Designing an International Support Community for Educators in Robotics

An Interactive Qualifying Project
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degree of Bachelor of Science

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Abstract

In assistance to the development of OpenSTEM, we developed a proposal and prototype of a system that will act as the main resource for teachers in robotics across the world. We assisted the WPI marketing team in creating a website that acts as a landing page for this project. We conducted studies to determine the best options available for quick access to robotic support. We developed a common way of communication that allows everyone to ask questions, collaborate, and receive feedback promptly. Additionally, we sought to build a community for teachers, enabling them to become self-reliant as well as allowing them to be more engaged with the course.

Acknowledgments

Executive Summary

Introduction,

The global supply of STEM talent does not equal the current demand. With the demand comes the need for educational institutes to ensure access to STEM educates students internationally.

WPI is a global leader in robotics education and, for more than 50 years, "has shared its expertise and resources to grow the STEM pipeline" (WPI). One of the institute's founding principles is its ability to "prepare and support future scientists, engineers, and business leaders in their journeys to become the empathetic, collaborative, and resourceful STEM professionals the world needs" (WPI). The global supply of STEM talent does not meet the current demand. With the demand comes the need for educational institutes to ensure access to STEM education among students internationally and reduce the systemic inequality in STEM education.

To help bridge the gap of inequality, WPI has proposed the OpenSTEM program. This program seeks to understand problems in the local context and use WPI's resources to help people create solutions, beginning with robotics. The first course that the OpenSTEM program ran was the XRP Beta, a course built to provide educators in robotics with the materials to develop their robotics course. A support community was also designed to allow educators to communicate with the course developers.

Background

From the 1990s till now, STEM declares an important role in the world's development and improvement by providing scientific knowledge, innovation, and technology. Along with the rise of STEM is the need for STEM Education to nurture the younger generation of STEM professionals. STEM in education is not merely subjects relating to STEM, but also the integration of all disciplines of STEM in different subjects to encourage discussion, problem-solving, and collaboration while simultaneously giving students a practical skill set that is much needed in the technological era.

STEM Education is in high demand and plays an important role in many countries' top priority due to its strong influence on the future development and economics of the corresponding country. Interestingly, a study has found that developing countries have shown more focus and increased interest in STEM education in comparison to developed countries. This could be influenced strongly by each of the nation's growth and priorities', many developing countries are viewing STEM Education as the key to one's nation's success and economic growth. Despite such high demand, STEM Education is still facing multiple barriers to expand its accessibility for an inclusive and quality education for all genders and minorities. The lack of resources and supplies and the lack of teachers' readiness only exacerbate the issues. Each issue should be researched carefully to create a true global initiative STEM Program sufficiently.

At the end of our initial research, we reinforce our understanding of STEM and how it has developed over the years into a push for an inclusive, diversified community to help grow and support new opportunities.

With all that has been researched, in the next chapter, we formulate our initial discoveries and interpret them into a plan of action to create an ideal International Support Community for Educators in Robotics.

Methodology

Discovery

We will take another look at our background research, and based on this research will be narrowing down our issues, targets, and goals that we have for this project. We will see what are the issues we want to focus on the most, and try to discover all the goals that are feasible to achieve with the project, as well as find out any other issues we may face. We can achieve this by conducting surveys and interviews, and seeing different opinions and struggles from different backgrounds and how these struggles have affected their interactions with STEM.

Define

Now we will narrow down even further to say who we are targeting, as well as what our goals are and how we can achieve them. We will define what we want to accomplish with this project, and all the necessary elements our project would need for it to be successful.

Prototype

We will look at different platforms that already exist, and see what kind of a process we need to go through to determine what platforms we want to use for our project. We will do a further deep dive into what our platforms would need to be successful, and provide the users with the best possible experience. We also want to see how these platforms can help us moderate the platforms, as well as expand upon the platforms.

Test

Finally we need to be able to test how good the platforms are. We will develop a system of feedback, and what we want to see from the users of these platforms in order to develop the platforms further. With this feedback, we can also improve on the course, as what the users are struggling with could be made clear within the course itself.

Findings

Platform Selection

To select a good support platform, the team considered several different factors that determine a service's utility. Most importantly, for a platform to be useful in this program, it needed to be accessible, it needed to be organized, and it needed to be manageable for the course providers.

First, a platform needs to be ubiquitously accessible. A platform will only be useful if the members of the program can all access the application, so it needs to be an internationally used and available platform. On top of this, it needs to be free of use. Having a paywall between the platform and the users will hinder the user's ability to join and participate in the course.

Second, a platform needs to be organized. It needs to be clean and clear, without too much clutter to confuse the users. This helps users find the topics they are interested in, know where they can ask more questions, and find the resources they need. It allows the users to participate in the course without much trouble.

Third, a platform needs to be manageable for the course providers. This enables us to focus more on the users if we need to spend less time keeping up the maintenance on the platform. If the platform needs more moderation than we thought, we need to be able to respond quickly. If we don't, we could risk the course not being as friendly or accessible to the users as we would like it to be. Then we also want to expand the platform without much difficulty, so we can provide new challenges for the users if those are wanted.

Recommendations

From our delivered product, and the feedback we have received, we have written down recommendations and what we would like to see in the future of the OpenSTEM program. There remains plenty of work to be done in all aspects of the OpenSTEM project. We will provide recommendations on the following topics: internal operations, course delivery, hardware & software, and next steps.

Internal Operations:

- Employ a technical expert
- Better communications between OpenSTEM teams
- Agile development structure and weekly sync-up meetings

Course Delivery

- Find a more widely available and more accessible platform (not Canvas)
- Improve and finish the XRP Beta course
- Dedicated support staff who have technical knowledge

Hardware & Software

- Improve drive motor selection
- Make Blocky available
- Create a documentation page on the robots and code libraries

Next Steps

- Gain a sense of the countries robots and handed out to and the worldwide impact of OpenSTEM
- Create a WPI scholarship for students participating in OpenSTEM
- Host weekly/monthly challenges to implement on the robot to facilitate discussion, learning, and engagement

Final Thoughts

Though this was the first iteration of the OpenSTEM program, there is still plenty of work that needs to be done. Most of this was addressed in our recommendations for furthering the program. However, we would like to see three main changes before moving to the program's next iteration.

- More students should be involved in the program. Since the start of the program, there has been an increased demand for participation worldwide, which IQP students cannot meet.
- The support system prototype works for the 200 individuals we were aiming to serve. However, if the program grows significantly in participation and funding, other platforms should be considered before moving on.
- Most importantly, the course needs to be finished and formed into something that we would be happy to give as a final product to thousands of students and teachers globally. It should be reviewed by not only the OpenSTEM team but other teachers within the WPI robotics program to ensure that it is sufficient enough to be used by many.

Authorship

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Abstract		Samara	Tom
Acknowledgements		Samara	Tom
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	New Technology Adoption	Tom	Trang
	Self-Supporting Platform	Andy	Trang
	Moderation	Tom	Trang
	Prototype for E4USA	Samara	Trang

	Testing at FIRST Global	Samara	Trang
	Other Support Towards OpenSTEM	Andy	Samara, Tom
Chapter 5: Recommendations and Final Thoughts	Recommendations	Samara, Tom	Trang
	Final Thoughts	Samara	Tom

Chapter 1: Introduction

Professor Klaus Schwab believes that the world is entering its fourth industrial revolution. He states that, "It began at the turn of this century and builds on the digital revolution" (Schwab, 2016). He believes that there are four main megatrends that have "leverage[d] the pervasive power of digitization and information technology," including autonomous vehicles, 3D printing, advanced robotics, and new materials. However, Schwab also raises some concerns in this revolution, the main being systemic inequality. "Labour markets," Schwab states, "are becoming biased towards a limited range of technical skill sets," where only a small number of people will become "winners." The "winners" will be "those who are able to participate fully in innovation-driven ecosystems by providing new ideas, business models, products and services, rather than those who can offer only low-skilled labor or ordinary capital" (Schwab, 2016).

To mitigate systemic inequality by increasing the number of "winners," countries are prioritizing the development of STEM talent pipelines. For the United States, "the federal government has taken important steps toward diversifying the pipeline of STEM talent in the United States, primarily by supporting STEM education opportunities for historically underrepresented groups in these fields" (Diversifying the Pipeline of STEM Talent, 2018). The global supply of STEM talent does not equal the current demand. With the demand comes the need for educational institutes to ensure access to STEM education among students internationally.

WPI is a global leader in robotics education and, for more than 50 years, "has shared its expertise and resources to grow the STEM pipeline" (WPI, 2022). One of the institute's founding principles is its ability to "prepare and support future scientists, engineers, and business leaders in their journeys to become the empathetic, collaborative, and resourceful STEM professionals the world needs" (WPI, 2022). As the fourth industrial revolution moves forward, the need to reduce the systemic inequality in STEM grows.

To help bridge the gap of inequality, WPI has proposed the OpenSTEM program. This program seeks to understand problems in the local context and use WPI's resources to help people create solutions, beginning with robotics. The first course that the OpenSTEM program ran was the XRP Beta, a course built to provide educators in robotics with the materials to be able to develop their own robotics course. To allow educators to communicate with the course developers, a support community was designed as well.

The next few chapters will discuss the background, methodology, and findings in the development and deployment of the XRP Beta course, along with its support community. The last chapter will discuss the recommendations for moving forward with the OpenSTEM program based on the findings.

Chapter 2: Background

As detailed in Chapter 1, the goal of this project was to create a working prototype of a support system that would meet the requirements of the participants within OpenSTEM. This involved extensive research, development, and testing of a working prototype of an online professional learning community for teachers and learners around the world. These participants include both students and teachers of the curriculum, but also the prospective WPI staff that will be assisting in providing a majority of the support.

In order to properly achieve the team's objectives, we first need to explain the origins of STEM, detailing its importance, influences, and demand. We will then delve into the topics relating to issues within STEM education, including cultural stigma, diversity, and resource accessibility. Finally, in this section we will discuss the resources currently available in an attempt to lessen the gap between STEM education and international communications.

2.1 STEM Importance, Influence, and Demand

2.1.1 What is STEM?

Starting in the 1990s, the acronym STEM (formally SMET), coined by the National Science Foundation (NSF), has been used to refer to the topics of science, technology, engineering, and mathematics. Recently art has also been incorporated into this group of disciplines, and they are known together as STEAM to expand the limits of STEM (Hom, E. J., & Dobrijevic, D, 2022).

It is important to note that "STEM is not a curriculum" ("STEM-Beyond the Acronym", 2014). STEM is an approach to learning that hopes to replace the barriers that traditional education has. Traditional education is about using books and retaining information, while its counterpart, STEM education, focuses on where the knowledge can be applied (Jadav, 2018). STEM aims to allow students to learn through experiences and apply their knowledge to real-world issues.

STEM integration can take the forms of many different types as shown in Fig. 1. The first box of the inclined plane was developed by Jo Anne Vasquez and was discussed in her book, *STEM Lesson Essentials, Grades 3-8*. It explains the increasing levels of integration, starting at disciplinary, where students learn concepts and skills separately in each discipline, ending at transdisciplinary, where students apply knowledge and skills from different disciplines to real-world problems. The new inclined plane proposal includes neodisplinary, where students fully immerse themselves in real-world problem-solving tasks.

The new incline plane of inquiry-based/PBL/STEM integration
(Addition of Neodisciplinary class of integration - Alex Delaforce 2016)

The inclined plane of STEM integration (Vasquez, 2014)

Neodisciplinary

Transdisciplinary

Interdisciplinary

Multidisciplinary

Disciplinary

Students learn concepts and skills separately in each discipline

Students learn concepts and skills separately in each discipline but in reference to a common theme

Students learn concepts and skills from two or more disciplines that are tightly linked so as to deepen knowledge and skills

By undertaking real world problems or projects, students apply knowledge and skills from two or more disciplines and help to shape the learning experience

Students fully immerse themselves in authentic, real world problem solving tasks and address them using and developing appropriate skills in combinations that in a real-world sense disregard the traditional silos of disciplines (effectively creating new categories of skills and knowledge networks)

Source: Delaforce 2016 http://delaforce.info/wp-content/uploads/2016/10/Neodisciplinary-1.png

Fig. 1. The New Inclined Plane of STEM Integration

2.1.2 What is STEM Education?

STEM education refers to the inclusion of the topics of science, technology, engineering, and math, along with their cross-disciplinary counterparts, into traditional education (Li, Wang, & Froyd, 2020). As mentioned previously, traditional education is about the use of books and the retention of information, while its counterpart, STEM education, is focused on where the knowledge can be applied (Jadav, 2018). STEM education has been a growing focus for educators as it sparks interest through learning by doing.

STEM education creates a desire and passion for the pathway and eventually, drives the innovation of today's technological achievements. According to the National Research Council, there are three major goals of STEM education, (1) increasing the number of students pursuing advanced degrees and careers in STEM, (2) expanding the STEM-capable workforce, and (3) increasing STEM literacy for all (National Research Council, 2011). STEM education aims to encourage discussion, problem-solving, and collaboration while simultaneously giving students a practical skill set.

The heart of STEM education is in integration within the classroom. As previously discussed with Vaquez's theory of the inclined plane, as the level of integration of STEM increases, so does the interest in STEM. The ideal new goal of STEM education is to reach the neodisiplinary stage, where students can apply knowledge and skills gained from multiple disciplines to help shape their education.

STEM education's focus is on the application of knowledge gained within the classroom. With increased applications comes an increased interest and desire to pursue STEM as a career. The desire to pursue a STEM career is necessary in moving forward though the "fourth industrial revolution" and it is why the world needs to develop its STEM education curricula.

2.1.3 Why is There a Demand For STEM Education?

There are three primary reasons why there is a demand for education. The first reason is because of the ever-changing world. Specifically, the world is entering a digital age. The second reason is that there is an increasing amount of STEM opportunities as a result of the first reason. The third reason is that STEM is the basis of understanding many of the world's problems which we will detail later in this section.

In the past two decades, STEM education demand has increased due to the changing world. As the world enters what Professor Klaus Schwab considers "the fourth industrial revolution", we are seeing an increase in reliance on robotics and technology. According to the U.S. Department of Education, the world is changing and getting more complex which makes it very important for the nation's youth to prepare to "solve problems, make sense of information, and know how to gather and evaluate evidence to make decisions" (U.S. Department of Education, n.d.).

The National Research Council found, "The primary driver of the future economy and concomitant creation of jobs will be innovation, largely derived from advances in science and engineering" (National Research Council, 2011). According to the U.S. Bureau of Labor Statistics, between 2020 and 2030, STEM occupations are projected to increase by 10.5% (*Employment in STEM Occupations, 2019*). Yet, the NRC found that, "4 percent of the nation's workforce is composed of scientists and engineers" (National Research Council, 2011). With the increasing amount of STEM opportunities and the deficit of people capable of filling the roles, comes the demand for STEM education.

There is a demand for scientists and innovators to tackle topics such as, "climate change, overpopulation, resource management, agricultural production, health, biodiversity, and declining energy and water sources" (Kelley & Knowles, 2016). For these problems, STEM is the basis of understanding (Thomas & Watters, 2015). Demand is high and according to the US Department of Education, "If we want a nation where our future leaders, neighbors, and workers can understand and solve some of the complex challenges of today and tomorrow, and to meet the demands of the dynamic and evolving workforce, building students' skills, content knowledge, and literacy in STEM fields is essential" (U.S. Department of Education, n.d.). Fulfilling the demand should be a priority amongst the world as we enter this "fourth industrial revolution", but this issue's resolution starts with STEM education.

