmed pinouts.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may guess GPIO pins, voltages, or wire colors. No wiring based on guesses before approval.

Lesson Acceptance and Assessment Evidence

Clearly distinguish power paths from control signals without invented numeric values.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 09 | First Power-On and Safety Inspection

Student Workbook Objective | Complete the first power-on checks

Main Student Activity | After the teacher verifies firmware and battery condition, elevate the chassis and power on using the official factory procedure

Before-Class Preparation | Teacher-approved startup procedure, chassis stand, and battery/mechanical checklist

Teacher Guidance and Demonstration

Check mechanical acceptance, battery appearance, and firmware status; demonstrate only after supporting the chassis and maintaining safe clearance.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may switch on the robot at a table edge. Require an elevated support and sufficient distance from bystanders.

Lesson Acceptance and Assessment Evidence

Document pre-start checks, observed response, and actions taken if an abnormality occurs.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 9.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 10 | Mobile App Operation and Motion Observation

Student Workbook Objective | Observe remote-controlled movements and safe stopping

Main Student Activity | Use an approved app for one low-risk movement; record posture, response, and stopping behavior

Before-Class Preparation | Robot Dog 2.0 app, BLE device-identification method, and a safe test area

Teacher Guidance and Demonstration

Demonstrate BLE scanning, device identification, connection, Stand, and Stop; then test low-risk movements one at a time.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may mistake Unknown BLE for the correct device or the app's Stop button for a safety-rated emergency stop.

Lesson Acceptance and Assessment Evidence

Record device identity, connection state, motion response, and stopping method.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 10.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 11 | Installing Thonny, USB Connection, and Serial Ports

Student Workbook Objective | Establish a development connection between a computer and the ESP32

Main Student Activity | Install Thonny, connect a data-capable USB cable, and choose the MicroPython (ESP32) interpreter and serial port

Before-Class Preparation | Computer, data-capable USB cable, and approved Thonny installation version

Teacher Guidance and Demonstration

Demonstrate installation, interpreter selection, port identification, and Shell responses without overwriting any program on the board.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

A charging-only USB cable or the wrong COM port may prevent connection. Check the cable before changing settings.

Lesson Acceptance and Assessment Evidence

Identify the correct serial port and obtain a response from the Shell.

Student Workbook Check Question | Why might a charging-only USB cable not work for uploading programs?

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 12 | MicroPython Firmware Flashing and Version Verification

Student Workbook Objective | Understand the difference between firmware and a program

Main Student Activity | Check the current firmware version and back up original settings; demonstrate flashing only with teacher approval and a completed backup

Before-Class Preparation | ESP32 board details, approved firmware, backup and recovery procedures

Teacher Guidance and Demonstration

Compare flashing firmware with uploading a .py file. Demonstrate flashing only after approval of the backup and firmware version.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may overwrite factory code with a generic firmware image. Use a conceptual demonstration when recovery materials are unavailable.

Lesson Acceptance and Assessment Evidence

Explain the difference between the two operations and the risks of overwriting.

Student Workbook Check Question | How does flashing firmware differ from saving hello.py?

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 13 | Your First Program: Running, Saving, and Uploading

Student Workbook Objective | Run and save a first program

Main Student Activity | Run print in the Thonny Shell, then save hello.py to the computer and an approved device

Before-Class Preparation | Thonny, a connectable MicroPython device, and hello.py

Teacher Guidance and Demonstration

Run print in the Shell, save to the computer first, then save to the approved device under a name other than main.py.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may accidentally save hello.py as main.py. Explain the risk of automatic execution at startup.

Lesson Acceptance and Assessment Evidence

Program runs, saves to both locations, and preserves the original main.py.

Student Workbook Check Question | Why should main.py not be overwritten during the first exercise?

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 14 | Python Basics (1): Output, Variables, and Types

Student Workbook Objective | Use output, comments, variables, and data types

Main Student Activity | Create variables for robot name, number of legs, and battery state; inspect output from type()

Before-Class Preparation | Thonny and a data-type observation sheet

Teacher Guidance and Demonstration

Have students predict numeric and string output, then verify with print and type and change one variable at a time.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may treat the string "4" as the integer 4. Verify using type().

Lesson Acceptance and Assessment Evidence

Explain variables and data types, supported by code and output evidence.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 14.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 15 | Python Basics (2): Operators and Conditions

Student Workbook Objective | Use comparisons and branching

Main Student Activity | Write an if/elif/else program to decide whether testing is allowed using a simulated battery value

Before-Class Preparation | Conditional-flow diagrams and simulated battery data

Teacher Guidance and Demonstration

Emphasize that battery values are simulated, not actual EDU Mini readings; compare results at branch boundaries.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may mistake demonstration thresholds for product protection settings. Clearly mark them as simulations.

