

FIRST for All: Robotics Coaching in Residential Foster and Incarcerated Facilities

Needs Assessment

Victoria Heric

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Introduction

Robotics competitions empower youth to build robots that complete tasks to score points in tournaments with other teams. The First Tech Challenge (FTC) competition was designed by US FIRST in supplement to their existing FIRST Robotics Competition (FRC) as a more budget-conscious beginner level high school program option (Center for Youth and Communities Heller School for Social Policy and Management Brandeis University Waltham, MA, 2011). FIRST for All (FFA) is a professional development program for robotics coach facilitators interested in mentoring teams in residential group foster homes and residential incarcerated youth facilities. The program aims to provide the necessary mentorship, supplies, and ongoing support for robotics coach facilitators to grow and sustain FTC teams and compete in person or remote matches. The program's goal is to improve educational outcomes, workforce opportunity skills and spark interest in STEM-related learning for underrepresented youth.

The First for All program consists of three distance learning modules held over Zoom and hosted by a FIRST certified trainer facilitator, graphic visual aids, a series of instructional videos, a secure online forum on the FIRST Inspires website for the community, and an added remote match series for incarcerated teams. Teams meet at their group locations. A coordinator will be available to conduct in-person training on a case-by-case basis on-site through an existing professional development network. Corporate sponsors will be matched by the FIRST organization for qualifying FFA teams. The Robot Inspection Checklist, Field Inspection Checklist, and Engineering Portfolio, which are requirements of the existing FIRST Tech Challenge, will serve as the tool for the program's final evaluation. The terminal program objective is:

- Given an online hub with additional audience-specific resources, the First Inspires website, and distance learning focus groups, participants will be able to plan, design, and build a First Tech Challenge compliant robot for competition.

Deliverables

The student participant and robotics coach facilitator teams will be provided with:

- A unique website known as the “online hub” that includes links to the science and technology survey, code of conduct, supply kit ordering, graphic aids, a series of instructional videos, Zoom FFA facilitator lead recordings, inspection checklists for evaluation, a secure online forum for the community, and an added remote match series scoreboard for residential facilities
- dashboard on the existing FIRST Inspires website for the robotics coach facilitator to log in student team members and manage donations and purchases from sponsorships
- FIRST Inspires website that includes existing gameplay materials, including robot building and programming resources and rules

FFA facilitators will be provided with:

- Google Slides for distance learning modules lead over Zoom
- log in credentials to the online hub for one-to-one support and mentor assignment

Needs Assessment and Root Cause

Determining the need for a training engagement is essential to the process (Hodell, 2016). Why is FFA needed now? Incarcerated youth do not have access to the same educational resources as the public community, including rigorous curriculum, credit recovery, GED preparation, and vocational

workforce skill-building opportunities. Despite the U.S. Departments of Education and Justice guiding educational principles, only eight states report offering programs with educational equity (Locked Out: Improving Educational and Vocational Outcomes for Incarcerated Youth, 2015). Foster youth in residential facilities do not have access to updated computer technology or parents with STEM-related backgrounds in the home and report lower high school graduation rates (Child Welfare Information Gateway, 2021). Youth who have completed academic and vocational programs while incarcerated experienced a lower recidivism rate and more significant employment following release (Foley, 2001). Foster youth STEM programs, such as Pivotal, offer a social community and sense of connection for students by providing Saturday STEM clubs, laptops, and Silicon Valley mentors, resulting in positive outcomes, internships, and employment (*Pivotal*, 2021).

In a recent study by the Center for Youth and Communities Heller School for Social Policy and Management Brandeis University Waltham, MA (2011), participants and team leaders in FTC reported gains in critical outcomes, including a better understanding of the use of science and technology in the real world; increased interest in STEM and STEM-related careers; increased interest in school success and college readiness; and gains in several workplace skills among them critical thinking, problem-solving, communications and teamwork. The same study also found that weaknesses of the FTC competition included funding, curriculum, and technical assistance resources. Among those surveyed, 75% reported that it would make it easier for new teams to become part of FIRST by lowering costs and helping teams find sponsors. Participants indicated the need for more instructions, manuals, and workshops, plus help with fundraising and recruiting mentors as priorities for team support.