Interestingly, though Western countries have more resources at their disposal than developing countries to advance their STEM programs, interest in pursuing STEM careers has fallen. Conversely, interest in pursuing STEM has increased in many developing countries such as India and Malaysia, despite the lack of resources (Thomas & Watters, 2015).

"Improving teaching and learning in STEM education has become an economic factor in developing countries, emerging economies, and in long-established economies such as Europe and the United States"(Kennedy & Odell, 2014).

2.2 Barriers for STEM Education Accessibility

Indubitably, the priority to integrate STEM subjects into the school curricula has proven the importance of STEM in education and the career market. However, despite the great interest in STEM globally, STEM and STEM Education still face many challenges to be accessible to all students. In this

section, we will discuss the gaps and barriers that STEM education is facing in cultural stigma, funding, and resources for different places around the world.

2.2.1 Women and Minorities

One of the top barriers to STEM's accessibility to students lies in cultural stigma in both gender and race. Despite the need for STEM knowledge, many students lack the opportunity to develop STEM-related skills due to traditional beliefs, stigma, and assumptions from the society around them. The underrepresented and historically marginalized population in STEM not only brings a concern to the equity in the field but is also harmful to STEM innovation.

To understand the problem more, we will be looking into the gender gap in STEM globally as well as the diversity in STEM in a more mixed environment, such as the United States of America.

Gender Gap in STEM

Engineers, scientists, and many more positions associated with STEM are seen as "the man's job" in several countries around the world. The bias against women is strongly influenced by the patriarchal system that dominates the world in placing "the woman's role" to be more passive, a stay-at-home housewife, etc. According to the United Nations (UN), "almost 90 percent of people, including women, interviewed across 75 countries have at least one clear bias against gender equality in areas such as politics, economics, education, intimate partner violence and women's reproductive rights" (United Nations). The norms and beliefs in the traditional woman's role in daily life strongly affect their education and accessibility in STEM. In another Unicef report, over 100 million girls of primary and secondary age in the developing world are out of school. The girl's exclusion from education "begins early and increases over time." Although the "vast majority of adolescent girls of upper secondary age begin primary education, fewer than half make it to the upper secondary level where STEM skills can be further solidified" (Unicef).
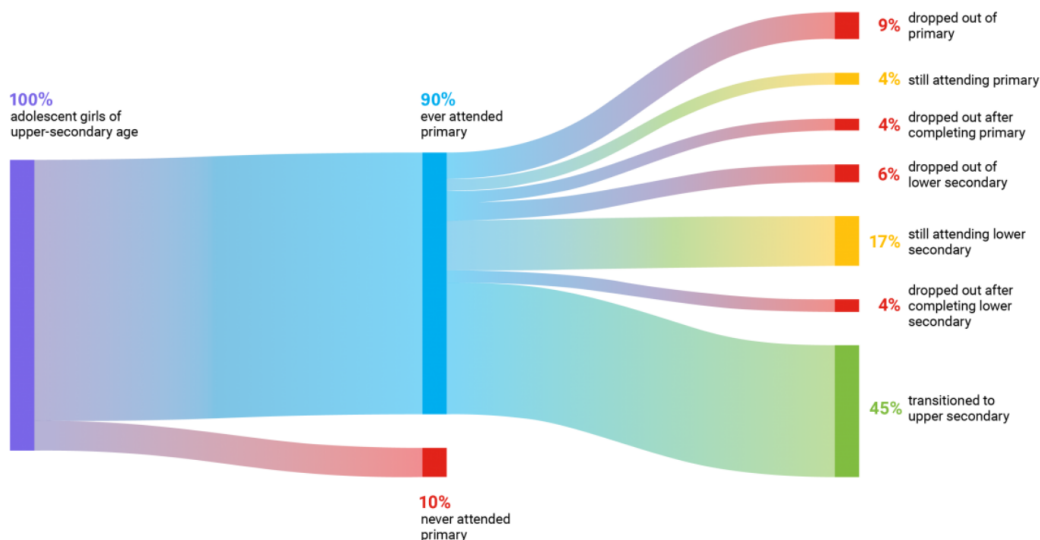

Fig. 2. Unicef Education Pathway Analysis Dashboard on a sample of 92 LMICs across all regions.

It has been proven in many research studies and observations that girls can do just as well as boys in critical thinking and advanced skills if given opportunities. However, with the existing gender norms, biases, and stereotypes, girls and women are less confident in the STEM field at

both the educational and professional levels. Gender bias exists in many different forms that affect STEM education representation directly or indirectly, including but not limited to:

- Gender stereotypes
- Gender bias in the curriculum
- Gender bias in parental expectation
- Gender bias in the classroom
- Gender bias in peer perception
- Lack of female teachers in STEM
- Lack of appropriate role models
- Inadequate information and career guidance

Although many changes are seen in the STEM movement in narrowing down the gender gap, these changes are seen more in higher-income countries than low and middle-income countries, which prompts yet another economic factor into the issue.

Unicef pointed out that the gender gap plays a big role in lowering girls' self-confidence in STEM abilities and potentially affects their decision to commit to STEM for a professional career. This shows how deep-rooted and hard it is to solve the gender gap and bias in STEM. It affects multiple dimensions of gender equality in society. However, it is one of the most important issues to solve to expand STEM's diversity and bring more diverse interpretation, representation, and innovation to the field.

Diversity in STEM

One challenge for the team's research was to find out what we mean by *diversity* within the STEM field. Since the project scope is to expand the reach of STEM globally, the team has to consider different dynamics, cultures, religions, etc. Therefore, we think that a STEM society is *diverse* if STEM representation reflects equal opportunities for every individual in such society. We recognize that different societies include different groups of minorities - based on but not limited to race, identity, religion, culture, ethnicity, gender, socioeconomics, geography, etc. - and often these are the groups that suffer from the structural bias and norms of society. The question of making STEM equal and inclusive while keeping up with highly-skilled individuals is very tricky due to many underlying issues and problems that started from the early stage of the STEM pipeline itself.

Similar to the gender bias in STEM, minority groups are often less supported in the STEM field due to the lack of a role model, confidence, resources, funding, and much more. For example, many mountainous regions and towns still do not have consistent electricity in Vietnam. Due to the geographic location of these places, many towns don't have efficient school systems or even enough teachers, which often leads to students dropping out of school or students who are unable to receive the same amount of knowledge as students in the city. Vietnam is also home to 54 different ethnic groups. This introduces barriers regarding languages, cultures, stereotypes, and income in traditional and STEM education. Tran points this out in their article, *Reducing gaps education remains important in Vietnam as the new School year kicks in,* "by age 19, only a fifth of students from the poorest 20 percent remain in school, compared with 80 percent of those in the wealthiest 20 percent. Inequities persist across ethnicities and geographies, with ethnic minorities often falling behind in educational attainment" (Tran).

| Enrolment rates by household wealth quintiles | Enrolment rates by ethnicity group |

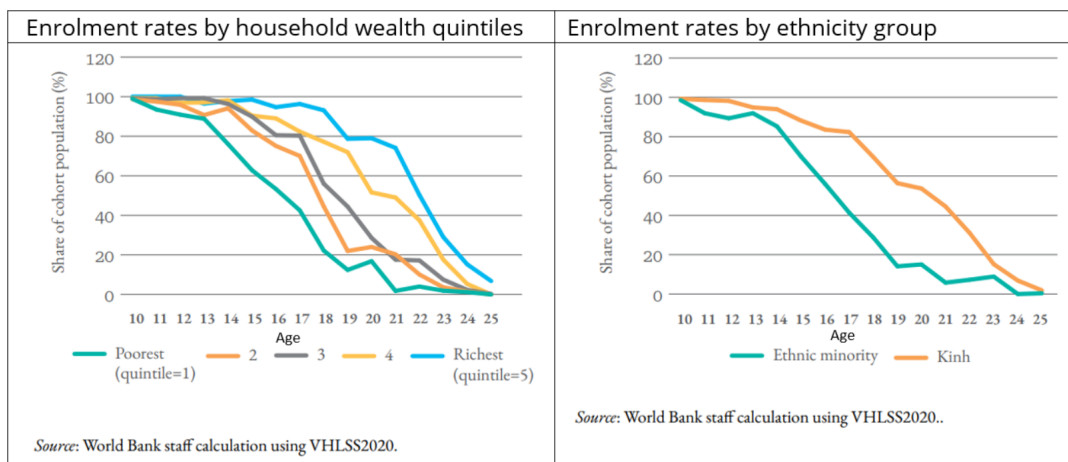*Source*: World Bank staff calculation using VHLSS2020.

Fig. 3. Enrollment Rates.

In the U.S., racial stereotyping and discrimination still exists in the STEM workforce. For example, there is often an assumption that "Asian Americans are better at math and science," which at first sounds like a compliment. However, it restricts specific groups of students to certain categories and potentially can harm other students who feel out of place due to the stereotype. Such stereotypes and assumptions also shadow the fact that the APPI (Asian Pacific Islanders) subgroups are still underrepresented in STEM in America, according to the Asian Americans Advancing Justice, such as Cambodians (9%), Laotians (8%) and Hmongs (7%) compared to other professions within the United States (12%).

This is definitely a complex issue that requires more detailed work depending on each country and population. The team believes that this is an important topic to look into if we truly want to create a globally inclusive STEM program.

2.2.3 Resources Accessibility

One of the important barriers to STEM lies in its accessibility in terms of resources and funding. Certain STEM subjects, such as robotics, science, and other STEM classes, can be expensive because they utilize different materials, hardware, software, etc. Not only that, but as technology improves, the need for frequent up-to-date versions is often crucial to keep STEM education relevant to the real world. According to a Pew Research study conducted in 2018, "The most commonly cited reason for not pursuing a STEM career was cost and time barriers (27%), such as high expenses required for education or a lack of access to resources and opportunities" (Kennedy, Hefferon, & Funk, 2018). The lack of resources can be divided into the lack of funding, the lack of supply, the lack of educators' readiness, and a national priority in matters.

Since we are looking at the barriers globally, it is important to point out how different countries in different states of economy and priority face different resource-related barriers. However, to have an overall perspective, we will expand the team's research to cover as many barriers we recognize as possible.

Supply and Material

STEM development and new technologies such as electricity, internet, planes, etc. have elevated living standards in many countries and enabled many incredible innovations worldwide.

However, such developments are distributed unevenly, leaving a gap in technology amongst the countries themselves, or even among towns/cities within a country. We will look specifically at the existing digital devices, an inequality with Internet access, and therefore, digital knowledge and resources, and the lack of access to hardware as well.

Internet access plays an important role in STEM education since most information and resources are either stored or shared digitally. The rapid development of technology can potentially affect the teaching materials, tools, and relevance of certain topics. For example, computer science and robotics will be complicated to introduce and teach without updated software, updated software libraries, and open-source code. Certain teaching tools such as block code, Scratch, or advanced calculators can also influence how materials are delivered to the student. According to the World Economic Forum, "a third of the world's population (some 2.9 billion people) suffers from the digital divide – even though 95% of the world's population resides within range of a mobile broadband network" (World Economic Forum). Not only that, the inconsistent access and bandwidth of the internet also inhibit participation in virtual activities and more.

Hardware access is also limited due to the distribution of manufacturing sites around the world. For certain subjects that require hardware as teaching material, such as robotics, chemistry, or physics, the availability of hardware locally is key for how the curriculum will be constructed. When hardware needs to be used within a global program, certain countries might suffer due to difficulty in purchasing parts, delay in delivery, or even higher price brackets if those parts can't be locally substituted. For example, many teams purchase the recommended robotics kits during FIRST Robotics Competitions (FRC). The same kit that takes about a couple of weeks to deliver in the US can take up to a couple of months for an FRC team in Africa or Southeast Asia.

Educator's Readiness and capacity

Teachers and Educators in STEM play an important role in constructing and developing the STEM education curriculum. However, despite the high demand and need for STEM and STEM education around the world, teachers are struggling to provide quality materials due to a lack of training with up-to-date technologies and a lack of experience with teaching certain STEM topics. The team looked closely at STEM teachers in Turkey and Indonesia to understand the causes and needs that affect teacher readiness in STEM education.

According to a study regarding STEM teacher readiness in Turkey, Asiroglu et al, with 353 teachers representing Siirt and Batman, most teachers find themselves inadequate in "implementing teaching designs that are inventive, use scientific methods, develop creative STEM products, and aim to raise students who critically examine these products" (Asiroglu et al. 2018, 2461). In addition, many teachers find it difficult to use computer technologies in classes and plan activities to encourage students to analyze, synthesize, and evaluate information instead of memorizing it. One of the important findings was that many teachers have a misconception of STEM Education; they thought of STEM as "associating natural science with mathematics only" or merely "integrated teaching of subjects" before they were trained (Asiroglu et al. 2018, 2468). Asiroglu et al. stated, "STEM education requires that all disciplines should be studied in an integrated manner, not by associating a discipline" (Asiroglu et al. 2018, 2468). The study further emphasizes the need for a qualification program for in-service training for teachers to provide constant support and sufficient knowledge to aid teachers in designing their STEM curriculum accordingly.

In another study among 101 Indonesian Physics Teachers during the recent COVID-19 pandemic, Sulaeman et al. find that although most teachers in Indonesia understand and show strong alignment with STEM education and its implementation, many teachers still do not have experience conducting STEM lessons. Furthermore, the quick transition from the traditional classroom to the online classroom posed by the pandemic weakened "the possibility of implementation" of STEM in the curriculum, which could affect the learning experience overall (Sulaeman et al, 2021). Sulaeman et al. concluded that, "professional development in STEM education is needed for both in-service and pre-service teachers to develop their readiness, which is an initial step toward the implementation of STEM education in the classroom", which further stresses the importance and need for efficient support and a training system for teachers especially in STEM education (Sulaeman et al. 2021).

Finally, the team looked into the current shortage of teachers worldwide. UNESCO predicts that "69 million teachers are needed to reach universal basic education by 2030" (Unesco, 2022). The Director of UNESCO, Audrey Azoulay, stated that "lack of training, unattractive working conditions and inadequate funding" are some of the reasons that "undermine the teaching profession and aggravate the global learning crisis" (Unesco, 2022). She pointed out the importance of the right to an "inclusive and quality education" and furthermore stated that there is an "urgent need" to recognize and focus on the problem right now. UNESCO further stresses the importance of training alongside adequate working conditions and salary for teachers as one of the first steps to improving education.

> "Too many teachers have poor working conditions, insecure contracts, low wages, little recognition and heavy workloads, affecting their motivation and increasing attrition." (UNESCO 2022).

In low-income countries, teachers have a heavier workload; according to UNESCO data, "each primary teacher in these countries has an average of 52 pupils per class at primary level, while the global average is 26" (UNESCO 2022). Despite the heavier load and higher demand, teachers in low-income countries face a lack of training and access to tools at hand for their classroom with "26% of primary and 39% of secondary school teachers do not have the minimum qualification requirements in low-income countries, compared to respectively 14% and 16% globally". The data also shows how teachers are not getting paid enough for the work they are giving, in specific, "6 out of 10 countries pay primary school teachers less than other professionals with similar qualifications"; this difference is, "particularly evident in high-income countries" (UNESCO, 2022).