Lesson Acceptance and Assessment Evidence

Explain if/elif/else branches and boundary conditions.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 15.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 16 | Python Basics (3): Loops and Timing

Student Workbook Objective | Understand repetition and delays

Main Student Activity | Use for to simulate four-leg numbering and a while loop with a safe termination condition for counting practice

Before-Class Preparation | Loop flowcharts and sample programs with limited iterations

Teacher Guidance and Demonstration

List four leg numbers using for, then show a while-loop termination condition and manual interruption.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may forget termination conditions. Ask when the loop will stop before execution.

Lesson Acceptance and Assessment Evidence

Both loop types have bounded termination conditions and predictable output.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 16.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 17 | Python Basics (4): Functions and Parameters

Student Workbook Objective | Use functions to encapsulate repeated tasks

Main Student Activity | Define report_joint(leg, joint), pass parameters, and inspect the return value

Before-Class Preparation | Function-call diagrams and input/output test sheets

Teacher Guidance and Demonstration

Demonstrate passing arguments and using return; test the function with several input combinations.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may confuse print with return. Show how to use the returned value in another statement.

Lesson Acceptance and Assessment Evidence

Function can be called repeatedly with at least two recorded tests.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 17.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 18 | Python Basics (5): Lists and Dictionaries

Student Workbook Objective | Represent joints and movements using data structures

Main Student Activity | Use a list for the four leg names and a dict for the three joint names of each leg

Before-Class Preparation | Sample leg data and a list/dictionary comparison chart

Teacher Guidance and Demonstration

Build lists and dictionaries from leg numbers or simulated joint data; demonstrate lookup and updating.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

List indices start at 0, unlike dictionary keys. Have students predict the results first.

Lesson Acceptance and Assessment Evidence

Retrieve values correctly and explain the choice of data structure.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 18.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 19 | Modular Programming, Exceptions, and Debugging

Student Workbook Objective | Read errors and debug systematically

Main Student Activity | Intentionally trigger ValueError and use try/except to record the error

Before-Class Preparation | Modular programming examples and deliberately introduced syntax errors

Teacher Guidance and Demonstration

Show how to read a traceback, isolate the fault, and handle expected errors using try/except.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may ignore every error with an empty except block. Require the error details to be recorded.

Lesson Acceptance and Assessment Evidence

Reproducible error and correction evidence without concealed exceptions.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 19.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 20 | Joint Angles, Control Interfaces, and Safety Limits

Student Workbook Objective | Distinguish simulated angles from actual robot control

Main Student Activity | Check angle ranges in software examples first; use only QADIR-approved APIs for actual robot commands

Before-Class Preparation | Angle-checking simulation code and approved control API documentation, if available

Teacher Guidance and Demonstration

Evaluate example angles in software first; explain that the example range of -30 to 30 is not the robot's actual safe operating range.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may apply simulated limits directly to joint commands. Do not make actual API calls without approval.

Lesson Acceptance and Assessment Evidence

Clearly distinguish simulation, factory calibration, and physical joint limits.

Student Workbook Check Question | Why must simulated angle limits not be used directly as safe operating limits for the robot?

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 21 | Posture, Center of Gravity, and Standing Stability

Student Workbook Objective | Understand support polygons and center of gravity

Main Student Activity | Draw different combinations of supporting feet and explain when tipping is more likely

Before-Class Preparation | Center-of-gravity diagrams, flat floor, and safe supports

Teacher Guidance and Demonstration

Discuss support polygons and center of gravity using sketches, then observe controlled, low-risk postures.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may focus on chassis level while ignoring foot contact and center-of-gravity projection.

Lesson Acceptance and Assessment Evidence

Provide recorded observations supporting a judgment about posture stability.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 21.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 22 | Gait Principles and Parameters

Student Workbook Objective | Understand gait phases and stride length

Main Student Activity | Use cards or simulated data to sequence the lift and placement of four feet and analyze stability

Before-Class Preparation | Gait-phase diagrams and step-timing record sheets

Teacher Guidance and Demonstration

Compare gait parameters with slow animation or paper timing charts; do not begin by increasing actual robot speed.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may assume higher step frequency always means greater stability. Discuss contact time and support.

Lesson Acceptance and Assessment Evidence

Label gait phase sequences, parameters, and expected effects.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 22.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 23 | Forward, Backward, and Turning Motions

Student Workbook Objective | Distinguish parameters used for directional control

Main Student Activity | Compare foot-trajectory diagrams for forward, backward, and turning movements and record differences

Before-Class Preparation | Level test area, distance markers, and approved motion-control method

Teacher Guidance and Demonstration

Test forward, backward, and turning one command at a time, changing only one condition per test.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may change several parameters simultaneously, making cause and effect unclear. Require separate test records.

