ENCOURAGING STUDENTS WITH LEARNING DISABILITIES 
TO BUILD A PAYLOAD BOUND FOR SPACE

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1 The Vision

Building an object that flies at fifty times the gravitational force and leaves the confines of the Earth’s atmosphere is exhilarating, challenging, and may be limited to only those who work in the aerospace field. Access to space (universe) for scientific or engineering purposes may seem like it is reserved only for those in highly technical fields, but with a growing number of opportunities, cheaper launch costs, and launch availabilities, more and more people from various professions, institutions, and governments can launch experiments into space. Launch opportunities like the ROCKSAT-X program run by the Colorado Space Grant Consortium allow students of various universities to design, build, test and launch a payload into space every year. The students of universities that take part in the ROCKSAT-X program are usually engineering or science students that are gifted, talented and usually represent the best of their university's program of study. The object of this paper is to focus on encouraging and including students with learning disabilities to build a payload bound for space. As a part of a pilot program, students with learning disabilities will design, build, test, and launch a payload into space.

1.1 Nature of the problem

The National Center for Learning Disabilities defines learning disabilities otherwise known as learning and attention issues as “brain-based difficulties in reading, writing, math, organization, focus, listening comprehension, social skills, motor skills or a combination of these” [1]. The use of the terms “brain-based” implies that learning disabilities and mental disorders are interlinked. At this point, after defining the term learning disability, a question arises, why should students with learning disabilities be included in highly technical fields such as the aerospace field? The answer is simple: to increase participation in Science, Technology, Engineering, and Math (STEM) programs. Initially launched by the Obama administration, the STEM program "aims to make The United States of America more competitive in the world by increasing the number of professionals in the STEM fields" [2].

The National Aeronautics and Space Administration (NASA) supports the STEM program and has three primary education goals as follows: strengthening NASA and the Nation's future workforce, attracting and retaining students in science, technology, engineering, and mathematics, or STEM disciplines, and engaging Americans in NASA's mission [3]. While NASA does embrace STEM and encourages the involvement of those with learning disabilities, this paper will discuss creating a project where students with learning disabilities would build a scientific or engineering payload that will launch into space in the 2018 to 2020 launch window. There is often a stigma surrounding students with learning disabilities. A report published by the National Science Foundation (NSF) focusing on accommodating students with learning and attention issues, indicates that American students with learning disabilities are excluded from postsecondary STEM education [4]. Exclusion from STEM-related education would imply that students with disabilities do not necessarily have the same opportunities compared to students without disabilities. In a world where technology grows at a rapid pace, students with and without disabilities must get exposure to STEM-related fields. The same report [4] states:

Research has demonstrated that when compared to peers without documented disabilities, students with disabilities enroll in and complete postsecondary education at only half the rate. Yet the problem is not limited to postsecondary education. Accommodating students in K-12 science and mathematics courses is
often problematic, and many students with disabilities are not integrated within the general classroom and are relegated to learning in special education classrooms that do not prepare them for the rigors of university education in STEM fields [4, p.10].

With the lack of inclusion in STEM programs, individuals and students with learning disabilities could have increased difficulties in finding employment in highly technical fields.

Universities wanting to send their best and brightest students to STEM programs related to NASA, such as the ROCKSAT-X program, would mean that those students are motivated, have high self-esteem, good social skills, and exceptional math and reading skills. Often a person’s willpower or motivation is enough for success. Motivation many times comes from peers, teachers, friends, family, co-workers, and others. Research conducted by the National Center for Learning Disabilities suggests:

Success in college and the workplace is heavily influenced by internal resilience factors such as temperament and self-perception. Low self-esteem and stigma help explain why young adults with learning disabilities—who are as smart as their peers—enroll in four-year colleges at half the rate of all young adults. Lack of self-advocacy and self-regulation skills may explain why students with learning disabilities who attend postsecondary school are less likely to graduate than students without disabilities [1].

Lower graduation rates and fewer enrollments for students with learning disabilities could lead to fewer jobs in the STEM fields. Working adults with learning disabilities that are looking for jobs may find it difficult to find them. Research indicates that adults with learning disabilities are twice as likely to be jobless when compared to their peers without disabilities [1].

1.2 An In-depth view of the problem

A study conducted by the National Center for Learning Disabilities (NCLD) provides some staggering statistics:

![Figure 1-1 Staggering Statistics](image)

Rishabh Maharaja
To better understand the broader impacts of the pilot program in which students with learning disabilities design and build a space-bound payload, it is best to include a wide range of neurodiverse students. Overall, the pilot program outlined in this paper is only sustainable if it involves students with various learning disabilities. According to the NCLD, learning disabilities and attention issues include Attention-deficit/Hyperactivity Disorder (ADHD), Dyscalculia, Dysgraphia, Dyslexia, Dyspraxia, Executive function deficits, and Nonverbal learning disabilities [1]. A STEM-based pilot program for students with learning disabilities should define a metric that differentiates instruction and assessment, based on the needs of the students. A metric that differentiates instruction and assessment is crucial for the program so that skills obtained in the program can be related to potential STEM-based job requirements. In data provided by the NCLD in Figure 1-2 below, disabilities are broken down by their prevalence:

<table>
<thead>
<tr>
<th>ISSUE</th>
<th>PREVALENCE</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyslexia</td>
<td>5%~17%</td>
<td>Pediatrics in Review</td>
</tr>
<tr>
<td>Dyscalculia</td>
<td>5%~7%</td>
<td>Science</td>
</tr>
<tr>
<td>Dysgraphia</td>
<td>7%~15%</td>
<td>Pediatrics</td>
</tr>
<tr>
<td>Dyspraxia*</td>
<td>5%~6%</td>
<td>DSM-5</td>
</tr>
<tr>
<td>ADHD</td>
<td>5%~11%</td>
<td>DSM-5, CDC</td>
</tr>
</tbody>
</table>

![Figure 1-2 Disabilities and Prevalence [10]](image)

The biggest obstacle to this pilot program is cultural. People may ask, why even create this program? Or where will this program go after the launch of the project? Or can students with learning disabilities be included in building something that will fly into space? Isn’t building something that will fly into space difficult? Isn’t access to space expensive? Before answering such questions, let’s look at a study done by the NCLD that diffuses certain myths about learning disabilities with facts:

![Figure 1-3 Myth vs. Fact [10]](image)
As indicated in Figure 1-3, children who have learning disabilities are as smart as their peers but need a targeted approach. The pilot program outlined in this paper will provide a dynamic, flexible and targeted approach to developing a payload for spaceflight. A pilot program that focuses on allowing students with learning disabilities to launch a payload into space can further debunk the myth that students with learning disabilities are less intelligent. Often when people talk about launching a rocket or satellite, they only associate engineers and scientists with such spectacles. The reality is, the space field is very vibrant and requires skill-sets from various experts including artists, accountants, economists, historians, medical experts, business experts, to public relations and media experts. Space is connected to all facets of humanity. In the literal sense, life as we know it exists due to the various elements and matter spewed by exploding stars. The space-bound payload pilot program for students with learning differences aims to neutralize the notion that space is only for the privileged and reserved exclusively for scientists and engineers. Figure 1-3 makes it very clear that there is a stigma surrounding learning disabilities. In a survey conducted by the NCLD [10], responses indicated the following cultural trends and attitudes:

1. 33% of educators say that sometimes what people call a learning disability is just laziness.
2. 43% of parents say that they would not want others to know if their child had a learning disability.
3. Doctors who recommend evaluating a child for learning and attention issues say parents follow their recommendation only 54% of the time.

To address the question, isn’t building something that will fly into space difficult? The short answer is yes, but the main goal of this pilot program is geared towards creating a program that encourages students with learning disabilities to participate in developing a payload for spaceflight and building critical thinking and resilience by analyzing the degree of success or difficulty of the work involved. In short, these students will participate fully in a rigorous engineering design project, which may or may not be entirely successful but whose primary purpose is to build self-esteem, engender critical thinking and possibly build “grit.” All the aforementioned skills will grant these students an advantage in a STEM-based workforce.

1.2.1 Federal Laws

There are six federal laws enacted to help students with learning disabilities in several ways. According to the NCLD, the six laws are as follows [10]:

1. Section 504 of the Rehabilitation Act (Section 504), passed in 1973
   • Academic institutions that receive funding shall not discriminate against students with disabilities. Accommodations must be provided by academic institutions while removing barriers for students with disabilities.
2. Individuals with Disabilities Education Act (IDEA), passed in 1990, with updates in 1997 and 2004
   • Schools that receive federal funding shall provide an evaluation at no cost to the parents of children that may have disabilities.
3. Americans with Disabilities Act (ADA), passed in 1990
   - Public and workplaces shall not discriminate against persons with disabilities. A workplace with 15 or more employees must provide reasonable accommodations to persons with disabilities.
4. Workforce Innovation and Opportunity Act (WIOA), passed in 2014
   - This law enhances employment services, job training, and education for persons with learning disabilities.
5. Every Student Succeeds Act (ESSA), passed in 2015
   - Along with replacing the No Child Left Behind Act, ESSA demands that a center be created to focus on issues that children with disabilities face.
6. Research Excellence and Advancements for Dyslexia Act (READ), passed in 2016
   - Asks the NSF to provide funding for researching the science of learning disabilities.

While the six federal laws stated above aren’t a direct obstacle to the pilot program outlined in this paper, the NCLD suggests that “these laws have not been adequately funded” [1, p.1]. To make the problem worse, “In 2016, the federal government covered 16% of the extra cost of special education far below the 40% that Congress promised to fund, leaving states to grapple with this multibillion-dollar shortfall.” [1, p. 1]. The lack of funding by the federal government may potentially make it difficult to obtain funds necessary to fund this pilot program. If the Congress cannot deliver on promised funds, the difficulty in obtaining funds may come in the form of a lack of applicable grants or initiatives. Advocacy and marketing for the pilot program outlined in this paper will increase awareness and help overcome social stigma.