Teacher readiness is essential in how STEM education is being implemented and taught to students. From this research, the team found that in order to make a great impact in STEM education globally, we need to support the teachers and educators locally. In time, this will spread the impact of STEM and further develop a suitable curriculum needed for diverse groups of students.

2.3 Resources Currently Available

Before developing a resource for educators in robotics internationally, it is important for us to look at the resources currently available not just at WPI, but also internationally. In this section, the team will be discussing STEM programs, WPI resources, and current efforts to improve STEM education.

2.3.1 Programs in STEM

America's focus on STEM started in the late 1950s during the Sputnik era when in 1957 the Soviet Union launched its first satellite into orbit. This challenged Americans to pursue careers in STEM and pursue advancements in these fields. Shortly after, the National Aeronautics and Space Administration (NASA) creation helped to "organize the nation's science programs and served as the leader of the country's push for greater STEM education and awareness" (Ballotpedia, n.d.). With the public's eye more on engineering and getting into space, more students were encouraged to pursue related fields.

In the 1980s and thereafter, the Engineering Workforce Commission measured approx. 80,000 students graduated from engineering programs per year, though the projections predicted that not enough skilled graduates met the growing need for jobs in STEM fields, so "this gap and desire to gain global leadership in the increasingly necessary field of STEM subjects has inspired more attempts to reform and improve STEM education" (Ballotpedia, n.d.).

2.3.2 WPI Resources

WPI has been focusing its efforts on project-based learning for nearly 50 years, however, the Center for Project-Based Learning was only launched in 2016. The mission of this center is "to support and coach higher education institutions and practitioners committed to driving equitable, sustainable, and systemic pedagogical, curricular and cultural reform, through project-based learning (PBL)" (WPI Project Based Learning, 12). Not only does WPI have this project center, but also runs plenty of other projects, research groups, and centers.

WPI has been a driving force in the robotics community and as one of the first robotics programs in the nation, has been leading the field, while simultaneously trying to bring that to other parts of the world. One of the examples where this is seen is in the Math and Science for Sub-Saharan Africa (MS4SSA) initiative. In collaboration with the World Bank, MS4SSA was launched in 2016 in hopes of providing materials and "assistance to enhance learning outcomes in those subjects among primary and secondary school students" (MS4SSA, n.d.).

WPI has projects and project centers running in many different countries focusing on many different topics.

WPI also has a STEM Education Center which "is committed to empowering educators with the guidance to lead relevant, integrated, and inclusive STEM learning experiences with their students and communities" (*The STEM Education Center*, n.d.). Started in 2012, the STEM Education Center is "designed to help support teachers in creating a spark of passion in their students" (STEM Education Center 10th Anniversary, 2022).

> *"We know teachers with strong content knowledge make a long, lasting impact on large numbers of students over their career, which is why we're dedicated to empowering PreK-12 educators in creating a new generation of STEM-proficient problem solvers."*
>
> – Martha Cyr, Founder and Senior Fellow, STEM Education Center at WPI

Past efforts in global STEM education conducted by students have provided and are currently providing a good platform for educators to start teaching STEM in their own schools, but there is a gap between teachers abroad and WPI in providing ongoing support for educators. In many cases, such as the Training the Trainers IQP that was conducted in Namibia during the

Spring of 2021 (Fisher, DiRuzza, Marsh, & Benoit, 2021), WPI students were able to provide a curriculum and teaching resources, but once the project ended there was no line of communication between teachers in Namibia and WPI. In their conclusions, the IQP team recommended that "P.A.Y. sets up a collaboration or line of communication with WPI's MS4SSA. MS4SSA could work with P.A.Y. to set up a mentorship-like program between P.A.Y. instructors and WPI professors or faculty who have experience in fields where the educators need advice. This will allow P.A.Y. instructors to get advice and help when needed without needing to participate in a time-consuming mentorship program."

Due to this gap in ongoing support in mentorship, it is difficult for teachers abroad to continue to teach or even start teaching hands-on classes in STEM topics, especially robotics.

2.3.3 Current efforts to improve STEM Education

Many countries have paid close attention to developing and improving STEM education to bring teach STEM as a combination of disciplines rather than separated skills to more students of different age levels. Improving STEM education is not an easy task as it refers to improving access, quality, equality, and desire.

For Inspiration and Recognition of Science and Technology (FIRST) is a non-profit organization founded by Dean Kamen and Woodie Flowers in 1992. FIRST creates a global robotics community where students are inspired to innovate, collaborate, communicate, and develop different ideas to solve problems and challenges.

2022 marks thirty years of FIRST and its impacts on students internationally. In the 2019-2020 season, over 679 thousand students participated in FIRST in team-based competitions including FIRST Lego, FIRST Tech, FIRST Robotics, and FIRST Global (FIRST Inspires 2020). FIRST creates a fun, practical, and challenging playground for students from Pre-K to 12th-grade allowing students to explore their passion for STEM.

Moving toward the global effect of FIRST in STEM, we can't forget to mention the yearly Olympics-style robotics competition for students also known as FIRST Global. In the latest game in 2019, teams from 180 countries around the world marked the most countries that participated in this robotics competition.

2.4 Background Summary

From 1990 to the present, STEM imposes an important role in the world's development and improvement by providing scientific knowledge, innovation, and advanced technologies. Along with the rise of STEM is the need for STEM education to further nurture the younger generation of STEM professionals. STEM education does not merely subjects relating to STEM but also the integration of all disciplines of STEM in different subjects to encourage discussion, problem-solving, and collaboration while simultaneously giving students a practical skill set that is needed for the technological era.

STEM education is in high demand and plays an important role in many countries due to its strong influence on the countries' future development and economics. Interestingly, a study on *Perspectives on Australian, Indian and Malaysian approaches to STEM education* finds that developing countries have shown more focus and increased interest in STEM education in comparison to developing countries. This could be influenced strongly by each of the nation's growth and priorities. Many developing countries are viewing STEM education as the key to a nation's success and economic growth. Despite such high demand, STEM education is still facing multiple barriers to expanding its accessibility for inclusive and quality education. These barriers include gender norms and minorities,

lack of resources and supplies, and lack of teachers' readiness. Each issue should be researched carefully to create a true global initiative STEM program sufficiently.

At the end of our initial research, we reinforce our understanding of STEM and how it has developed over the years into a push for an inclusive, diversified community to help grow and support new opportunities.

Chapter 3: Methodology

From our background research, the team can take steps to develop our plan and put it into action. The team will go over what we gained from our background research and how it will help us develop our plans and goals for this project. This research and planning are necessary for us to be able to choose the platform or platforms that would provide the best experience for our target audience.

3.1 Discovery

In the discovery stage, the team attempted to narrow down the problems by revisiting our background research, and looking into the past IQP projects related to STEM education. This stage shapes the expectations for the product and enables us to learn from prior IQPs to define our targets and goals further.

For each of the past IQP projects, the team summarized their goals, achievements, and findings. Based on different projects in different locations around the world, the team formed some general assumptions to help us better approach an initial prototype stage for an inclusive platform. The team also heavily emphasizes STEM barriers worldwide in our background research so we understand the current struggles, problems, and goals as clearly as possible.

3.1.1 Interviews

Besides researching available literature and projects, the team also planned interviews and surveys. These were aimed for STEM educators, teachers, and students from WPI, as well as some pilot groups such as teachers from E4USA and robotics teams from FIRST Global. From this research we could gauge interest in an online professional learning environment, find the needs of different types of learners (teacher and students), and find the pros and cons of current, similar programs.

The team created a general list of research questions that can be found in Appendix B. From this list of general questions, we planned to create a specific and target interview agenda or survey that is suitable for different groups and goals. With how fast-paced the project was, we identified different groups/people that we would like to interview as well as what we wanted to get out of each interview. Some of the identified groups are as follows:

1. Teachers who participated in the pilot workshop of OpenSTEM.
   Goals: Gauge interest and suggestions on a support system that can help them all connect to each other and get help on the material and program specifically. What format? What resources? Follow-up from the workshop.
2. Students and teachers interested in STEM programs around the world.
   Goals: Reach out to current Students and Teachers (end users) from different places around the world to gauge their interest and needs in STEM Ed. Better understand what we can help and what problems we can target.
3. Students who have participated in the FIRST program.
   Goals: Similar to above, but limited in the FIRST Programs since they are all connected with a very specific Robotics Competition. Put the focus on their needs and challenges that they have faced for the competition. As the teams are from around the world, we can see how their different backgrounds can help us see what range of challenges there could be for these students.

a. WPI Summer Frontiers has a number of students from the FIRST Dean List around the world.
   b. WPI Robotics Engineering department also has a huge community with FIRST/Vex backgrounds from different places around the world.

4. WPI Staff, professors, the WPI STEM Education Center, WPI Students and Alumni who participated in projects related to STEM education
   Goals: Find out the existing effort WPI is doing towards STEM Education for teachers and existing projects regarding the topics. Look into what all the past works have found out, and what are some things we can look more into moving forward to provide a good support system to assist STEM education globally.

However, due to time constraints and conflicts in scheduling, we were not able to interview as many people as we had planned above. We interviewed Annie Hughes, lined up with our category 4 above, who helped us tremendously in defining the problem and brought the local perspective from Namibia that we didn't have (detail Interview Script in Appendix C.). We also focused on getting information and data from our available sources (our advisor and ourselves). Our team is also rather diverse, with different gender identities, sexual orientations, and being from around the world. We also received information from WPI Press on the current efforts by WPI in STEM globally.

3.2 Define

Now we need to define our goals and who we are targeting. From this, we can have an effective product for the problems we have outlined in our research. We specifically want to define whom we are targeting, so we know our audience. Then, we want to define the technical platform, and what we need from the technical platform. Finally, we want to define what we want our online learning community to look like.

3.2.1 Problem and Targets

The targets of our platform are both teachers, as well as students interested in STEM internationally. We do not want to discriminate against anyone and we want our platform to be suitable for all nationalities, ethnicities, genders, etc. This will go to all of our considerations for the future. This means we cannot have a platform that the users would have to pay for, and the platform should be widely available. Unfortunately, it may be difficult to find a single platform to suit all these needs, so when this project scales up, we may need to look at a multi-platform solution. It would be preferable to keep the project on a single platform, so as not to lose any users in the process of registration, but one platform may never be able to serve the diversity of the users we are trying to serve the project to.

3.2.2 Technical Platform

It is necessary for our technical platform to be easy to use, easy to maintain, as well as accessible. To select a suitable platform, we looked into multiple chatting and forum based platforms that are in wide use currently, and scored them accordingly with the following categories. In our rankings the highest total score is considered as the most suitable platform for this project. The six major categories that were important for the platform are affordability, ease of maintenance, accessibility, searchability, privacy, and response time. We also divided our

platforms into types; Course Delivery, Discussion/Q&A, and Chatting. Discussion/Q&A is a platform where technical questions can be asked, upvoted, and answered. This type of a platform would need a lot of moderation by staff, to always have a good response time to questions being asked. Chat is determined by its ability to form a welcoming community where not only questions can be asked, but participants can communicate regarding other topics such as course progress, new robot implementations, concerns, etc.

3.2.3 Online Learning Community

With our technical platform, our ultimate goal is to create a self sustaining online learning community. We want to be able to achieve a community where anyone confused can ask questions, and others in the community could answer the questions instead of staff. Incentifying peer learning and getting all users more engaged with the course and anything that could come after it. For example, if there are teachers who are trying to create a course for their students using the XRP robots, they could use this community to ask for ideas on what would be great activities for that course. Or ask if other teachers have already been able to create this type of a course, and what was the reception of the students like.

3.3 Prototype

Now that we have defined the audience for the prototype, and goals we want to achieve, we are going to look into different platforms to see what is out there for us to use. We want to look at three major aspects our prototype would need. The first one is that we need it to be able to hold a good and active community. Second is that we need some type of forums in our platform, this is so that it will be easy for users to ask questions when they are confused about a topic. Thirdly, we need the platform to help us provide support to the users in an easy manner. Finally, if possible, we would want to try to have one platform that could support all of these necessary parts for our platform. Then we ensure that there won't be too many different platforms the users would have to download to get the full experience from the course.

In order to quickly build our prototype. We first select suitable platforms using the method in section 3.2.2. Here we will decide which platforms are best fit for our purpose of creating a community and a Q&A technical forum. We prioritize low cost (or free) platforms that are widely accessible around the world to accommodate multiple global pilots. We also made some educational assumptions to better help select the best prototype platform(s); more detail is in section 4.1 Assumptions.

3.3.1 Community

For our community we looked at currently popular platforms that already have successful communities built into them. We designed a suitable list of channels that is needed to build a professional platform while it being a welcome and inclusive place for all participants to be a part of. The most important part of the community platform prototype is to get people to participate voluntarily and share their common interest toward the subject as well as sharing ideas and to help each other. We want the discussion to develop naturally, although at the beginning the moderators may need to take a more active role to facilitate discussion. It will be much more difficult for natural discourse to happen in a server where nobody sends any messages.

Fig. 4. Discord Community 'general' channel example.

Here we can see how a community could be built in Discord. There are multiple different channels that encourage participation by the users in different ways. There is a pets channel, where everyone can post pictures of their pets, general where anyone can post anything, and a memes channel. Each of these are being actively used, and help facilitate discussion on the server. For our platform, we would want to be able to do something similar for building discussion on the server. We want channels where the users could post pictures to, introduce themselves, or just general chatting. Then we also would want to separate these channels from the questions that are asked about the project and the course.