Lesson Acceptance and Assessment Evidence

Record movement direction, deviation, and stopping response.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 23.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 24 | Motion Sequences and Data Logging

Student Workbook Objective | Create reproducible motion records

Main Student Activity | Design fields for motion names, times, test results, abnormalities, and versions

Before-Class Preparation | Sequence flowcharts, data logs, and timestamp examples

Teacher Guidance and Demonstration

Design a motion–wait–record sequence, simulate it first, and then observe the robot using approved methods.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Missing pauses or log fields can prevent reproduction. Record versions and test conditions.

Lesson Acceptance and Assessment Evidence

Repeat the same sequence and compare the results.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 24.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 25 | Basic Kinematics and Motion Improvement

Student Workbook Objective | Understand the relationship between joint angles and foot positions

Main Student Activity | Calculate foot position using a simplified two-link model and discuss differences from the actual three-joint robot

Before-Class Preparation | Leg geometry diagrams, length measurement tools, and paper calculations

Teacher Guidance and Demonstration

Explain that the simplified geometric model rests on assumptions; compare predictions with observed deviations.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may treat a two-dimensional diagram as a complete mechanism solution. State assumptions and limitations clearly.

Lesson Acceptance and Assessment Evidence

Propose one testable hypothesis for improving motion.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 25.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 26 | Project Design and Experimental Planning

Student Workbook Objective | Propose a testable project

Main Student Activity | Write goals, variables, controlled conditions, measurements, risks, and team assignments

Before-Class Preparation | Project requirements form, risk assessment form, and schedule

Teacher Guidance and Demonstration

Ask each group to specify a measurable goal, verification method, completion criteria, and safety constraints.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may offer an idea without acceptance criteria. Ask how they will prove success.

Lesson Acceptance and Assessment Evidence

Complete objectives, test conditions, team assignments, and risk assessments.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 26.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 27 | Project Implementation and Testing

Student Workbook Objective | Complete group experiments and improvements

Main Student Activity | Run teacher-approved experiments, log data, analyze failures, and improve the design

Before-Class Preparation | Project work area, test log, and teacher inspection sheet

Teacher Guidance and Demonstration

For each round, record before change–change–result, with safety supervision and version backups.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may change multiple conditions or fail to save records. Encourage small, incremental tests.

Lesson Acceptance and Assessment Evidence

Complete at least one data-supported improvement cycle.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 27.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

Lesson 28 | Project Presentation, Assessment, and Reflection

Student Workbook Objective | Present outcomes and limitations clearly

Main Student Activity | Submit code, operation logs, problem analysis, a presentation, and peer feedback

Before-Class Preparation | Presentation criteria, peer feedback form, and grading rubric

Teacher Guidance and Demonstration

Require goals, design, test evidence, failures, and limitations; assess the verification process, not only the result.

50-Minute Lesson Plan

- **0–8 min | Review, perform safety checks, and confirm the lesson task.**
- **8–18 min | Demonstrate, ask questions, and check prior knowledge.**
- **18–38 min | Students work in groups; teacher observes and records anomalies and evidence.**
- **38–46 min | Peer checks, error analysis, and corrections.**
- **46–50 min | Collect worksheets and preview the next lesson.**

Common Issues and Teacher Intervention

Students may show only successful videos without discussing failures or limitations. Prompt them to propose next steps.

Lesson Acceptance and Assessment Evidence

Results are reproducible and supported by sufficient data, with risks and limitations clearly communicated.

Student Workbook Check Question | Explain the key steps, acceptance criteria, and one potential risk in Lesson 28.

Teacher Notes | Attendance/Group: _____ Issues/Remedial Instruction: _____

5. Teacher's Before/After-Class Checklist

Before Class

☐ Student workbook and robot firmware versions checked

☐ Workspace, battery, and cable safety checked

☐ Demonstration sample, data cables, and teaching aids ready

☐ All robot commands and APIs have documented approval

☐ Abnormal-stop and on-site response procedures prepared

After Class

☐ Student work records and worksheets collected

☐ Abnormalities, failures, and corrections recorded

☐ Demonstration files and student programs backed up

☐ Equipment, battery, and component conditions checked

☐ Next-lesson remedial or extension tasks arranged

6. Engineering Confirmation Checklist (Before Formal Teaching)

☐ Factory firmware version and recovery process

☐ ESP32 board type, USB connection method, and compatible tool versions

☐ Joint control API, command formats, and safe angle/speed limits

☐ Actual app button/slider functions and adjustment ranges

☐ Official assembly/inspection drawings for body, legs, cables, and battery

☐ Startup and fault-handling procedures for each kit configuration

Note: The items above require confirmation by QADIR engineering before teaching; they do not imply that the current product lacks these functions.