1.2.2 The Bigger Picture

The pilot program outlined in this paper is projected to continue after the launch of the payload in August of 2018. It is intended that hopefully the first batch of students that take part in this pilot program transition to a STEM-related life after high school or college. It is hopeful that the biggest impact the pilot program will have on students with learning disabilities is boosting self-confidence and defeating cultural stigma. In a study done by the NCLD:

1. 24% of students with learning disabilities informed their college they have a learning disability
2. 7% did not inform their college even though they still considered themselves to have a learning disability
3. 69% did not inform their college because they no longer considered themselves to have a learning disability (even though people do not “grow out” of learning disabilities)

The above statistics were taken from a comprehensive study done by the NCLD [1, p. 5]. Lessons learned, and the metrics created as a part of this pilot program may lead to better skill-set categorizations and even an actual CUBESAT. The continued theme of the state of learning disabilities report published by NCLD has been that the stigma surrounding learning disabilities
has been the most significant factor in affecting employment or undertaking a degree at the undergraduate or graduate level. A study by the NCLD further suggests:

Lack of disclosure of disabilities and the stigma surrounding learning disabilities makes it harder to provide opportunities to those that have learning disabilities. The stigma leads to higher unemployment amongst individuals with learning disabilities and lower enrollment and completion rates in institutions of higher education. When it comes to disclosure of learning disabilities, job applications for various aerospace companies like KBRwyle, have a field for the declaration of disabilities. Applicants are encouraged to disclose their disabilities. The stigma surrounding learning disabilities may lead to lack of disclosure and may also lead the hiring manager to exclude such individuals from the hiring process. While it is illegal for employers to exclude someone from a job opportunity due to their disabilities; hiring managers could use lack of skills as an excuse to not hire individuals with learning disabilities. With a skills metrics and overcoming the stigma surrounding disabilities through boosting self-confidence, it would be harder to elude the solution.

Many universities and schools take part in various STEM programs administered by NASA. In 2012, elementary school students from St. Thomas More Cathedral School in Arlington, Virginia participated in building a small satellite called a CUBESAT. The name of the satellite was STM-1 [6]. In the STM-1 project, the nexus of institutions consisted of NASA Goddard Space Flight Center (GSFC) and the elementary school. STM-1 was launched as a part of NASA’s CubeSat Launch Initiative (CSLI) program with ride-sharing partners such as the Massachusetts Institute of Technology (MIT), the University of Michigan and the Johns Hopkins Applied Physics Lab [6]. It is unclear if STM-1 included students with learning disabilities. It is also unclear if the skills obtained in the STM-1 program were related to general skill-sets required in the aerospace field. The lack of clarity about the inclusion of students with learning disabilities may be the result of the stigma surrounding learning disabilities. The lack of disclosure of learning disabilities makes it harder to gauge if the STM-1 program reached out to students with learning disabilities. While NASA embraces the idea of STEM outreach, a pilot program that is focused on students with learning disabilities would prove to be vital for the career growth and empowerment of those with a learning disability. While it is encouraging to see that government agencies such as NASA promote hiring individuals with disabilities [7], a pipeline created around a hands-on technical program must be put in place so that individuals with learning disabilities can successfully enter a STEM-based job market.
2 The Solution

The Aerospace field is highly technical and encompasses various skills sets required to design, build, test, and launch a space-bound payload. Due to the dynamic nature of the aerospace field, aerospace-related projects for individuals with learning disabilities would provide a significant boost to their confidence and skill sets. The solution points towards starting projects that are technical and hands-on for individuals with learning disabilities. Starting such projects requires new policy, chronological step by step parameters, fixation of a geographical area, and a nexus of institutions. After interviewing teachers and parents of students with learning disabilities, a project designated explicitly for making a payload bound for space would be beneficial for students with learning disabilities. Due to the experimental nature of such a project, keeping the geographic location limited to the Maryland, Washington D.C., and Virginia area would allow for greater and centralized control over the project. The chosen geographic area has the necessary institutions required for initiating such a project.

2.1 Theory of Change

As a society, we often fail to realize how regularly we interact with space or space technologies. When we need to find an Uber ride, we use apps that use information from GPS satellites to geolocate the Uber driver. Uber is a transportation company and does not launch rockets or satellites, but it does integrate various space-based technologies as a part of its business practices. It is crucial to market the fact that anyone can be a part of the space program—private, academic, or government. When Apple, the technology company, launches a new iPhone, it markets the product by placing television ads and billboards. The theory of change here is to start a pilot program and to raise awareness of incorporating students with learning disabilities in the STEM fields. Experiments that fly into space are often well screened, and thus the marketing of such an experiment is straightforward. Credibility is automatically formed when spacefaring institutions recognize the flight by granting access to space. Furthermore, using social media to promote this pilot program will serve as an advertisement. The innovative approach taken here is to include students with learning disabilities in building a space-bound payload while directly stating the intentions, thus raising awareness.