This separation of channels will also help the flow of all conversations. If there was simply one channel all discussion went to, it would be really difficult to follow multiple conversations at once, and if there is already a discussion going it would be really difficult to intervene with a question about the project.
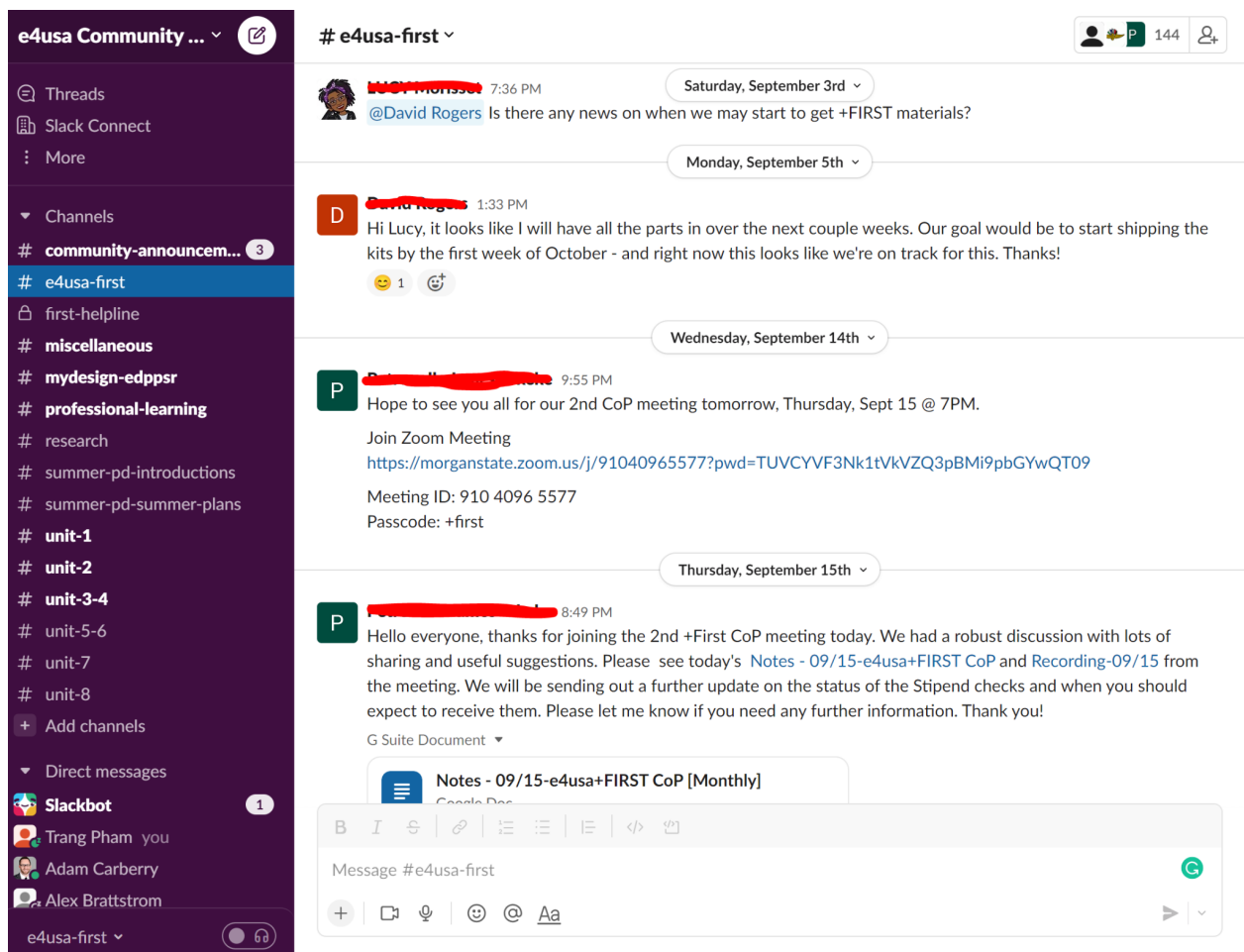
Fig. 5. Slack Community specific channel example.

Here we can see an example of how a community can be built on Slack. It is very similar to discord, you can separate the channels into multiple topics, and people can talk in the channels they are interested in. We can encourage users to participate in anything they feel comfortable participating in, and are passionate about. Recently though, Slack has taken away the ability to view messages past 90 days, without paying for Slack. This reduces the accessibility of this platform for us, as to be able to search messages and problems you have had in the past, cannot now be done without paying for the platform. In a lot of other platforms we have found that this issue does not exist.

3.3.2 Forums

Similarly, with the forum options we looked at multiple working platforms in the market nowadays. Originally, there was no stress on having both the community and forums to be on the same platform due to the limit on available platforms in the market; therefore we prioritize functionality and cost to best select the most suitable platform. The forums should be private and controlled due to the specific questions regarding the program itself as well as the early stage of the project. The forums should also send notification to admins when a question or new comment is posted to help maintain response speed. Furthermore, we highly rated platforms that could

help sort questions into different topics as well as weight best answers to help users easily find support as needed.

Fig. 6. StackOverflow example showing the upvote system.

Here we can see how questions are being answered in Stack Overflow. The system is very good, it is meant for purely asking questions, and getting good responses. It has an upvote system, where it would be possible to have only good responses upvoted, while responses that don't answer the questions would be not as visible. The problem with this platform though is that we would need it to be a private space, so that not any person who knows nothing about our project can come and downvote or upvote everything they see. For this to happen, we would need to pay a lot of money to Stack Overflow to be able to host this kind of a community on their platform. This would greatly reduce the accessibility of our support system, and we can see that we would need something that is free for our users to use.

Fig. 7. Canvas Discussions example.

Here we can see how forums would work on Canvas. We can set up any discussions we want, and users can ask questions about specific topics under the discussions. We are also able to make it so that the users can ask anonymous questions, which could encourage them to ask questions more. The problem we can see with these discussions though, is that the users are not very able to make their own forums or discussion posts. We have to anticipate the questions the users might ask, and some of these discussions could never be used and another one might be way too active. From this example we can see that we may want to find some platform that could allow our users to make the forum posts that the course staff could respond to.
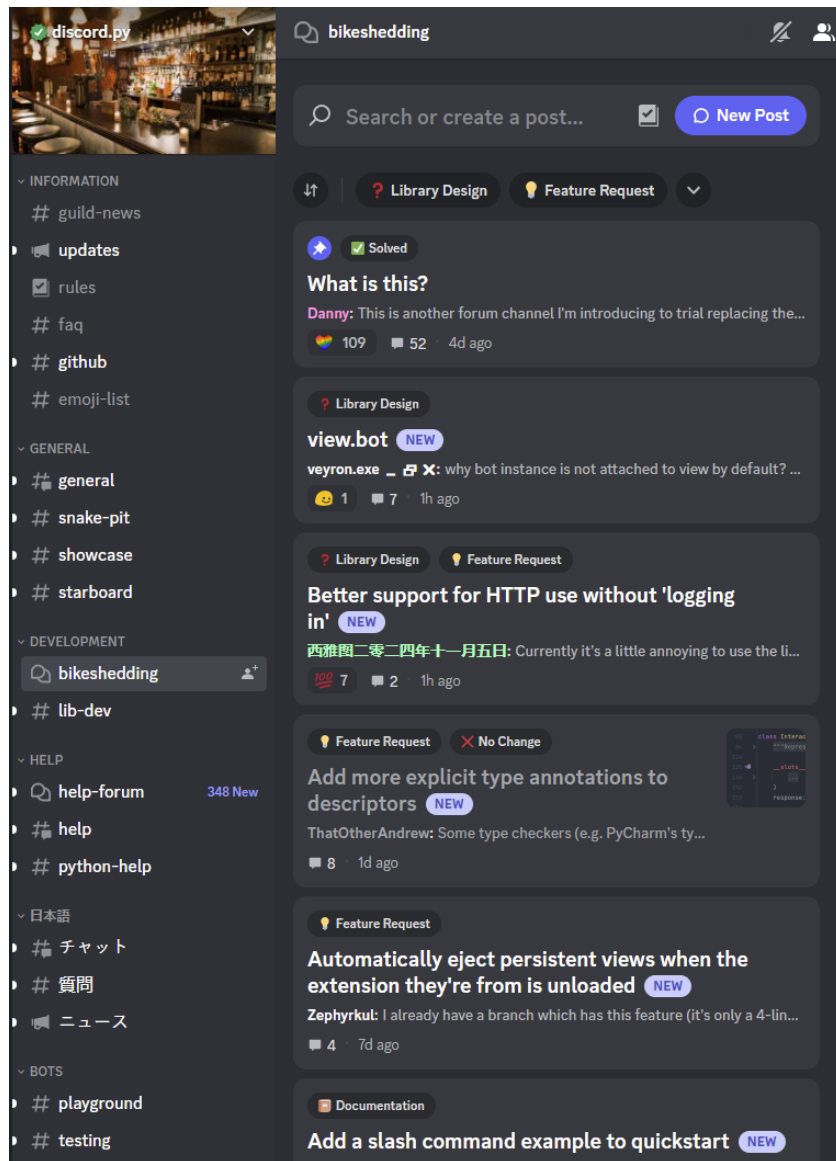
Fig. 8. Discord Forums example.

Here we can see how forums can be implemented on Discord. This is very new technology for discord, and it is unsure how good the implementation is, but what has been released is looking very promising. It is easy to ask questions, comment in the forums, as well put tags on what the questions are about. We can see tags on the image such as "Feature Request" and "Library Design", that help staff respond to these questions. It makes both parties' lives easier.

3.3.3 Moderation for the virtual platform

For a pilot prototype, moderation is very important to kick start a virtual environment as well as setting a good foundation for the community. To grow and potentially become self-supported, the moderation needs to be more active at the beginning to help the users in the platform start discussions as well as guide them to the right places to ask questions. At the beginning our IQP team would run the majority of moderation among the support platform. The

team has the responsibility to respond and help guide participants through the program. After some time though, we need to expand the program and get more people to run the platforms used for the project. This IQP team will not be working on this project for that long, and it needs a more dedicated team for the future.

Before we switch to another team, our IQP needs to provide a set of rules for the users to follow in the platforms. There also needs to be norms that the moderators will follow while interacting with users. All of these will be covered further later in chapter 4.

3.4 Test
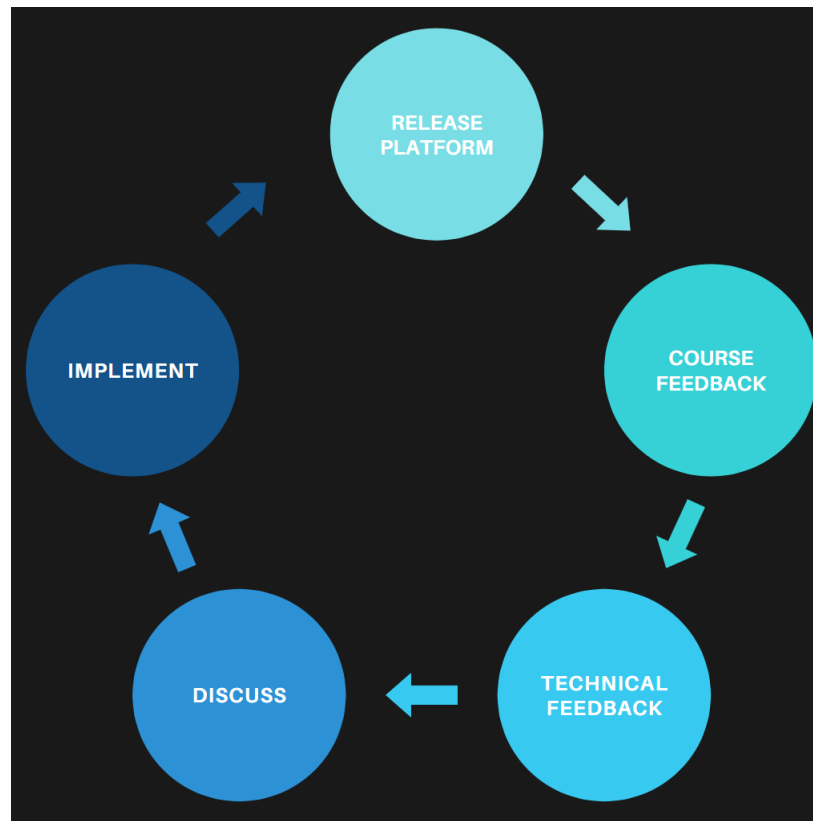
Fig. 9.: Testing Cycle

We planned a testing cycle following Agile Testing Methodology. The idea behind the testing cycle is to quickly launch the prototype to any pilot groups of the project and get feedback quickly. After the feedback is gathered from the participants for the course and the platform, we noted down changes needed to make for the platforms. All the changes are then discussed, and we will implement them to the best of our ability for the platforms. Once these changes have been made, we will let the users test the platform again for a while, and then ask for more feedback on what to improve.

With the unpredicted number of participants, this cycle helped us gather and process all feedback timely to improve the platform without creating any significant interruption for the project. The test group size varies from one person to 30 people.

In order to gather feedback, we reached out to participants individually and asked them to share their experience and thoughts. This is rather a slow way to gather feedback, however, suitable for a small group of testers as we can focus on initial details based on the highly participated individuals. With a predicted larger group in the near future, a frequent survey should be sent out to the group to gather more data and feedback.

Chapter 4: Findings

Following the research conducted in Chapter 2, and our methodology that we will be following from Chapter 3, we are looking at different potential platforms and choosing what we want to use for our prototype.

4.1 Assumptions

Before we started looking at the platforms, we needed to make some assumptions about the participants in the program to gauge their ability to finish this course.

Assumption 1: The participants have access to the internet. Without this access, they would not be able to communicate with us, so our part of the project would not be feasible. They could still participate in the course, but have a difficult time participating in the support network for the course.

Assumption 2: The participants have access to a computer. The program's course requires the teachers to code on an IDE. They need to have a device where they are able to write the code, and then upload it to the robot. For this, they would need some type of personal computer.

Assumption 3: The participants have at least beginner knowledge of STEM. We are assuming that all of the teachers that are being provided robots are teachers of a STEM subject. This makes the course easier to follow and adapt to their own needs, as they may already have some experience with concepts in robotics.

Assumption 4: The participants are able to understand English to a fair level. Without this assumption, we would not be able to communicate with the teachers, and as the course is in English, they would not be able to understand the course unless they knew English.

4.2 Platform Selection Considerations

To select a good support platform, the team considered several different factors that determine a service's utility. Most importantly, for a platform to be useful in this program, it needed to be accessible, it needed to be organized, and it needed to be manageable for the course providers.

First, a platform needs to be ubiquitously accessible. A platform will only be useful if the members of the program can all access the application, so it needs to be an internationally used and available platform. On top of this, it needs to be free of use. Having a paywall between the platform and the users will hinder the user's ability to join and participate in the course.

Second, a platform needs to be organized. It needs to be clean and clear, without too much clutter to confuse the users. This helps users find the topics they are interested in, know where they can ask more questions, and find the resources they need. It allows the users to participate in the course without much trouble.

Third, a platform needs to be manageable for the course providers. This enables us to focus more on the users if we need to spend less time keeping up the maintenance on the platform. If the platform needs more moderation than we thought, we need to be able to respond in a quick manner. If we don't, we could risk the course not being as friendly or accessible to the users as we would like it to be. Then we also want to be able to expand the platform without much difficulty, so we can provide new challenges for the users if those are wanted.

4.3 Platform Trade Study

Below is the scoring determined for the consideration of using the platform in the support system. We also opted to create a website to act as a landing page for OpenSTEM participants.

Beneficially, in the process of creating this project, the WPI Marketing Team joined in helping us create this website.

The affordability was a very important factor in our platform choices. The cost of the platforms needs to be minimal because we cannot be charging participants to use the support platform. Initially, the best options for a free platform were a website for course delivery, Stack Overflow for Q&A, and Discord, Teams, or WhatsApp for chat capabilities. Though WhatsApp is the main platform used in many countries, we were hesitant about its ability to withstand a community. It was initially thought that StackOverflow would be free, however, to generate a private group, each individual would have to pay if we exceeded 50 members. This category makes StackOverflow prohibitively expensive for our use case.

Ease of maintenance is important because this IQP team won't be the only support for the rest of the program. It should be easy to define moderators in the platform. Platforms can have useful self-moderation of selection features for content, that allows users to vote for the best topics and comments, and the best get displayed first. Platforms like Stack Overflow and Reddit are great examples of this. Discord has also recently added forum capabilities to its application. These platforms will likely require WPI to provide moderators and mentors/experts/staff/faculty to keep those services going. The best options for maintenance are Canvas, Stack Overflow, Reddit, and Discord.

Accessibility is another factor we need to consider for this program because it will be run in many different countries. For accessibility, we found that Discord provided the most accessibility despite WhatsApp being the most widely available platform. This is because WhatsApp is not great for communication amongst hundreds of people.

Searchability features are needed because they allow users to quickly find answers to questions that may have already been asked by others. This would allow moderators to spend more time on brand-new problems, not rehashing the old ones. In terms of searchability, the best option for Discussion / Q&A is StackOverflow, while the best option for Chat is Discord.