The current state is that participation is low to non-existent for residential group foster homes and incarcerated youth facilities and would seem unlikely to grow or flourish given the above-referenced challenges in the survey of sponsorship, training, and mentors. FIRST for all bridges the gap

and fills the educational need to create and provide these resources using FTC, a lower-cost and more accessible robotics competition, and additional resources to meet program goals.

Educational Program Goals

As Tyler (2013) shares, “Education is a process of changing the behavior patterns of people” (5). The program's overall goal is to provide opportunities for underserved populations to improve educational outcomes, workforce opportunity skills and stimulate interest in STEM careers. Coordinating a robotics team and competition can be intimidating. The goals of the training materials include mastering the basics of the FTC competition, including onboarding the team to the gameplay rules, robot building guidelines, and engagement with meets and qualifying matches. Additional educational program goals of FFA incorporate training for Coach Facilitators working with a high need population, visual scaffolding supports to close the gap for English language learners and special education students, access to corporate sponsorships for equipment, supplies, transportation, and mentorship engaging in meets and qualifying tournaments.

There are three desired states as outcomes for our program, which provides critically needed equal access to educational services. The first desired state is increased confident participation of residential foster and incarcerated youth in FTC qualifying tournaments with designed robots equivalent in look and feel and performance to currently enrolled teams during in-person or remote matches. The second desired state is a raise in math and reading benchmarks, increased high school graduation and GED rates, and data that reveals an increase in pursuing STEM careers for students who participate in our program. A third desired state is a positive survey result from Coach Facilitators that the additional program materials met or exceeded their needs while mentoring a robotics team.

Population Profile

Our population consists of the Coach Facilitators and the students benefitting from the FFA experience. The student target population for FFA is high school-aged students from 9th to 12th grade in residential group foster homes and incarcerated youth facilities. There is approximately 36,000 incarcerated youth in U.S. residential facilities (Locked Out: Improving Educational and Vocational Outcomes for Incarcerated Youth, 2015), and an estimated 4,000 youth living in residential group foster homes in the state of California alone out of a U.S. population of 423,000 (Child Welfare Information Gateway, 2021). The population is disproportionately male, African American, Hispanic, and Native American, but FFA will also target Caucasian, Asian and female students. Our population may need special education support; they may be English language learners with math and reading skills below grade level which may be at risk of not graduating from high school or identified as previously dropping out of school (Locked Out: Improving Educational and Vocational Outcomes for Incarcerated Youth, 2015).

Coach facilitators will be community volunteers, career technical educators, teachers, and STEM professionals passionate about introducing science and technology topics to at-risk youth (Center for Youth and Communities Heller School for Social Policy and Management Brandeis University Waltham, MA, 2011). It is assumed that some coach facilitators will have technical knowledge, but many may not. The program will pair technical mentors with coach facilitators who request support and provide for collaboration using the online community. The robotics coach facilitators and student participants are known collectively as a "team."

FFA facilitators will be certified trainers who have previously participated in a FIRST Tech Challenge competition and have experience with existing professional development programs in the FIRST organization. This is a compensated position.

The club is voluntary, and students will indicate an interest in Science and Technology topics by a survey. No prior experience with robotics is required. The program's motivation to engage should be stimulated using the existing FIRST Inspires website and the newly created online community for residential youth programs. Coach Facilitators should adopt an andragogical approach where students collaborate in a non-authoritative climate (Knowles et al., 2020). Behavioral issues working with the population may be expected and therefore preparing the learner and then setting mutually agreed upon objectives is essential to team management (Tyler, 2013). The Coach Facilitator is a change agent, sometimes working with tools and equipment that involve safety concerns; therefore, the learner must be self-directed and enjoy inquiry-based problem-solving tasks. Robotics provides an opportunity for students to engage the three domains of Bloom's Taxonomy: cognitive, affective, and psychomotor. Students engage in the cognitive domain by learning the information and knowledge needed to assemble and program the robot, students engage in the affective domain by learning the rules of gameplay and the value of teamwork in competition, and they engage with the psychomotor domain as they build and iterate the robot design (Knowles et al., 2020).

Participants are expected to support technology and distance learning to engage with FFA enthusiastically. Some of the population will be incarcerated and unable to have full access to materials otherwise. Additionally, students and Coach Facilitators begin by completing a survey indicating an interest in Science and Technology.