2.2 The Pilot Program

The experiment involved in the pilot program is to be built by students with learning disabilities and will encompass programming a raspberry pi computer, soldering wires, mounting the raspberry pi camera unit onto the raspberry pi computer, and creating an algorithm that will allow the raspberry pi computer with a camera to take images of the Earth. For their payload, the students with learning disabilities will:

1. Name the experiment
2. Image the Earth in the visible spectrum at low resolution (this will determine the pointing of the payload)
3. Design the payload using computer-aided design (CAD) software
4. Build the payload using the materials purchased for the experiment:
   a. Raspberry Pi computer
   b. Raspberry Pi camera
   c. Wires
5. Integrate the payload with the team at CTU
6. Test the payload’s functionality
7. Test the payload as a system with the team at CTU
8. Retain images on a microSD card
9. Participate in all reviews required by the Colorado Space Grant Consortium (COSGC) and NASA WFF
10. Integrate and test the payload at NASA WFF with a team of students from CTU, NASA engineers, and other ROCKSAT-X participants.
11. Participate in the launch of the payload from NASA WFF

The experiment designed by students with learning disabilities will fly on the ROCKSAT-X 2018 program as a secondary payload to CTU’s primary payload. The engineering experiment called Project Janus, which is currently under development by a team of students at CTU, will mimic two CUBESATs flying in a cluster formation. Project Janus will “demonstrate the use of a laser ranging system to measure the speed of CubeSats within a constellation” [9].

2.2.1 The ROCKSAT-X Program

The ROCKSAT-X program was developed by the Colorado Space Grant Consortium (COSGC) to “provide hands-on experiences to students and faculty advisors to better equip them for supporting the future technical workforce needs of the United States and/or helping those students and faculty advisors become principal investigators on future NASA science missions” [5, p. 1]. The ROCKSAT-X program relies on a partnership with NASA’s Wallops Flight Facility (WFF) located in Wallops Island, Virginia. All of the experiments selected to fly on the ROCKSAT-X program, usually fly onboard NASA’s sounding rockets that can typically reach altitudes of 150-170 Km above the Earth’s atmosphere. Sounding rockets are launched into space for scientific purposes or engineering validations of specific payloads. Sounding rocket or sub-orbital flights are cheaper than orbital flight, and they typically collect scientific measurements at altitudes and velocities that are too low for satellites [8]. For engineering validation purposes, sounding rockets offer a harsh launch environment and access to the environment of space, i.e., the vacuum of space, and the radiation hazards of space. A one-year design, build, test, and launch cycle of the ROCKSAT-X program means that a group of students and faculty can quickly launch a payload into space without worrying about student turnover due to graduation or other factors. The ROCKSAT-X program is open to educational institutions only. Therefore it is the perfect launch platform for a pilot program that involves students with learning disabilities.

2.2.2 The Secondary Payload

There are three reviews that must be presented to the COSGC before the primary and secondary payloads outlined in the paper are accepted for flight in August of 2018 as a part of
ROCKSAT-X 2018. The three reviews include the Conceptual Design Review (CoDR), Preliminary Design Review (PDR), and the Critical Design Review (CDR). In the CODR the team only outlines the concept, wherein the PDR, the team, presents the first iteration of the payload design, and the CDR is the finalized version of the payload. The students of CTU have already presented the CoDR and the PDR. For the CDR, students with learning disabilities presented the review on the 4th of December 2017 jointly with the team of CTU students. The joint nature of the project means that students with learning disabilities are seen on an equal footing with their peers who do not have a learning disability. The joint nature and the equal footing of the program will automatically allow for a boost in confidence for students with learning disabilities.

The secondary payload designed by students with learning disabilities will take images of the earth. The mission of the secondary payload was decided by the students with learning disabilities. The team of students with learning disabilities decided to call their payload the “U2-Pi-Imager.” The inspiration behind the name came from the U2 spy plane. The term Pi comes from the type of computer used in the payload, the Raspberry Pi computer. The functionality of the payload was presented in the CDR. As required for the CDR, the team of students with learning disabilities designed a logo for their payload, created a PowerPoint presentation, drafted a mission statement, identified the functionality of their software, created a software flow diagram, created a payload outline using a Computer Aided Design (CAD) software, integrated their PowerPoint with team Janus’s CDR slides as section seven of the overall CDR, and demonstrated public speaking skills.

Figure 2-1 CDR Diagrams [9]

Figure 2-1, shows where on the payload deck team Janus of CTU plans to integrate the experiment designed by students with learning disabilities. Team Janus at CTU has been tasked with developing the necessary power circuitry required for providing power to all experiments on the base plate. Team Janus plans to investigate if lasers can be used for tracking orbital debris and for formation flying of future CUBESATs. The overall goal of the experiment developed by team Janus is to provide a trade study that leads to the development of using a cold gas propulsion
system for maneuvering out of the way of on-coming orbital debris. Project Janus will eventually spin-off into creating a self-defense mechanism for the spacecraft. Orbital debris larger than three millimeters can pose a severe threat to a satellite. How does being a part of team Janus help students with learning disabilities? The answer is simple: since their project encapsulates taking pictures, the data provided by their experiment could potentially be used as visual evidence of the functionality of Project Janus. The camera unit built by students with learning disabilities will be integrated as the primary camera unit so that images of both the Earth and the payload itself are captured and retained. When it comes to the bigger picture, including students with learning disabilities on a project that tries to measure distances between two satellites, further helps the notion that students with learning disabilities can participate in complex projects. The fabrication process will not start until the concept behind this pilot program has been accepted by COSGC for flight in August 2018.