Privacy is necessary for our group to ensure that the support for questions relating to the low-cost robots is sent to us and answered by us. If the questions are answered by a third party, they may not provide helpful services because they won't be familiar with the robot. In terms of privacy, the best option for Discussion / Q&A is StackOverflow and Canvas Discussions, while the best option for Chatting is tied amongst all options.

Finally, we need the response time to be low. Participants will be asked questions from several different time zones, so it would be preferable to have the response time as minimal as possible. In terms of response time, the best option for Discussion / Q&A is Reddit, while the best option for Chat is Discord.

Ultimately, Discord was found to be the best scoring chat platform and a prototype community was developed to fit the needs of the OpenSTEM program and provide technical support for the launch of the XRP Beta trials.

Platform	Affordability	Ease of Maintenance	Accessibility	Total
Course Delivery				
Canvas	4	6	8	18
Website	10	2	8	20

GitHub	8	4	4	16
Discussion / Q&A				
Canvas Discussions	10*	8	8	26
Facebook	10	2	6	18
Stack Overflow	0	8	8	16
Reddit	10	6	7	23
Chat				
Discord	10	8	8	26
Teams	10	6	6	22
Slack	6	8	7	21
Whatsapp	10	6	7	23

* If Canvas is already in use. 2 otherwise.

Table 2. Platform trade study for users.

Platform	Searchability	Privacy	Response Time	Total
Discussion / Q&A				
Canvas Discussions	8	8	6	22
Facebook	4	6	4	14
Stack Overflow	10	8	6	24
Reddit	8	6	7	21
Chat				
Discord	6	8	8	22
Teams	2	8	4	14
Slack	4	8	6	18
Whatsapp	3	8	5	16

4.4 New Technology Adoption

One of the biggest challenges we faced with this project is introducing this new technology for our users. Potentially, a lot of the people that we are trying to get to use Discord and Canvas have never used them. Discord used to advertise mostly to the gaming community, but has recently tried to change their image (Discord, 2022). Still, it is much more popular with a younger audience than adults. This provides us more difficulty in getting adult users to join, as well as getting them to actively participate on the platform. It makes the onboarding for these platforms very important, as we need the users to access the platforms they have never used before. During the onboarding, we may lose some teachers if it is too complicated to join the different platforms.

The benefits of using these modern platforms are their ease of use for the user and the features the platforms provide us. Even if the users haven't used them before, the learning curve for understanding how the platform works is very low. On top of that there are multiple places you can download the platform into. For example, you can use it on a phone as well as a PC. In our assumptions we assume that our users would have at least one of these, so everyone that is participating in the course should be able to download the platforms somewhere they have easy access to.

We can also get the teachers to be comfortable with platforms that are already widely used. If they want to develop their own courses, with a little research, the teachers can make use of these platforms themselves. As Discord is already popular within a younger audience, teachers who would learn how to use this platform could connect better with the students using a discord to establish discussion in a course.

So, although there may be the initial negative of new users being adamant about using a new platform, in the long run it can be beneficial for both the users as well as the moderators of the platform. This can make it easier for the users and moderators to interact with each other, for the users to ask questions, as well as get them the answers quicker than in other platforms.

4.5 Self-Supporting Platform

The decision to approach a self-supporting platform is inspired by the work and interview of Annie Hughes (Appendix C.). Annie shared that one of the most difficult parts in global projects, especially in STEM Education, is to build a self-sustainable model in funding educators' drive for the project to keep living after she leaves Namibia. Therefore, we believe that the crucial key to building a long lasting community in STEM Education that can support every individual within is ultimately focused on making it sustainable in the long-run.

There are a number of studies related to the topic of building communities in online learning environments. They discuss methods of best achieving a thriving community and some of the psychology and mechanisms by why a community grows and becomes successful. One such study compared two different types of bonding psychology (Groth, & Bergner, 2007). They found that "identity-based" bonding strategies were more effective in increasing member engagement in the community than interpersonal bonding strategies. Generally, this means that members became more attached to and engaged better with certain ideas and topics of discussion within the community. Members also engaged better if the community was able to foster a sense of belonging and identity that members share. In our case, a community of mostly STEM educators would be expected to form a sense of identity around that common role. Because of this insight, it is vital for moderators in the community to provide information about the group and what the goals of the group are so that members can be engaged in the community.

Another study described five stages of community building in online learning communities (20). The first two stages involve gaining access to communication technology and learning how to use it.

The third stage describes when information begins to pass between community members. The fourth and fifth stages describe more in-depth interactions, longer conversations, and members seeking out learning opportunities on their own.

The same study also presented a number of lessons learned from their own community of elementary school teachers. The authors recommended occasional face-to-face meetings related to various discussion topics in order to achieve the best possible collaboration between members as some people prefer face-to-face conversations to communicate on discussion boards. They also discussed how Fostering disagreements is important. Disagreements give community members the best opportunity to reflect on and share their own ideas. Discussants reinforce their current understanding of the topic of disagreement by expressing their own opinions and having an opportunity to make changes to their views. In this worst case, disagreements can devolve into circular arguments and name-calling, which can be dealt with by the platform moderators. But at their best, they can bring valuable data sharing and learning.

Community activities and resource sharing instigated by the moderators and a valuable way to keep community interaction going. The article points out that the best topics for activities and further reading are often the same topics that are being discussed by community members. An example related to a robotics community might be a number of conversations about a specific topic such as line following. If the moderators notice a lot of questions about line following in a certain week, they might consider posting a line following challenge in the forums. Members can submit videos of their successes and those that are struggling with the topic can receive help from others in the community who are more knowledgeable and who were also just working on the same problem because of the challenge posed by the moderators.

4.6 Moderation

In moderating our platform, our most important goal is to make it into a safe space, where everyone will be able to ask any questions without fear or feeling overwhelmed. The first thing we then needed to set out were the rules on how to use our platform, and what is allowed and what is not. The rules need to be clear and easy to follow. We as moderators need to be able to point to them if any conflict would arise. Then we can show that we are simply enforcing the rules the user has agreed to upon entering and interacting with the server. The rules also need to protect any minorities that would exist in the server, so we can ensure that everyone will feel welcome to be in the server, as it is purely for learning.

On top of having rules the users and moderators can follow, we need to ensure that we as moderators will create a welcoming environment. This means that we need norms that the moderators follow while acting on the server. Moderators inherently have a position of power over the users, as they are able to mute them, kick them, as well as ban them. This means that users will likely interact with the moderators differently from other users, so the moderators need to be more careful while using the server not to make the users uncomfortable. The moderators should then be somewhat active in the server, so the users can view them in a more positive light, and feel comfortable telling them if anything is bothering the user in the server, so the moderators can try to solve that issue.

Then there is also the problem of continuity of moderation. We will not be running the platform for a long time, but the platform will need continuous moderation upon its usage. This means that we need to find someone to hand the platform to and all the permissions that come along with becoming the new owner of the platform. For now, we will give it to the team that is working on the IQP after us, as they will continue some of the work that we have already done. Afterwards it should be given to someone that is actively participating in this project for a longer time, and who would be running the

relations, communication, and networking side of this project. That person also needs to be taught how exactly the platform can be successfully run prior to handing over the ownership of the platform.

4.7 Prototype for E4USA

The initial study we attempted to conduct was with the Engineering For Us All (E4USA) program, which consisted of approximately 15 teachers. These teachers were given the first iteration of the low-cost robot and participated in a workshop to familiarize them with the robot. For the study, we wanted to give the teachers a couple of challenges to complete using the robot.

For this platform prototype, Discord and StackOverflow were selected as a community and technical platform respectively. To gauge how well the platforms worked, there would be a collection of data from them through participation within Discord and StackOverflow. The small sample size of 15 teachers made it an easy initial test.

We expected to get participation within two weeks, however, due to communication issues and timing, the E4USA program was not able to participate. Nevertheless, the preparation made for the E4USA group ensured that the platforms were set up for the next testing phase. For the next phase, which will be discussed in the next section, we were scaling up participation. Due to incurring costs with increased participation, StackOverflow could no longer be used. The technical questions were moved to Discord Forums.

4.8 Testing at FIRST Global

The FIRST Global Challenge is, "an annual Olympics-style international robotics competition that brought high school teams from more than 180 countries together in Geneva, Switzerland, in the spirit of solving global challenges together" (WPI, 2022). This competition became our new study group, consisting of approximately 180 teachers from across the globe.

As the competition approached, we began preparing the Canvas course as our course delivery option, the Discord server as our community chat and technical platform, and the second iteration of low-cost robots to give out to the teachers attending. We also had Canvas Discussions opened as a second option for asking technical questions.

The robots were handed out on the first day of the competition. Along with the robots came a QR code leading to the website landing page. Linked on the website were the Canvas invite link and the Discord invite link.

For this testing phase, the plan was to give the teachers the robots and assist in any issues that may come up when progressing through the Canvas course. It is important to mention that the Canvas course was only open to teachers while the Discord was open to both teachers and students.

4.8.1 Participation

The low-cost robots were handed out to over 180 FIRST Global participants and it was expected that the Canvas and Discord participation rate would match the number of robots handed out. However, we saw an increase of fewer than 50 participants for both platforms. The reason for this is believed to be the difficulties in joining the Canvas course. Multiple steps were needed in registering for the course, giving plenty of opportunity for students/mentors to give up on registering.

We believe the low Discord participation was a result of the lack of emphasis on how important it was to join Discord to receive support. We received many messages asking for support through emails to the advisors, to the support email, and even to the WPI RBE Discord.

Though the link to Discord was on the landing page, the main emphasis on joining it was within the Canvas course. With the Canvas participation rate being low, we saw a low participation rate within Discord as well.

4.8.2 Administration Team

Technical Team: Professor Miller and the curriculum team including the Canvas Team and students group who helped build the curriculum for the robot. This team plays an important role for the technical forums platform, because they have experience working with the course. Therefore, they are responsible to provide technical answers needed for any technical support the users in the platform may need. The actual connection between the user and the team can either be direct and indirect through the platform support team.

Outreach Team: Professor Doiron and WPI Marketing. This team is in charge of the multiple outreach activities, and holds many necessary connections to support participant success in the program. This team is crucial for the construction of a professional learning community. Similarly to the Technical Team, a connection between the client and the team can either be direct and indirect through the platform support team.

4.8.3 Demand

As the robots were handed out, it was discovered that the demand for these robots was much greater than previously thought. With this demand, we would need to take another look at our current platforms and their ability to support thousands of users. If this project scales to a massive global scale, then we may need multiple platforms and more staff to properly handle all the support needed for the project. There may need to be region specific support on top of the global support that would already be given.

4.9 Other Support Towards OpenSTEM

4.9.1 Website

The team originally planned to host a website that could be a central hub for information relating to the OpenSTEM platform. The idea was to host information about the XRP Beta robot and the course associated with it, with links to join the course delivery platform, repositories of information about the robot itself such as build instructions and software library documentation, and the support platform.

Around the time XRP robots were being brought to FIRST Global in Geneva, WPI marketing began running the website along with sending out news articles and promotional material on OpenSTEM and the XRP Beta program.

4.9.2 Canvas Curriculum

Throughout the course of this project, our advisor, Brad Miller, worked with a team to develop a Canvas curriculum aimed for teachers to learn about the XRP robot enough to be able to use the robot to teach students around the world. The main reason Canvas was selected as the course delivery platform was because WPI already uses Canvas (by Instructure) for all of their actual classes throughout the university. This made it relatively easy to get set up quickly with a new course. Unfortunately, because of how registration in Canvas courses offered by WPI are

managed, all participants in the course outside of the University have to register through WPI's outward facing professional development Instructure course catalog. This made joining the course a multistep process that students at FIRST Global were often unable to participate in. Additionally, the XRP Beta course participants could only participate in the course for 90 days after registering.

4.9.3 Robot Testing

During the leadup to the debut of the XRP Beta program at FIRST Global in Geneva, the IQP team assisted in testing prototypes for the robot that would be used in the course. During this testing, it was found that the drive motors ("blue motors") were actually from one of three different models of similar Chinese made motors that lack documentation and technical specifications. This made it difficult to provide support for the drive motors once the program started. Additionally, through our testing of the robot, we were able to make a number of recommendations to the team developing the Canvas course and point out the gaps in the course and areas that needed to be improved upon.

Chapter 5: Recommendations & Final Thoughts

From our delivered product, and the feedback we have received, we have written down recommendations and what we would like to see in the future of the OpenSTEM program. There remains plenty of work to be done in all aspects of the OpenSTEM project. We will provide recommendations on the following topics: internal operations, course delivery, hardware & software, and next steps.

5.1 Recommendations

5.1.1 Internal Operations

Recommendation 1: The team should employ a full-time technical expert who can lead the team in the support system. The support should be divided into both software and hardware.

Recommendation 2: There should be more clear communication between the teams. There was a large separation between the hardware and support teams on many occasions. If there was a question we needed from another team (curriculum or hardware), it took a lot of time to receive answers.

Recommendation 3: There should be a cycle of development implemented. An agile structure would work well along with weekly sync-up meetings with everyone to get a better idea of what is going on in each team of the OpenSTEM program.

5.1.2 Course Delivery

Recommendation 1: The course platform should be moved to somewhere more widely available and easier to access. Canvas had several issues, especially with allowing participants to join and being too costly to run. Only teachers were given access to Canvas for a time period of 90 days. It would be beneficial to have a course open to both the teachers and the students for an unlimited amount of time along with the opportunity to download course materials for offline use.

Recommendation 2: The course needs to be improved upon. We feel that the course creation was rushed and resulted in an unfinished course being published to several people. For the next iteration, it is recommended that more people work on the course with more dedication in time towards the project.

Recommendation 3: There needs to be dedicated support staff for participants that ask questions. There were multiple times when there was a question in Canvas discussions that were not answered in a timely manner due to there not being dedicated support staff to look at the discussions. Discord answers were answered more quickly due to the current developers also using Discord, but there needs to be more dedicated people responding to the questions not only in their free time.

5.1.3 Hardware & Software

Recommendation 1: Take another look at the motors being used for the current design of the robot. Currently, they are using blue motors that WPI uses in the unified robotics 1 course for the gripper lift power mechanism. The problem with these motors, even if they are good enough for the unified robotics course, is that they do not have a datasheet that is useful to look at when there is something wrong with the motors. They are used as drive motors, and if anything is

wrong with the motor, it is difficult to find exactly what is wrong with the specific motor, and make the motors work equally for driving.

Recommendation 2: Make Blockly usable for the course. There has been feedback from teachers that would like to use Blockly as a tool to teach people Python before they jump into writing lines of code. Blockly would be an easy tool to implement.

Recommendation 3: The team should create a page for documentation on the robots and the code library provided. Oftentimes, questions were asked relating to the robots, but it was difficult to find one source for the information on the robots.

5.1.4 Next Steps

Recommendation 1: The team should find better ways to understand the engagement of the users in the course. One suggestion we have would be to create a dataset of countries in which these robots were handed out. This would be helpful in knowing where the robots are in the world and is beneficial in knowing the global impact. The robots are not only exposed to the First Global Challenge (FGC) teams we originally handed out to, but to their communities. From this dataset, a geospatial visualization could be created.