Prerequisites

Student participants in the FFA program will qualify if they: a) are a high school-aged student in a residential group foster or incarcerated youth facility, b) positively complete an online survey indicating an interest in science and technology topics, c) agree to follow a code of conduct to maintain access to the tools and supplies. Robotics coach facilitators in the FFA program will qualify if they: a) are

at least 21 years old with interest in volunteering with at-risk youth and technology, b) speak and write English at the High School level, c) pass a background check that authorizes the ability to work with students, d) have a laptop computer and an internet connection available.

FFA facilitators will qualify if they: a) are at least 21 years old with interest in working with at-risk youth and technology, c) have at least one season of experience with the FIRST Tech Challenge competition, d) are a FIRST Certified Trainer, f) pass a background check that authorizes the ability to work with students g) foster Gracious Professionalism® and FIRST Core Values in students.

Additional Considerations

Students will be encouraged to embody FIRST Robotics' concept of "Gracious Professionalism," defined on the FIRST website as "a way of doing things that encourages high-quality work, emphasizes the value of others, and respects individuals and the community" (*First Robotics Competition*, 2021). Students are encouraged to build social networks with other teams to improve their designs, update their code and engage in science and technology topics. While some students in this population may struggle with these concepts and ultimately decide that the program is not a fit, others will build these skills by joining the club and accessing the additional resources of FFA. Youth enjoy trying different clubs and groups and may change their interests. Small but nimble teams are expected and encouraged. Groups may have multiple teams participate and compete for residential facilities with great interest.

References:

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Figure 1

Robot Inspection Checklist



Robot Inspection Checklist

Team Number: _____

Robot Inspection Status (circle): **PASS** / **FAIL**

Team Insp.	Robot Size Inspection	Rule #
	Robot is presented at inspection with all mechanisms (including all components of each mechanism), configurations, and decorations that will be used on the Robot during the competition.	<I06>
	Separately test the Robot in all of its unique starting (pre-match setup) configurations. The Robot fits within the Sizing Tool without exerting undue force on the Sizing Tool sides and Robot Motion Warning Label is attached if servo motors move during the Robot initialization.	<I06>a <RG02>
✓	✓ General Robot Rules	Rule #
	Robot does not contain any components that could damage the Playing Field or other Robots.	<RG01>a&b
	Robot does not contain materials that are hazardous.	<RG01>c
	Robot poses no obvious unnecessary risk of entanglement.	<RG01>d
	Robot does not contain sharp edges or corners.	<RG01>e
	Robot does not contain animal-based, liquid, or gel materials.	<RG01>f&g
	Robot does not contain materials that would cause a delay of game if released.	<RG01>h
	Robot does not contain elements that electrically ground the Robot frame to the Playing Field.	<RG01>i
	Robot does not contain closed gas devices.	<RG01>j
	Robot does not contain hydraulic devices.	<RG01>k
	Robot does not contain vacuum based mechanisms.	<RG01>l
	Team number is visible from at least 2 sides and meets requirements.	<RG04>
	Alliance Markers are present and meet requirements.	<RG05>
	Energy used by the Robot, (i.e., stored at the start of a Match), shall come only from approved sources.	<RG06>
	Robot is not capable of launching its own components.	<RG07>
✓	✓ Robot Mechanical Parts and Materials Rules	Rule #
	All components on the Robot are from allowable raw materials and Commercial Off The Shelf products.	<RM01> <RM02> <RM06>
✓	✓ Robot Electrical Parts and Materials Rules	Rule #
	The Main Power Switch is installed properly, labeled, readily accessible, and visible to competition personnel. The TETRIX, REV, and MATRIX switches are the only allowed Main Power Switch.	<RE01>
	All batteries are securely attached to the Robot in a location where they will not make direct contact with other Robots or the Playing Field.	<RE02>
	Exactly one (1) Robot Main Battery Pack of an approved type is on the Robot and it is properly connected to the Main Power Switch and either the REV Expansion Hub or REV Control Hub.	<RE03> <RE05>a(i&ii)
	Where present, fuses must not be replaced with fuses of higher rating than originally installed or according to manufacturer's specifications. Fuses are single use only.	<RE04>
	Allowed electronic devices are powered by power ports on the REV Expansion Hub or REV Control Hub except as noted in <RE05>a&b, <RE13>, and <RE14>.	<RE05>a
	The REV Expansion Hub and/or REV Control Hub is powered by the Robot main battery.	<RE05>a(i&ii)
	REV SPARK Mini Motor Controllers and REV Servo Power Modules are powered by the Robot main battery or a REV Control or Expansion Hub XT30 port.	<RE05>a(ii)
	Allowed sensors may only receive power from the REV Expansion Hub or REV Control Hub.	<RE05>a(iii)