The collaborative atmosphere of the project will serve as a confidence booster by providing positive reinforcement. By demonstrating the fact that students with learning disabilities can work on an equal plane with students without disabilities will help overcome the stigma surrounding learning disabilities. Being seen on an equal plane is crucial to boosting confidence. Even though the entire ROCKSAT-X 2018 sounding rocket flight will last only fifteen minutes, the learning experiences obtained leading up to, during, and after the flight will be crucial in further developing and solidifying this pilot program. The actual fabrication of the payload by students with learning disabilities will be a boost to their self-confidence.

2.3 The Coalition and Institutional Nexus

As of October 16th, 2017, the pilot program to encourage and support students with learning disabilities has been launched. A coalition has been forged, and this section will focus the role of each party involved. The immediate coalition includes the following parties:

1. Dr. Levinger of the George Washington University (GWU)
2. Rishabh Maharaja, an Aerospace Technologist and a mentor of CTU’s Project Janus.
3. Dimitra Neonakis, a teacher with 25 years of experience involving working with students with learning disabilities.
4. A team of students with learning disabilities that are handpicked by Dimitra Neonakis:
   a. Logan Reardanez
   b. Ethan Shipler
   c. Kat Moore
   d. Nick Cabral
   e. Meredith Dean
5. Capitol Technology University (CTU)
6. Students involved in Project Janus
The role of actors and institutions listed above will determine the initial development phase of the pilot program. Dr. Levinger of GWU initially approved the use of the pilot program outlined in this paper as a project thesis for a lateral leadership project. Initiation of the project has implications outside of engineering, and so the approval of such project is a crucial first step and provides a motive for change. All of the aerospace technologist and engineering professionals involved in the pilot program will oversee the technological integration and the systems engineering process behind the primary payload (Project Janus) and the secondary payload (U2-Pi-Imager). All of the engineering professionals will also assist in writing the necessary grants involved for both the primary and secondary payloads. All of the students with learning disabilities will participate in fabricating, designing, testing, and integrating the secondary payload with the primary payload.

Ms. Neonakis who currently teaches at the Anne Arundel Community College (AACC), will directly work with students that are involved in this project, and will further assist with formulating a plan to recruit more students with learning disabilities into this project. Ms. Neonakis will develop a chain of command within her team of students and will bifurcate the tasks associated with this project to particular students that can attempt the work. CTU will write a grant to obtain a berth on ROCKSAT-X, and the Colorado Space Grant Consortium will host a series of reviews that are necessary to test the readiness and launch worthiness of both the primary and secondary payloads. The students of CTU, led by Josiah Hall (the student leader of Project Janus) will work closely with Ms. Neonakis in making sure that the secondary payload is on track and compatible with the systems designed by the students of CTU. The pilot program outlined in this paper is unique in that it designates a part of a rocket flight deck for students with learning disabilities. Because a program like this has never been attempted before, small steps that turn into giant leaps are necessary. The program will intentionally start off as a secondary payload to a primary payload. By being a secondary payload, initial lessons learned obtained from this experience will be applied to future programs. Due to lower costs, the secondary nature of the payload also makes it easier to obtain funds necessary for launch.

2.3.1 Resources Required
The resources required for this project are broken down into three categories as follows: technological, human capital, and travel-related expenses. For the Primary Payload (Project Janus), CTU will pay for all of the necessary technical equipment and the launch costs required for the project. The money for CTU’s primary payload and the launch cost of both the primary and secondary payloads will come from the Maryland Space Grant Consortium. CTU’s financial breakdown requirements are $15,000 for launch, $8000 for travel, lodging, meals, and $2000 for the technological parts required for the fabrication of the payload. Since the secondary payload will fly with Project Janus of CTU, the launch costs will be provided for. To help the students with disabilities build their payload, an additional amount of $8000 to fund travel, equipment, and meal costs will be requested via grants or through private funds. Additional resources such as facilities for payload design, fabrication, and testing will be provided by CTU. Expenses related to the
equipment for the secondary payload is the least expensive element of the entire pilot program. Parts including the raspberry pi computer, camera, yoga mats, and altoid cans cost $60. Team Hermes of CTU, launched a communication payload on ROCKSAT-X 2017 that flew altoid cans and yoga mats to protect the raspberry pi computer from vibration [11].

2.3.2 The Metrics

KBRwyle hires people in over 457 different professions ranging from accountants to Television Producers to Engineers to Proposal Writers to Word Processors. A wide array of skills are required in the space industry. The table below is an evolving metrics that lists the required skills for the project and if the students are interested in those skills, and if they have attempted the required skills. The listed twelve skills are the minimum set of skills utilized for designing, building, and testing the secondary payload. The skills metrics attempts to outline the interests of each student and the exposure to those interests as a part of the project. The pending items in the table below are a set of skills that the students have yet to be introduced to as a part of the project. The table below will be updated as each student completes the skills of interest to them.