Recommendation 2: A WPI scholarship should be formed for students completing the OpenSTEM program. After handing out the low-cost robots at FIRST Global, many students contacted WPI with interest in applying. It would be great to see that participation in the program could help them in their education at WPI financially if they choose to apply/enroll.

Recommendation 3: Create weekly/monthly challenges to implement on the robot. This can facilitate discussion, learning, and engagement after students and teachers have finished the course.

5.2 Final Thoughts

Though this was the first iteration of the OpenSTEM program, there is still plenty of work that needs to be done. Most of this was addressed in our recommendations for furthering the program, however, we would like to see three main changes done before moving to the next iteration of the program.

First, we would suggest that more students be involved in running this program. Since the initial start of the program, there has been an increased demand for participation across the world, which cannot be met by IQP students.

Second, this prototype of the support system and program itself worked for the 200 individuals we were aiming to serve, however, if the program grows significantly in participation and funding, other platforms should be considered before moving on that can better support much larger numbers of users.

Most importantly, the course needs to be finished and formed into something that we would be happy to give as a final product to thousands of students and teachers globally. It should be reviewed by not only the OpenSTEM team, but other WPI robotics faculty members, to ensure that it is sufficient enough to be used by many.

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Appendix B. Presentation

IQP Final Presentation Link:
https://www.canva.com/design/DAFSnbNXzhM/I8PPatEr6MZxv4pIZknR0Q/view

Appendix C. Interview/Survey Question

C.1 Initial Research Questions

How well do the platforms work (Discord, Website, StackOverflow)?
- Do you find it easy to find answers to your questions?
- Do you think the response time is relatively short?
- Is the platform easy for you to access?
- Is it important that the platform is mobile (on a phone app)?
- Is there any other platform that you would like to see? Or an additional feature?

How did you find the course to be?
- Do you feel you've been given everything you need to teach the course?
    - What got left out (what medium is missing)
- If you could have another lesson on the subject, what would you like it to be about? - **we need *how* they want to learn not *what***
- Where would you like to ask your questions?
- Would you prefer a forum over direct messaging to receive answers?

What kinds of resources do you want?
- We're assuming that forums or communities like Stack overflow or discord would be helpful, or that website resources would be good, but maybe they need something different
- Workshops? Website resources? Videos?
    - What kind of stuff would they want to have on the website?
- Do you think you will need support? How often do you find yourself needing other resources for help?
- Would you prefer to have a workshop or another conference as a follow-up? Would you prefer to have these more often?
- When you come into an issue, whether it be with our robot or something else, what source do you find yourself going to?
    - What do they go to vs
    - In a perfect world, do they wish they could go to
- Most common:
    - What did you like about the …
    - What did you not like about …
    - What do you suggest/want to have?

Some Questions on Larger Scope of the project:
- What are some existing STEM program(s) in where you are from?
- What resources do you use to approach STEM? (Class, online, competition, etc)
- What are some challenges that prevent you from pursuing/providing further STEM activity? (Funding? Restriction? Competitive program? Lack of Coach? Lack of knowledge for teaching?)
- How easy is it to access STEM resources where you live?
- Besides physical/material challenges for STEM, do you think there is a culture or stereotype barrier for students to select STEM?
    - If so, what are they? Do you feel encouraged to pick STEM?
- As a student, what would you like to learn, and have hands- on experience more?
    - Lessons Materials?
    - Coaches or teachers?
    - Hardwares? machines?
    - Competition Opportunity?

- Etc.
- As a teacher, what would you like to learn more or bring to your students?
    - Specific Materials?
    - Curricula?
    - Don't know where to start?
    - Etc….
- What do you think about a Global STEM program? Would you participate in it either as a student or teacher?
    - What would you like such a program to provide you?

C.2 XRP Check-up Interview Questions

1. Introductions

Hello,

We're { Project Team } and we're students at WPI working with Professor Doiron and Professor Miller on the XRP robot project. We've recently developed and handed out these robots in hopes of creating a robotics community in several different countries around the world. We are in the early stages of this project and we would love to hear about your experience with the robot.

To start off this interview we'd love to know:
- Where are you from?
- How many people are on your team?
- How much experience in robotics did you have before the course?

So you've had the robot for { time period }, can you tell us a bit about what your experience was when your first received your robotics kit?

2. Sign Up Process

From our understanding, the robot kits had a QR code linking to the website with resources on it, were you able to successfully find those resources? If so, how easy was it for you to get the initial information about the robot and all the necessary links?

What did you expect about the course and the robot before signing up? Were your expectations met when/if you found the course?

3. Upon Logging In

**Move to section 4 if the users did not log in to Canvas or Discord

The two platforms that we are using for this program are Canvas for the course and Discord for the main support. Had you ever heard of or used these platforms?

You successfully logged in, did you experience any difficulties when joining or attempting to join? Did you find the platform easy to navigate?

An important reason why we wanted to use Canvas as a platform was that it featured Canvas Discussions did you find the discussions form on Canvas helpful?

Do you have any final thoughts on the platforms and the login processes? What should be improved upon?

Specifically for Discord, there are many channel sections we created, is there any channel that you would like to see added to the server?

4. Initial Setup of the Robot

Okay, so { with/without } the help of the course website and the support platform, were you able to set up the robot to run some basic commands yet (driving, led, etc)?

If not, was it difficult to install the IDE mu?

How easy was it to follow the instructions on Canvas?

So you've been able to run the basic commands with the robot plugged in and install the IDE, were you able to run it without a cable attached?

In doing all those tasks with the robot, did you use Canvas or Discord for any support?

What other extra sources did you use to set up this robot, if any?

5. Getting Support for Issues

How often did you ask for support (using Canvas or Discord)?

Is there anything stopping you from participating in the live support platform?

Did you get your question(s) answered in a timely manner?

How often did you look for other forms of support (google, stack overflow, etc)? Why?

Did you feel welcome to ask questions on the platform?

What do you like? Dislike? What do you wish that we had for the support platform?

6. Overall Experience

Canvas
- What is your experience using Canvas?
  - Easy to follow? Hard? Hope there is more?
- Is there anything we should know that interrupts your experience?
  - Lost? Don't know where to start?
- Any inconvenience?
  - Certain functionality doesn't respond? Mobile ver/laptop? Etc
- Like? Dislike? Wish for more?

Discord
- What is your experience using Discord?
- How do you feel about discord, do you like it as a platform to receive support from?
  - New? Have used it before and loved it? Other?
- Besides support for q/a, do you think discord is good for building community?
  - Do you feel welcome?
  - Would it be something you feel helpful to connect to people in the project?
    - Yes, absolutely. No, I'm shy? etc
- Like? Dislike? Wish for more?

General
- Did you learn something from the modules?
  - Was the material…
    - Interesting?
    - Interactive?
    - Easy to follow?
    - Too easy or too hard?
  - Did the quizzes appropriately test your knowledge of the material?
- How did you like using the Robot?
  - Was it gratifying or frustrating to use?

- Was the design easy to understand?
- Would you recommend this course for other people to take?

Closing Remarks

So our interview is coming to an end and we really appreciate all the feedback you've given us. This information is really helpful in us catering our platform to all the users. Are there any other questions you may have for us? If you can't think of any right now, you can always email or message us on Discord.

Thanks!

Appendix D. Interview Script

D.1 Annie Hughes's Interview

D.1.1 Summary with Questions

- Question regarding **IQP**:
    a. Inspiration on the project and goals
        • Our initial project was to develop an Educational Robotics curriculum for Physically Active Youth, and to provide robotics kits for the center.
        • https://wpiroboticsed.wixsite.com/iqp2020
        • Groups in the following years built on the curriculum, developed a teacher resource framework, and helped get the group involved with a robotics competition
    b. Something you expect/ didn't expect on the project
        • The way we ended up organizing/developing the lessons wasn't particularly effective for delivery in a classroom
    c. Some aspect you think was important to look at
        • Problem and issue (long term/short term) that you tried to address or need to be addressed in STEM Education.
            • The idea that you need 'subject matter experts' to teach the content. I think that the things that are often associated with STEM can be daunting and require expensive resources/equipment, but sometimes the most important aspects are problem solving abilities, critical thinking skills, and a sense of curiosity - which can all be achieved with simple activities.
        • Did you achieve your goal? Why? Why not
            • Not entirely, because we brought in expensive robotics kits.
        • Anything you think could be done better or different?
            • I think that it could be really cool to develop a low-cost robotics kit, or a STEM curriculum similar to the activities that the Engineering Ambassadors do, that require very low-cost or low-resource items that are easily replaced/replenished. Almost like a 'grocery store item' project-based STEM curriculum.

- Question regarding **Current Project**
    g. What is your current project/research on STEM Education?
        • I am currently in Windhoek, Namibia for 9 months on Fulbright Student Research Grant
        • I'm teaching robotics, coding, 3D printing, and engineering concepts to students ages 6-18 at Physically Active Youth, an after-school program serving disadvantaged youth in Katutura
        • My research involves developing and proving the efficacy of a curriculum and teacher preparation program for a sustainable project-based extracurricular Educational Robotics program

The inspiration behind it and goal

- My team and I did not get to travel to Namibia for our IQP due to COVID, and I really wanted to find a way to deliver our curriculum on the ground. Projects like these really need someone in person to hit all of the road bumps and be willing to figure out solutions to make it run smoothly in the future.

h. What is the big picture and what do you hope to achieve?

- I am hoping to have a deliverable for PAY at the end that will allow this program to continue sustainably, and with any educator, after I leave.

i. Why is it important?

Before I arrived, these students had no exposure to STEM, and unless the project is sustainable, they likely will not have any exposure after I leave.

- More **general STEM Program Questions**.
    j. What resources do you use to approach STEM? (Class, online, competition, etc)
        i. I teach at an after-school program, in a classroom setting. I typically run activity-style classes, where I introduce the topic and give some context, then the students apply the new information with a hands-on activity/challenge.
    k. What are some challenges that prevent you from pursuing/providing further STEM activity? (Funding? Restriction? Competitive program? Lack of Coach? Lack of knowledge for teaching?)
        i. Funding. PAY is an NGO, so the funds need to go to many other things before they can go to Robotics. In other words, any funding for the STEM programs needs to be donated and/or in the form of a grant specifically for this endeavor.
        ii. Competitions. There are some (not a ton) of other groups doing robotics in the area, but finding other teams who also have the same robotics kits can be tough. We did find a way to have a competition with multiple kit varieties and teams from different schools/programs.
        iii. Coach/teacher. It isn't sustainable to depend on one teacher to support the program. I'm trying to start an internship program with one of the local universities so that all of the resources I have gathered and lessons I have developed can be used to train college students to keep the program going.
    l. Besides physical/material challenges for STEM, do you think there is a culture or stereotype barrier for students to select STEM?
        i. If so, what are they? Do you feel encouraged to pick STEM?
        ii. I'm currently working with pretty disadvantaged students, and it has been pretty obvious that the biggest barrier across the board is exposure. You won't know that you want to pursue STEM or that you're interested in it unless you experience it first-hand. I believe that bringing equitable opportunities to those that wouldn't otherwise be exposed to these topics is really important.

- What are your thoughts on a **good support system** for teacher in Initiative Stem Ed
    - A community? A technical Chat? Workshop? Website? Etc
    - I'm in a Facebook Group for VEX IQ Global, and it seems like a good option for asking questions and getting quick/consistent responses. I definitely think it would be helpful to have a place where people could ask specific questions and more experienced educators could answer.

- What are some of the aspects you think we should look at when creating an effective global assisting/supporting system? (cultural, social, etc)
  - Definitely identifying a point person in some of the areas you're hoping to target, just so that people know the resource exists. Then you can use the "point people" to send updates to, and also they can hopefully direct new educators to the system as they start out.
- Questions regarding collaborated online platform using STEM Education
  - (Discord, Slack, etc)
  - Whatever the platform is, make sure it is promoted to teachers that are just starting out. Maybe find a way to have it pushed out in preexisting facebook groups, on the VEX Stem Labs webpage, in some way with FIRST.

D.1.2 Raw script

Transcribed by https://otter.ai

Thu Trang Pham 00:00
All right. All right. Yes. Okay, so I think we'll go through a quick introductions about us and obviously about you as well. We'll do a little bit overview. And I believe Tom already sent you like a quick agenda that we kind of just draft up with just a few questions to ask about your project and your current project and everything else. But my name is Trang. I am currently a super senior. And glad to be in this IQP team. I'm a robotics and computer science major. I don't know if. Tom, Alex.

TOM 00:42
Yeah, hi I'm Tom. I'm a rising junior also. RBE. I'm just doing BS/MS. And then, yeah. I'm happy to be in this IQP team. So yeah.

Alex 00:56
Okay, so hi, my name is Alex. I'm a rising senior Robotics Engineering student.

Annie 01:08
I'm Annie Hughes I graduated in 2021. So two years ago, one year ago. I got my bachelor's and master's in biomedical engineering. I worked at Boston Children's Hospital after I graduated for nine months, I was living in the city. And then I moved to Namibia in March of this year for a Fulbright scholarship. And so I'm here for nine months, I'm rounding the corner on my halfway point. So I've been here for just about four and a half. And yeah, I don't know if you want me to. I know. We'll probably get into like my IQP and Fulbright. But that's my intro.

Thu Trang Pham 02:02
Yes. Thank you so much, we were like trying to find all your informations about you and everything else like that. Most of our information come from Professor Doiron. Yes.

Annie 02:13
Yeah, I'm happy to I also, I, like just took some notes on that agenda that you had sent me and I can like for sure, send that along to as well, if that will be helpful.

Thu Trang Pham 02:27
Yes

Annie 02:28
Yeah. Or anything else? So just just ask, and I'm willing to send things along.

Thu Trang Pham 02:33
Yes. Thank you so much. Yes.

Annie 02:35
You're welcome

Thu Trang Pham 02:35
All right, I guess. I mean, you probably have read some of the stuff that we've sent you already. But for this project, just a quick overview, we are working for the Global STEM Initiative program specifically for like robotics, with Professor Doiron and Professor Brad Miller. Our main objective is actually to create like a virtual supporting system for teacher who's going to be participanting in this program, all around the world. And we kind of just we started like earlier this summer. So right now, there's still piece and pieces that we tried to put together of like, what should we look into what kind of platform do we want in everything else like that? So you actually one of our first interviews. So we really want to know, and according to Professor Dorion to the IQP, that you have done is pretty much like, you know, like the first stone, that mean piece for this project. And so it's like, a lot of the detail will be very relevant for what we're doing. So we really, you know, want to learn more about your IQP as well as the current project, you're working in Namibia as well. And I guess, as you, are alumni have done an IQP currently on a project where its, like, very similar to this team. We just want to know, you know, like your view, how you approach what you have done. That's, that's hopefully a quick overview. Yes. I don't know if you have any question regarding our project that you would like clarifications or if

Annie 04:19
Yes, can I when you say Global STEM initiative, is that separate from MS4SSA? Or is it like in-line

Thu Trang Pham 04:28
from how I understand we'll we'll be working alongside with the MS4SSA. But our project was supposed to be a little bit more overall. So I know that they want to create like a platform that can be applied for program like that and even more like currently right now Professor Miller is working with a program called E For Us All. Located for USA So Engineering for USA. So our assumptions is that they would carry on this project for more. Right now, in the near future, we are going to be more participant in the Namibia project. But if there's any other IQP relating to STEM educations for other countries as well I think would try to be there, but right now, like, it's obviously a very broad objective, which is something that we try to figure out as well.