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FIRST Robotics Competition. (2021). FIRST Tech Challenge.

(https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/field-inspection-checklist.pdf). In the public domain.

Figure 2

Field Inspection Checklist



Field Inspection Checklist

Team Number: _____

Field Inspection Status (circle): **PASS / FAIL**

✓	Drive Team Members Present	Rule #
	Coach (required), Driver 1 (required); Driver 2 (optional)	<C06>
✓	Driver Station and Robot Controller Hardware Rules	Rule #
	Driver Station consists only of one Android device (Circle): Motorola Moto G 2 nd Generation, Motorola Moto G 3 rd Generation, Motorola Moto G4 Play, Motorola Moto G5, Motorola G5 Plus, Motorola Moto E4, Motorola Moto E5, Motorola Moto E5 Play, or REV Driver Hub.	<RE07> <DS01>
	Smartphone Robot Controller Android device (if used) is one of the following models (Circle): Motorola Moto G 2 nd Generation, Motorola Moto G 3 rd Generation, Motorola Moto G4 Play, Motorola Moto G5, Motorola G5 Plus, Motorola Moto E4, Motorola Moto E5, Motorola Moto E5 Play. The Android device's USB interface only connects to a REV Expansion Hub or a USB hub.	<RE07>
	The touch display screen of the Driver Station must be accessible and visible to field personnel.	<DS02>
	The Driver Station consists of no more than two of the allowed gamepads (Logitech F310, Xbox 360, wired Sony DualShock 4 for PS4, or Etpark Wired Controller for PS4) in any combination.	<DS03>
	No more than one (1) optional external battery powered or unpowered USB hub is allowed.	<DS04>
	No more than one (1) optional COTS USB external battery connected to the REV Driver Hub USB-C port or a USB hub connected to the smartphone Android Device is allowed.	<DS05>
	Driver Station smartphone Android device (if used) USB interface is only connected to either a Mini USB to OTG cable or combination of cables connected to one USB Hub, or one gamepad USB cable connected to an OTG Micro Adapter.	<DS06>
	Driver Station Carrier (if present) meets requirements.	<DS07>
DS RC	Driver Station (DS) and Robot Controller (RC) Software Rules	Rule #
	Android smartphone(s), REV Driver Hub, and REV Control Hub are named with the official team number followed by –DS or –RC as appropriate.	<RS01>
	Android operating system satisfies the requirements: Motorola Moto G 2 nd Generation, Motorola Moto G 3 rd Generation, Motorola Moto G4 Play – version 6.0 or higher. All other allowed Android devices –version 7.0 or higher.	<RS03>
	DS and RC apps are version 7.0 or higher and the DS and RC apps have the same version	<RS03>
NA	REV Driver Hub (if used) operating system is version 1.1.0 or higher.	<RS03>
	REV Driver Hub (if used) has Bluetooth turned off and Wi-Fi turned on.	<RS07>
NA	REV Control Hub (if used) operating system is version 1.1.2 or higher.	<RS03>
NA	REV Expansion Hub (if used) firmware version is 1.8.2 or higher.	<RS03>
NA	REV Control Hub (if used) has Wi-Fi turned on, Bluetooth is turned off, and the password is different than the factory default value of "password".	<RS07>
	Android smartphones (if used) are set to airplane mode, Wi-Fi is turned on, and Bluetooth is turned off.	<RS07>
	Android devices are not connected to any local networks.	<RS09>
	All remembered Wi-Fi Direct Groups and Wi-Fi connections on Android devices have been removed.	

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FIRST Robotics Competition. (2021). FIRST Tech Challenge.

(https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/robot-inspection-checklist.pdf). In the public domain.