<table>
<thead>
<tr>
<th>Skills</th>
<th>Logan Reardanez</th>
<th>Ethan Shipler</th>
<th>Kat Moore</th>
<th>Nick Cabral</th>
<th>Meredith Dean</th>
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<tbody>
<tr>
<td>CAD Design</td>
<td>Yes</td>
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<td>Yes</td>
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<tr>
<td>Fabrication</td>
<td>Pending</td>
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<td>Graphic Design</td>
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<td>Yes</td>
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<tr>
<td>Problem Solving</td>
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<td>Soldering</td>
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</tr>
</tbody>
</table>

Figure 2-2 Skills Metrics

Since this pilot program will be an iterative process, a more fine-tuned version of the two metrics will not be ready until a final post-launch report is written in September 2018. The metric will be accredited to the coalition formed for this project. Each actor of the forged coalition listed above will contribute directly or indirectly to the formation of the metrics. Each actor involved in this project brings a different background and set of skills that are necessary to form the metrics. Once again, the space field is very diverse, and a broad array of skill-sets are required for all space-related projects.
3 Leadership Challenges

The primary assessment of the coalition and the strategy of the pilot program depends on how all of the mentors and teachers involved in the pilot program, ensure that students with learning disabilities are respected and properly guided through the program. The coalition must advertise their work as much as possible. The marketing element is crucial for this pilot program to succeed. The goal is not only to provide an excellent opportunity to those that don’t have access to such opportunities, but the results of the program are only worthwhile if there is a sustained path forward. The coalition listed in section 2 is expected to grow as the project continues to progress forward. The end goal of the pilot program is to start a Non-Profit Organization that exclusively provides aerospace-based opportunities to students with learning disabilities.

3.1 Possible Obstructions

Since the launch of the pilot program on the 16th of October 2017, no major obstructions have halted the advancement of the pilot program. A team of students involved successfully presented all the necessary reviews to the Colorado Space Grant Consortium (COSGC). The presentations were well liked by the COSGC, and no comments were made about the secondary payload. Only positive feedback was received for the pilot program. As the pilot program advances, the coalition of actors and institutions will have to grow. In the future, the following institutions will have to be engaged:

1. The Maryland Space Grant Consortium (MDSGC) for funding the development costs of both the primary and secondary payloads, launch costs associated with ROCKSAT-X, travel, lodging, and meal costs associated with ROCKSAT-X 2018.
2. The HR department at KBRwyle will be approached to provide feedback on the metrics outlined in section 2 of the paper.
3. NASA’s Education Office
   • Engagement required to spread awareness of the program.

The biggest challenge seems to be in overcoming the economic obstacle. Even though CTU will be paying for the seat on the rocket through a grant from the MDSGC, a grant still must be written to allow for the work to start on the secondary payload involving students with learning disabilities. If MDSGC is low on funds, there is a real possibility that students with learning disabilities may not have sufficient funds for travel and lodging required for the ROCKSAT-X program. Institutions such as the National Science Foundation (NSF) will be considered as a possible source of funding if the funding is rejected by the MDSGC. All of the technologists involved in this project will provide funding for all of the necessary equipment required for the fabrication of the payload that will be built by students with learning disabilities and will donate all necessary labor hours. In order to obtain the necessary funds, the coalition must market and advertise its work to as many institutions as possible. Even individual donations will assist with obtaining the necessary funds.
The second obstruction may come from obtaining the necessary permissions required to review and share HR policies. Typically, companies will not divulge proprietary policy information, and such documents cannot be shared without permission. To nullify the lack of a grant to view and share the HR policies, federal laws listed in section one of this paper, give a relative idea of the necessary HR policies. In short, accommodations must be provided for to those that disclose their learning disabilities. The HR department in a company is crucial to this project because it can serve as the bridge between feedback on skills demonstrated in the program and the actual job requirements necessary for employment.

3.2 Alternative Courses of Action

If the berth on the ROCKSAT-X 2018 flight is denied, the alternatives range from continuing the project or reaching out to the private industry. The flight on the ROCKSAT-X 2018 program could be declined if the space on the rocket is inadequate. Should the flight opportunity be denied, a private launch opportunity will be sought after. UP-Aerospace, a private company, based out of Colorado, USA provides sounding rocket flight opportunities for the private industry, the government, and educational institutions. The price of flight via UP-Aerospace ranges from $10,000-$25,000 or more depending on the nature of the experiment and the section of the rocket selected for flight. Even if the flight on ROCKSAT-X 2018 is rejected, the students could continue to build the payload as if they were launching it in August 2018. The fabrication process itself will allow students with learning disabilities to add a repertoire of skills to the ones already listed in the metrics shown in section 2.3. Since the ROCKSAT-X program is held every year, an attempt at qualifying for the ROCKSAT-X program can be made every year. A lack of berth on the ROCKSAT-X rocket is hardly a reason to stop the growth of the pilot program. Launch opportunities are abundant, and so the launch of the payload is imminent for the 2018-2020 timeframe.