Annie 05:37
I was just curious.

Thu Trang Pham 05:38
Yes.

Annie 05:39
Um, yeah, so I worked with Joe was my IQP advisor. And he was also like, pretty influential in helping me get my Fulbright. And then I've also done a little bit with Brad Miller as well. He was

actually one of our interviewees for our IQP. So. Um, yes. So do you want me to start with my IQP?

Thu Trang Pham 06:08
Yes, that would be nice. Yes.

Annie 06:11
Um, so I was supposed to go to Namibia in 2020. And I was on a team that was charged with the idea to or the project was to develop an Educational Robotics curriculum for Physically Active Youth, which is an after school program in Katatura, which is a township within Windhoek, which is the capital city of Namibia. And we were also asked to provide robotics kits for the center to like support the project. And so during ID2050, we were fundraising for the robotics kits. And obviously, like figuring out our methodology and everything, and working with the sponsor to figure out exactly what they wanted. And then once we arrived on the ground, we're supposed to be teaching kids ages 6 to 18. Using the robotics kits, and then going into like, engineering concepts and things as well. But it got cancelled three days before, because it was March of 2020. And so we couldn't go. And I did the entire IQP from my childhood bedroom, during lockdown. But we ended up building an online curriculum on our website platform that had lessons and sort of like a framework for the kids to be able to follow. And I can send you the link to that, if you haven't already seen it. It's kind of like an interactive website, where you click through the lessons and like, build robots along the way and do different programming activities. So that was a very cool experience. And that was kind of like the end of that project was that we gave them this big deliverable. And then, like later on, the kits were sent. And then the next year, there were three groups that worked with PAY kind of and also like this Global STEM Initiative, robotics thing, whatever the term correct term is, one of them developed like a teacher resource framework that was supposed, to be, to go alongside my groups curriculum, the other group helped get or like built upon our curriculum, like making the website a little bit better, adding some challenge levels, that sort of thing. And then the third group helped the kids at PAY get involved with a robotics competition and sort of like the starting beginnings of a robotics team, competitive robotics team.

Thu Trang Pham 09:07
Oh, that's nice.

Annie 09:09
Yeah. And so that was really cool to see it continue continued. This past year, there wasn't a group that went to Namibia, or they, I think got moved to Morocco. But my so I did that junior year. And then senior year, I decided, for a lot of reasons to apply for a Fulbright scholarship, which is funded by the US Department of State. And so that was kind of like my way of, hopefully, when I applied I was hoping to be able to deliver those lessons in person and like be on the ground. Yeah. So I think I don't want to go into that right away because I'm sure you have questions about that IQP.

Thu Trang Pham 09:59
Yes. I guess well seen the IQP was one of the first like, I guess your first project regarding STEM education in Namibia. I don't know if you remember or you have taken notes, some of the things that you expected or you didn't expected. I know you wasn't able to be there in person, but like throughout your research and background, per se, how the socials and like cultural play in a role or even more than that, something that you expect, I guess?

Annie 10:32

Yeah, I think the first thing was probably, like, it's not it I don't. It was kind of like our fault when I'm looking back on it. But we really didn't know any better. But the way that we built our website, it was like, we thought that it was really user friendly and interactive, like if a kid was gonna sit in front of the computer, and do it. And I think we thought that it would be really easily adapted to a classroom setting, like if a teacher were to take the lessons that we developed, and then like, deliver them and like do the activities with the students. And so that was something that I realized, once I got here, like, the way that we organized and developed them wasn't particularly effective for delivering in a classroom to to like class of students. So I've, I still use some of the stuff that we came up with. But I have to adapt it. And so it's a lot of work, it's definitely good work, it's a lot of work. But that's something like making sure that the way that a STEM program is developed is like targeting, it's, it's the same thing as like any design project, you do it, knowing who your customer is going to be, and like the environment that it's going to be used is really important.

Thu Trang Pham 12:05

Right. Would you mind if I asked like, what is the specific things that you know, you realized when you get there? Or like, do you like actually only, like, know, the difference once you there in person? Or did you know during your IQP to?

Annie 12:21

Um, so the kits weren't in the classroom when we were there, or when we were doing ours. So that's definitely a difference. Yeah, I think that like, and I've talked to Joe about this as well, a little bit. But knowing the audience, so like the level of understanding that different age groups would have for different topics. And knowing that, like, obviously, there's going to be a cultural curve with like, how students approach academics or how the teachers in the traditional schools approach different subjects and acknowledging that like, this content isn't something that the kids get otherwise. So that, I think I have a, I think another I don't know if this is like, super helpful for you guys. But I have another teacher that was kind of like in charge of the robotics program before I arrived. And he didn't, he didn't know a ton about it. So I'm kind of like training him as we go along. But I do find that having him there is very helpful, like, like in terms of making connections and like metaphors and things that they like, for sure will understand. Because sometimes I say things that like I know, would land really well for students in a classroom in the States. But I say it to these kids. And like, I'm like, we're taking the robot through a maze today. And they look at me funny and like, Do you know what a maze is? And they're like, maize meal like porridge? And that's just like a simple example. But there's times that like, I kind of lean on or depend on the other teacher because he grew up here and like, knows what words and vocabulary and like examples will land well with the students?

Thu Trang Pham 14:26

Well, that's really nice. You know? Yes, I think one of our challenges is that although our project name global, we have technically an on campus, IQP, so we don't get to travel. And they seem like some time we do feel like the quarter aspect might be a little bit difficult for us in they try to really, you know, generalize this whole project, so we can't really just pick one or two places. And based off that, yeah, which can be difficult. But

Annie 14:56

yeah, for sure. And like my, uh, my as, uh as amazing as like, the experience that I'm getting is, and like

the opportunity to teach in a global classroom and like have this just like be thrown into it, I think that if I were to take this to another place somewhere else that like has a pretty drastically different culture. I don't know how, like how easily these skills would apply, or like how beneficial they would be. So that's another thing like, you could get a ton of input from one geographical area, but it may not actually be as helpful or applicable elsewhere.

Thu Trang Pham 15:40
Right? Yes. Yes. That's a very good note for us. Yes. I guess seeing your IQP and your current project you're working on is so similar, I guess, like it would make sense for us to like not making like distinction between the two. Because some of the questions, we have a pretty much apply for both of them. So, yeah. So yes, besides like things that you didn't expect, until you like there in person, the classroom structure and everything else, if there's any, like problems that you can foresee, like short term or long term, and that you want to address in the STEM education that you're trying to implement in general.

Annie 16:26
Yeah. Um, so I think one thing that I, I still struggle with whether or not this is something that can be addressed. But the idea, I'm trying to find a way to limit the need for like subject matter experts to teach the content. Because I think that a lot of times, like the things that are associated with STEM and robotics can be like, pretty scary to just general, like early education teachers. And also, like in terms of the administration, they might be less willing to do it, because a lot of times the equipment is really expensive. So I think that it's like really important to find ways to expose kids to these topics and like, give them hands on experience, but not necessarily require, like having someone like me come in as a while I do have the engineering experience, I didn't really have the teaching experience. So I think that sometimes the teaching experience is what's really super valuable. So like being able to train educators, or like expose them to this stuff in a way that isn't super daunting is really important, because then it enables them to transfer the knowledge to their students. Even if they don't have an engineering or like a super stem heavy background.

Thu Trang Pham 18:07
Wow. Yes.

Annie 18:09
Yeah. And I think I've found that I found that here, like, problem solving and critical thinking skills and like, establishing curiosity amongst students, like, that's what you really want kids to get from stem, it isn't necessarily like, how exactly does a motor work because they're 11 or 12. And like, they're not gonna remember it, but if you can, like hand them a challenge, and they're motivated, and they don't give up and like, they think critically to figure out a solution. Like, that's what I'm kind of aiming for.

Thu Trang Pham 18:42
I see I see. So like, I guess, that kind of tied up with like, our main target actually will be the teacher. And as you have been working with a teacher there, like, how have you been like approaching it from a person with a STEM background, but not necessarily like teaching? I would assume you will have to like bringing out your curricula and try to like, showing it to to a teacher as well. Like, how did that process go? And what kind of support you think the teacher kind of need during that process?

Annie 19:19

Um, yeah, so I, I kind of, I think I wrote this down somewhere later on, but you were asking about, like support systems for your project. I, the ones that I've encountered, I'm in like a Facebook group for Vex, so I'm using VEX IQ kits. And in like a global, I think it's called Worlds worlds VEX IQ you educators or something like that. And I haven't actually used it like I haven't VEX IQ worldwide Coaches Association. And so they like, it's kind of like the question answer space like a forum to it says to share resources, ideas, best practices. And so people like, ask questions too, which is kind of cool. And there have been, like, there have been a few times where I'm trying to run a lesson, there's like, an example is I'm trying to learn a lesson, or develop one. And a lot of what I'm doing is like hands on activity or challenge based, so it's like, here's what you want to do. Now you guys do it. And I want to, like, have the solution to it ahead of time, just so I know it works. And if I can't find the solution, or like, I can't figure it out, right. I know, there's someone else out there that has done it before. And so like, having a space to ask and like, get a response would be really cool. And I think really helpful, especially for like, first time people doing this, right. Because I have like, some coding background from some classes and like, a little bit of the, like, hardware stuff, but like I, I can figure things out, because I like have taken programming classes. But I think that if I hadn't, I wouldn't be able to figure these things out. And so like, some of the Vex forums that exist are helpful in some cases, like, people will post links to things or solutions. But I think like a question answer where you I think that I don't know if Joe has showed you the Stack Overflow thing. Are you guys involved with that? He?

Thu Trang Pham 21:43

Well, he showed us the Stack Overflow that thing? Yes. Is this a new one that they made? I don't.

Annie 21:52

Um, I he added me to one. I'm trying to see if I can pull it up.

Thu Trang Pham 21:59

That was, yeah. Like we've been looking into that, as well seen. Both Professor Miller and Professor Doiron seem to be pretty much like fond on StackOverflow to be the Q&A platform. For a lot of- yeah.

Annie 22:18

Yeah, I think that like from what I saw on there, that was really cool. I think that could be a good option. Um, as long as it's a place, like the only the thing that you want to just be cognizant of is like that want somewhere where like, people are going to ask questions, and then someone will give them an answer. Because otherwise, you're just like, sending a question out into the ether. And then like, you're not going to hear back for two years until someone else has the question.

Thu Trang Pham 22:51

Right. Right. Yeah. So. So I don't know if this is too early to ask. But like, right now. So right now you are actively actually teaching the STEM program to the kid as well. Right? So after this nine month, like, Do you have a plan to maintainw hat you are doing without being then person? Yeah things like that? Yes.

Annie 23:18

Yeah, my whole goal, like the research that I'm doing is to develop and like, prove effective, the curriculum that I'm building, and also, like a teacher preparation program. Because I want someone to be able to pick up the lessons, like, do a little bit of background learning, and then

pick up the lessons and then be able to deliver them in a classroom, like, even I'm not going to be here and like even if the person that I'm training leaves. So the way that I'm doing that, as I'm going to pull in an intern, I might might be starting a like robotic Student Society at one of the like, close by universities, and then pull in interns from there that will be teaching. And so it's mainly a, my goal is to like create a landing page that has all the resources necessary for this specific after school program, to be able to like use the like, understand and use the Vex robots and understand the main like overarching topics that you need to know to deliver Educational Robotics, and then be able to like follow my lessons and execute them effectively in a classroom. Because I think that, and I wrote this somewhere on the page, but like, I'm working with very disadvantaged youth, and they would not otherwise be exposed to this content. And if my project is not sustainable, then they will not be exposed to it after I leave. So like creating a sustainable program that can exist without me, a subject matter expert from the United States is like really important.

Thu Trang Pham 25:34
Great. Yeah. Wow. Yes. That is nice. Yes, we are like kind of seeing some of this part as like part of our project, because essentially, our project might be passing on to other people, or if it's become really a things like pull and up running it per said, or will be Self-maintained, when any of this support system. We probably will follow your works. And definitely pick out a lot of it from from what you're doing right now. I don't know if Alex and Tome, do you have any questions regarding the projects, or anything else so far,

Alex 26:13
I know one of our concerns was about self sufficiency about having it recurring. Because I know when we did a Engineering for Us All (E4USA), when there was a q&a or like a feedback session, between their own part we were able to listen in, and some teachers were showing concern about them being able to make all the meetings or being able to provide time to be able to sustain their end into it. So we were thinking about, like, for ourselves, if we were to use like discord or Stack Overflow, we would probably need a team from WPI to be able to help make it self sufficient, rather than it being solely on the teachers.

Annie 26:59
Yeah.Yeah, I think I like very big on, like, making sustainable programs, especially. And when it's like these short term, mine is a little bit longer, but especially like an IQP, which is such a short term project, because you kind of come in as this like, magical solution master for seven weeks. And then like, once it's finished, you don't necessarily have the bandwidth to like, continue it on. And I'm definitely an exception to the rule where I am like continuing the project that I started while I was an undergrad. But I think that what you guys are doing could be very, very effective and helpful. But with most things, like if you just leave it dormant, it may not have the same effect that it could have if you had like a human being pushing it forward. So I don't know, you probably have already thought of this, but like, I don't know, if there will be WPI like faculty or someone in like the global lab or something that is going to kind of like follow this along. Because I don't know if I don't know if Joe like, plans to or has the bandwidth to do so. But like if you could have a human being connected to this that's like, operating and like keeping the discord alive, or the StackOverflow alive and like asking questions to keep people interacting with it. Yeah, that was I think I wrote that down somewhere as well that like, whatever you're doing, if you're trying to make it global, like having contacts, and people in different areas, like a point person would be really an interesting idea. Because then they could be your like helpers or the responsible person that would introduce new educators to this resource. Because that's

another thing that I have run into is like, I'm what four or five months in and I'm just now like, finding really helpful resources that I wish that I had on day one. And like if they're say, for this, for the sense of this example, like say that there was a robotics point person connected to WPI in Africa, they could have like, pointed me in the direction of you guys and then it would have been helpful

TOM 29:46
Yeah, because yeah, that's been at least my favorite the discord is like if we started and then we continue for like a and b term, then like afterwards how it will look like, like after those two terms. Um, yeah, I think I really have a, I don't really have any other questions. I don't really have questions. It's just like, nice to hear because like, our kind of main goal with the discord too is kind of like, if people have like quick questions or anything like that, or like, any annoying hardware issues, it's just like, gonna make it I guess easier for them to deal with. While they can then I guess, teach the kids the more valuable lessons, if they understand how the hardware stuff goes alongside, they don't have to worry about that too much.

Annie 00:12
Are you guys like mainly focusing on Vex? or are you doing? What's the goal?

Thu Trang Pham 00:21
You know, we've been throwing so many things. So I don't think we have a specific thing yet. What we are having currently right now, I know I don't know if you know, Zeke. But yeah, so he's working on a low cost robot

Annie 00:37
They are sending me one. Yes. So that robot, actually, yeah, you're in the Namibia. So that's the same robot that we are currently based off as and E4USA is actually using that robot. And that's why we kind of get involved a little bit. Now, Brad Miller did brought up a thought on future which is something similar to what you say too the idea of building like an after school program, and eventually making maybe like a local competitions and build up like a competitive robotics team for first global. So is that Okay,

TOM 01:15
yeah, there's a lot of things are like up, basically, it's just like, mainly focused on the aspect of like, helping, like making a Support Center for teachers. So that it's like easier for them.

Annie 01:25
And yeah, I, I've worked with both of your advisors, and they're incredible people whom I love very much.But I receive just as any tossed ideas as you do. And I try to I try to toss my ideas to sometimes they land, sometimes they don't.

Thu Trang Pham 01:47
Yeah, oh, yeah, we, we kind of like they're like, sometimes we do have to, like, try to prove our point. But you know, they have a good idea. I just see, like, they both see the problem in two different point of view. But it's good that like, sometimes we sit down together and then kind of, you know, getting to a same point and talking to you. And as far as like people who are more involved. Could it help with directing our direction as well.

Annie 02:16

Yeah, I think that I'm wondering like, are you creating a page with resources to or is your main deliverable going to be this like, q&a platform?

TOM 02:36
It's like, you're creating kind of like multiple things that we're trying to create, like the website, and then we have a discord. And then we have like, links to Stack Overflow. So it's kind of a bit of a mix of things. But like, this could have been like, very easy, quick, fast answers if people want to, like answer them, the Stack Overflow live really just exists, if like, people want to Google an answer, and then hopefully, they just go into Stack Overflow, basically. Or then from the discord. It's just as the links to like, frequently asked questions in it. And then the website would itself have just like, resource and general stuff on it. Like the beginnings or like, where to go from here, essentially.

Annie 03:15
Right. Okay. And so all of this is like for Zeke's robot

Thu Trang Pham 03:24
more than Zeke's robot, potentially in the future, For now, I think it is really for that low cost robot. Yes. Because it seems like it's like, different projects, but for the similar goal. And then it was like, well, may as well. Why don't you get just be involved in that as well. Cuz I think when we first started this project, we are given very broad idea. So even including the support system is never really clarify. Isn't that like one system of a certain platform, when anything else like that, which is why we try to approach with like, multi platform, just because although stack, Stack Overflow is great for just q&a, we do things because it says, quote unquote, global STEM initiative. We think that a community also very important in which we want to try discord, like there was just a debate between slack and discord so far, but we want to go with discord, and see how that go alongside with Stack Overflow, and potentially like a landing website.

Annie 04:34
Yeah. Cool. Right. Sounds like a good. I know, there's a lot of tough variables that you guys probably have to consider. So yeah, I admire I admire your project.

Thu Trang Pham 04:51
Well, yeah, eventually, maybe in the future, we'll hopefully can be able to try with a certain community and see how it actually works. Because right And now is just really based on our assumptions and many things else, right, so

Annie 05:05
yeah. I'm I'm trying to think if I think it could be like, I don't know if you guys will have the time, is your IQP be just over the summer? Or does it continue into the fall?

TOM 05:21
Or continue to A and b term. Yeah, basically couple of us are doing, like the summer, two thirds or the summer, I'm basically starting fully A and B term. I'm technically not getting any credits over the summer yet. Yeah,

Thu Trang Pham 05:38
some of us will be involved until the end of B term, actually, all of us will be there until the end of B term. This project is yes, the goal is to be the end of B term. But then some of the start early,

some will start later.

TOM 05:55
b term, at least what it's looking like to me is going to be basically us creating our paper, like the final
        paper and then just.

Annie 06:03
right, okay. Yeah, I would say, if you have the opportunity, it sounds like you have enough time. But you
        should aim to pilot this. And then adapt it and then pilot it again. Or I guess once you pilot it
        once the second time, it's just like another trial. But I'm doing it and like, Yeah, I think you could
        probably like, form some research around it, where you ask teachers beforehand, like, what are
        you hoping to get out of this? And then you pilot it. And then you ask them, like, was it helpful?
        What would you change? And then, you know, like, you at least have some feedback, because
        that's, like, we definitely got feedback on our initial curriculum that we built for ITP. But looking
        back on it, like, I wasn't a teacher, I, I had never really like worked with, I had worked a little bit
        with children in the classroom, but like, you need to talk to the people who are actually going to
        be using it and not make as many decisions yourself, which is hard when you're like trying to get
        stuff done. But yeah, like getting the input of the people that are going to be using it is like,
        probably shouldn't be one of your top priorities. Right? It's like, we picked a web thing and like
        you guys are picking this chord. But you should ask the people that are going to be using it like,
        is discord something that you would check frequently? Is it something that you think would
        solve the problems that you're currently facing? Yeah. So which is hard? And like, Yeah, I know,
        you want to? I know, you want to make progress, which is the frustrating part of it. Right?

TOM 07:57
Yeah, I think that's pretty smart. I think it'd be definitely have a lot of time in a way that we can actually
        just like do two trials, which would be really nice. Yes, yeah.

Annie 08:07
Yeah, like, because you could finish the first trial and be like, Wow, Discord was an entire flop. And we
        could do this so much more effectively on Slack. And like, I don't take my word on that at all.
        I'm just saying like, that could be the outcome. And that could be helpful. Because, and you
        could you could use teachers in the US. And then you could also use teachers in like, a few
        global areas, and then compare the results based on those things or see, like, Wow, it's really
        proven that someone in Africa can answer someone's question in North Carolina and vice versa,
        right. And like, yeah, so

Thu Trang Pham 08:49
yeah, that will be nice. I don't know.

Annie 08:51
You don't have to just take all this. With a grain of salt. You don't have to

Thu Trang Pham 08:58
do like, for short term goal we do. We do actually want to pilot it. Because right now, like, we can do so
        much research, but at the same time, it's like so hard to tell. I think we are currently working with
        Professor Dorian and see what is like the closest event upcoming we think

TOM 09:17

today already set that like we could potentially like early September on a date pilot

Thu Trang Pham 09:24
because he's going to Namibia. So

Annie 09:28
yeah, visiting me

Thu Trang Pham 09:30
when my when my contact you more often in the future. Yes. But that's, that's a goal actually. To figure out if it's going to work. Well, from your experience, what do you use for like, communications like that?

Annie 09:52
Here I feel like a lot of the communication is on Whatsapp. And I think that that is a very good, like global communication platform.

Alex 10:10
But

Annie 10:13
I don't know if this I don't know if it'll be good for what you're trying to do. Yeah. Yeah, I think something that I'm actually I might connect you with someone that at the University of South Africa, because I used, they like started this robotics competition. I don't know, like four or five years ago. And that is global. And like, you can submit videos, and they get scored and all of that sort of things. I see. And I think they have a WhatsApp group where people can ask questions, and I'm in and it's not very active. But they might be able to give you some input on like, what works or what doesn't? Yeah, yeah. I'll try. I'll keep it in, like, in the back of my head, too. Because if I'm trying to think of like other other than the Facebook group, and like, there's like a Vex forum. Those are the two that I mainly use if I have questions. But and I've never used discord truthfully. So. No, but like, that's just, I don't know, maybe I'm behind the curve my brother uses all the time to talk to his friends. But yeah,

TOM 11:41
it's like basically, what we think of it's like WhatsApp, like, because we also looked at WhatsApp a little bit. And the way we ended up with Discord is also like, because WhatsApp has the nice thing of like, you can communicate quickly. And it's like a mobile app. So with discord because we can also essentially just have it as a mobile app. It's also nice that you can just have easy communications, but because it has like the different channels like Slack does, except it's easier, easier to join the slack is because it Slack has some annoying things with workspaces. So it's like very accessible, which is why we kind of Yeah, yeah, so hopefully it worked in that way. Right.

Thu Trang Pham 12:19
That's all we had.

Annie 12:23
I think like if if WhatsApp had an option for channels, I would say like, yes for that. Yeah. Yeah, but WhatsApp is like the equivalent of GroupMe versus slack, I'm sure that this is like the same thing like me, are in a similar category, and then slack and discord in a similar category. But I

think whatever you end up doing, like make sure there's very clear instructions and like maybe even a video or something that shows some where like, I don't know, if you end up with like a landing page or something. There's just like, very clear like, this is how you join the discord, this is how you use it. This is all of that. Because if you're injured anytime you're introducing like a new technology or a new option to people that haven't seen it before, they're less likely to use it if they don't know how to

Thu Trang Pham 13:18
write this truth. Yeah, and thing, we didn't think about all that. And honestly, like, we're not sure either. So that would be nice. If we have like a pilot in and see how it's go. I can see that I we definitely heard a lot about WhatsApp. And then as much as it's not super flexible and straight out just like a group chat. The fact that it's really integrated in people's daily life already make them more likely to use it too. So that was really the pros and cons of where you go in between. Because the thing with discord, and even slack too. And as much as it is very nice. We quinoa and stuff. If we're going to be the only people end up using it. We don't know how likely people would be Yeah. Yeah.

Annie 14:03
And that's something that like, I don't know, if I would push for Facebook, but it's something that I definitely noticed about the Facebook group that I'm in is that like, people check Facebook? I don't know, I'm like, adults check Facebook on a daily basis. And so like, then they're gonna see these things. Whereas, like, if it's a notification from Stack Overflow, saying like someone asked a question, there's so many other emails in your inbox like you might not. So if you're scrolling through Facebook, and you're like, oh, I can answer that really quickly, then you will. But if it's like just another email coming from Stack Overflow, then you might not be as inclined to do so. But it's true. I can't I can't predict the outcome. That's like ya have to try it.

Thu Trang Pham 14:49
Right. Yeah, for sure.

Annie 14:56
Do you have any other questions?

Thu Trang Pham 15:00
Let me see, do you have any questions

TOM 15:03
I can think of

Thu Trang Pham 15:08
I guess like in the future besides like, more like sustainable, like, supporting website or anything else like that, do you foresee like workshop? Or like, you know, like calling assistant or stuff like that, for your program? Um,

Annie 15:32
like, would

Thu Trang Pham 15:33
be more, more like this more like zoom cockfighting.

Annie 15:39

Um, that was something that I was thinking about. So the the robot, the competition that the South African University ran, they had, like, they had people join the WhatsApp. And then they also had like a kickoff zoo zoom, where they went through and had people go through, like, frequently asked questions frequently, or like, frequently encountered problems, things that people have learned from doing it in past years. Which I think that stuff is super valuable, because it's like, little things that you wouldn't learn until you've done it one time. So I thought that was helpful. But that still goes back to the idea of like, you need people to be able to attend those meetings. Because if they don't attend it, then like, you can say you recorded it, but are they going to take the two hours out of their day to watch it? I was just like, you always have to consider those things. But I think they did put there they have like a landing page, and they put the recordings up and everything. So people are in theory, put the recordings up? I don't know. I don't know. I really, I think that that workshop is helpful, because you can ask live q&a, right? And have people's attention to be able to answer it in real time, which is something that you like, that's the only way that you're going to get that experience? Yeah, I think I think, I think for that, you need to have everyone on a similar playing field. So like, if you got a bunch of people together, and like some were doing Lego Mindstorms, some are doing VEX robotics, some are doing the robot, like, that's not as effective. So like, the reason that the one that I went to was helpful was because everyone was going to be doing the same robotics challenges, no matter what kind of robot kit they were using, like, everyone was going to be doing the same. Had the same objectives. So as long as like, everyone that's attending the workshop has the same objective, and it isn't just like, what problems are you having? Yes. Alex, would you do if

Alex 18:14

I was gonna say that was a similar experience that I had from the workshops, or at least from the q&a feedback group with the for USA was just like, you know, people. Like when they would have workshops, they had many different workshops. And sometimes teachers can't attend those. So they would record those and then post them to their slack. And I know one person Adam would, if there was a really long workshop or recording, he would break them down into bite sized videos, removing silences and whatnot from it. But again, you know whether or not people would take time out of the day to go back to that, or if it just like, they would also make the PowerPoints available. So unless that's easier to just go back and view that instead of watching it a whole video. But also being able to find time that they're available.

Annie 19:08

Yeah, for sure. I think one of the biggest things that I'm like noticing and acknowledging while I'm building a curriculum, and like teaching and doing all these things all at once, is that like, websites that are really straightforward and like very short, searchable and videos that have chapter marks and just like when things are easy to find it is very, very helpful because a lot of times like people are going through a lot of content in order to get to the answer that they need.

Thu Trang Pham 19:52

I guess it's approaching the end of these meeting, although we definitely will reach out to you in the future as well. If you don't I know that you guys have any last questions. Alex?

TOM 20:08

I don't have any question anywhere. Any further.

Thu Trang Pham 20:13
Yeah, well, I guess. Well, last questions from me. You are you have any tips, I guess, is pretty great that you have a view of the students in STEM as well as like somebody who's teaching it as well. As for us, would you have any advice as you have gone through it, the others, any things that you think that we should either not assume, or like looking into more detail, to help with our project?

Annie 20:51
I'm just trying to think that sometimes, like coming from a STEM background, and like having so much exposure to it, I don't always acknowledge, like how much I know compared to someone who may have had a background in just education, not to like, discredit them at all, because I think that people who get degrees in education are very, very, just like very talented and resourceful. But I think it would be important to like, like, very simple not I say it's simple things, but like, it's obviously simple, because we all went to ITT Tech, like a very technical school. But like, there are things that would be really hard for just like any normal, like fourth or fifth grade teacher that you wouldn't really expect. So as much input and like feedback that you can get from teachers that are not necessarily like, super experienced with STEM is probably helpful. So like, try to about like, if you're getting responses from robotics coaches, or like, if you interview like Brad Miller, or Ken Stafford, who have experience, like teaching robotics, to sixth to eighth graders, all of that is really valuable, and then tried to like balance that a little bit. I was, I think it from my opinion, I think balance that with like sixth to eighth grade teachers who have never had a robotics kit before. Because they might be like, challenged with the prospect of teaching this. And then as soon as they know that they have like a resource where they can constantly ask questions or get input or answers, then that's like, suddenly not as daunting of a task, if that makes sense. Yeah, for sure. Yeah. So like asking someone like, if would you be willing to do this? Like, would you feel prepared to do this? And then asking them again? Would you feel prepared to do this knowing that you have these two or three resources? And I'm sure the answer will be different? Because like, I, I think that I think that my like the job that I'm currently doing would be a lot harder if I hadn't taken programming classes or like, done the coursework that I did for my degrees,

Thu Trang Pham 23:48
right. Yeah. Yes, this is very nice, because actually, I do say, we actually, well, because he's talking about STEM education. I think I'll pull up interview right now. I'm mostly people, either in robotics program, or in a STEM program. And it's a nice point of view that now you say that we should actually look into the teacher aspect as well, because it is iniciative. One way or the other. So, yeah,

Annie 24:18
well, I think it was Brad Miller. Don't quote me on this. But I think it was Brad Miller that told me that they used to invite middle school teachers to come to the WPI, like middle school robotics events. And so those, those are like teachers that aren't necessarily in STEM, or maybe they maybe they're like science or math, but not necessarily like robots. And so they would invite them to like come and do the course alongside the students at the same time. And then they would have like, all of these new skills and things to take back to the classroom. So maybe I ask Brad about that. And like whether or not he thinks it would be valuable, like he thinks it would be valuable to talk to non stem people in your interviews? I'm sure he'll say yes. But like, he might also be able to point you in the direction of some people to.

Thu Trang Pham 25:16

Yes. Thank you so much. Yes. So I guess that if nobody have any other questions in common, I think that'd be the end of our interview. And I know that you mentioned that you have some notes that you can send us if you currently have your domain. Yes.