3.3 The Skills Challenge

As an aerospace firm, KBRwyle employs individuals in over 457 different professions. The large array of professions proves the fact that the aerospace field is not just limited to aerospace engineers. Due to the broadness of the aerospace field, the pilot program must provide a broad array of skill sets. In order to provide a broad array of skills, the pilot program must include individuals with several types of learning disabilities. It would be nearly impossible to create a skills metric that addresses all 457 different professions. The pilot program addressed in this paper will have to incorporate a broader array of skill sets and must evolve as time progresses. As the program grows, it should actively recruit a diverse set of professionals to join the program. The ROCKSAT-X program allows for the inclusion of various professions. As mentioned, the launch cost is $15,000, and the supplies and travel costs add an extra $8000, with a total cost of approximately $23,000. An accountant or finance manager skills are required to manage all of the finances and to ensure that the finances stay on track. In generic terms, below are a set of matrices that relate skills to a job category:
The metrics above relates four non-aerospace engineering based professions to the ROCKSAT-X program outlined in the paper. All the Yes columns in red, indicate that the skills need to be developed for the pilot program. The goal of the above metric is to depict that working in the aerospace industry does not just required engineers. Therefore, for the pilot program to address various professions in the aerospace industry, a broad array of students with various learning disabilities need to be included. A feedback loop needs to be created so that employers can continually comment and add to the skill-set metrics. The skill-set metric will grow as time progresses. The only way to make that possible is to have various aerospace companies be a part of the pilot program of this sort. The private industry can then request skills necessary for the students.

3.3.1 Assessment of the Coalition

Due to the temporary limitation of the geographical area and scope of the pilot program, the coalition formed for this program is adequate for carrying the program towards its goal of a space launch. The coalition has already completed the required reviews, found the funding for launch, and designed a payload. The coalition within its boundaries of the pilot program, must eradicate all stigma surrounding learning disabilities and enforce an equal playing field for all students. The social challenge here is that of making students with learning disabilities feel inclusive. The overall social impact of this program is positive in that it challenges the notion that students with learning disabilities are unintelligent. As mentioned in section one of this paper, government funding is usually promised but rarely delivered. The coalition must share the results of the pilot program with various government agencies to spread awareness. This pilot program
allows students with learning disabilities to disclose the fact that they have a learning disability, overcome stigma, build confidence, and have a better shot at finding employment in STEM-related fields. For the coalition and the pilot program to grow, the following needs to happen:

1. Spread awareness
   a. Recruit more students with learning disabilities by reaching out to family and friends, or schools, or colleges and universities.
2. Find a revenue stream
   a. Obtain funds from the private industry or the government or individuals
3. Recruit volunteers
   a. Due to the broadness of the aerospace fields, professionals from various fields can add to the skill-set metrics
   b. A broad array of professionals helps students with learning disabilities realize the fact that career choices are limitless in the STEM fields.
4. Think big
   a. Start a Non-profit organization that caters to students with learning disabilities. With incorporating skills from 457 different professions and the vastness of skills involved can highly benefit the students involved in the program.
   b. Obtain funding for the Non-profit from government bases grants and or private funding.

3.4 The Verdict (Conclusion)

Since the dawn of humanity, we have looked up to the heavens and have been fascinated with space. Early humans developed astrology to determine and understand orbits of various celestial bodies. Space is a field that fascinates many; as such it is a powerful motivator for students with learning differences. Spreading awareness and marketing the initiative is crucial in overcoming the political, cultural, and economic obstacles that surround this pilot program. The real challenge will be in continually developing a metric of success. After a successful launch of the payload, would companies genuinely hire students with learning disabilities? Further conversations with aerospace companies must be initiated. Each institution would have Human Resource (HR) policies regarding individuals with learning disabilities. Various other aerospace companies such as Boeing will be approached to further aid with the development of skills.

The real value of the space-bound payload program can only be judged if the skill sets developed, match the desired skills required by various employers. The pilot program combines rocket science and learning disabilities. Hopefully, a pilot program such as the one outlined in this paper will eventually lead to a non-profit organization that exclusively caters to providing students with learning disabilities an opportunity to grow in the STEM fields, by obtaining a STEM-related degree and finding a STEM-related job. The winning combination of rocket science and learning disabilities will surely defeat the notion that somehow those with a learning disability are unintelligent.
4 Appendix

4.1.1 Chronological approach to building the payload

NASA typically uses Standard Operating Procedures (SOPs) to define a method to solve a problem. Involvement in this project will require a new policy and a chronological approach. The policy will be to start a pilot program where students with disabilities would participate in a program that leads to building a payload bound for space. The payload can be an engineering or scientific experiment. The pilot program would be like a closed loop system, where feedback is necessary. The SOP based approach would be as follows:

1. Reach out to family, friends, co-workers, social media, and other mediums, to locate parents who may have a child or children with a learning disability or disabilities.
2. With the involvement of the parents and students, reach out to schools and educators who specifically teach students with learning disabilities.
   a. To continue further, understanding how children with disabilities learn is an essential step.
   i. Based on the learning habits of these students, formulate a project and determine how it would be beneficial for them.
3. Once an experiment is developed, fill out an intent to fly form (IFF) for the ROCKSAT-X program.
   a. Filling out an IFF will reserve a seat on ROCKSAT’s sounding rocket. The experiment will be chosen if it survives the gauntlet of reviews.
4. After reserving an opportunity for flight, write and submit a proposal to the MDSGC to obtain funding.
   a. If the MDSGC does not accept the proposal, contact the NASA education office or other sources such as the National Science Foundation for funding.
5. Upon approval of the proposal by the MDSGC, allow the students with learning disabilities to build the payload, with supervision from their teachers and an aerospace engineering consultant.
6. Contact NASA’s education office to discuss the program and its outcomes as the payload is being built.
7. With a complete payload, mate the experiment with NASA’s sounding rocket and launch!
8. Measure the success of the pilot program and determine how the students with learning disabilities benefited from the program.

The outlined eight-step process above is a closed loop system. The set of skills obtained would in-turn allow a student with learning disabilities to be more competitive in the job market, thus making it easier for them to find a job.
4.2 Acronyms

AACC Anne Arundel Community College
ADHD Attention-deficit/hyperactivity Disorder
CAD Computer-Aided Design
CDR Critical Design Review
CODR Conceptual Design Review
COSGC Colorado Space Grant Consortium
CSLI CubeSat Launch Initiative
CTU Capitol Technology University
GSFC Goddard Space Flight Center
GWU George Washington University
HR Human Resources
IFF Intent to Fly Form
MDSGC Maryland Space Grant Consortium
MIT Massachusetts Institute of Technology
NASA National Aeronautics and Space Administration
NCLD National Center for Learning Disabilities
NSF National Science Foundation
PDR Preliminary Design Review
SOP Standard Operating Procedures
STEM Science, Technology, Engineering, and Math
USA United States of America
WFF Wallops Flight Facility

4.3 References


5 MIPP Lateral Leadership Project Review Form Fall 2017

Student Name: Rishabh Maharaja

Project Title: ENCOURAGING STUDENTS WITH LEARNING DISABILITIES TO BUILD A PAYLOAD BOUND FOR SPACE

Abstract (100-200 words):

The pilot program outlined in this paper is an attempt at helping students with learning disabilities design, build, test, and launch a payload into space. According to the National Center for Learning Disabilities, 1-in-5 children in the USA have a learning disability. Students with learning disabilities enroll in colleges and universities at half the rate of their peers, and only 41% of those enrolled, complete their degrees. Only 46% of adults with a learning disability are employed. The pilot program will allow students with learning disabilities develop a secondary payload to Capitol Technology University’s primary payload. Both the secondary and primary payloads will fly into space onboard a sounding rocket launched from NASA’s Wallops Flight Facility in Virginia. The overall goal of the program is to develop a metrics to compare skill sets learned with job requirements of highly technical careers in STEM-related fields. The program aims to help overcome the stigma surrounding learning disabilities and help boost confidence for the students involved.

5.1 Reviewer Name: Gary Kinnaman
Reviewer Title and Organization: GSMO-2 Space Science Project Deputy Project Manager, KBRwyle Technology Solutions, LLC

Please provide your candid remarks concerning the following aspects of this project:

1. Originality: To what extent does the paper present an original and creative approach to addressing an international policy challenge?

   Mr. Maharaja proposes an innovative approach to a challenge facing the international aerospace industry – recruiting and retaining talented professionals who demonstrate dedication to excellence and a work ethic necessary to sustain that excellence. This approach, which focuses on encouraging and including students with learning disabilities when building a payload for space, recognizes that the skills needed are not the exclusive domain of the so-called gifted and talented, but are present and available in a much broader audience, including those with learning disabilities. By drawing upon this larger pool of candidates, this approach, if properly implemented and supported, has the potential to provide space-oriented projects – whether for government/scientific, military, or commercial purposes – a wealth of talent that is more readily accessible and adaptable to each project’s specific requirements.
2. **Viability:** Does the paper outline a viable strategy for making progress toward implementing the project over the next several years?

   Within the constraints and boundaries identified by Mr. Maharaja (e.g., limiting the locus of activity to areas where there is a concentration of available talent, financial support, and institutional resources), the strategy is a viable one. The steps in Sections: 2.2, and 4.2.2 present a high-level, but achievable, roadmap to success. Certain aspects of this strategy, such as supports (both technical and psychosocial) tailored to the needs of those with learning disabilities, and opportunities for feedback throughout the process to refine and/or adjust the current approach – as well as to provide a better foundation for subsequent efforts – can be inferred but need to be more explicitly addressed in actual implementation.

   Implementation of this approach in regions where one (or more) of the critical elements mentioned above is either lacking or limited presents challenges that are not addressed in this proposal. Such considerations must be further examined and potential remedies identified if a broader reach is to be achieved.

3. **Potential Value:** If successfully implemented, what significant benefits might this project provide?

   The benefits of this project are several, some of which are cited in the project and this analysis – e.g., greater confidence and self-esteem, along with increased opportunities for meaningful employment, for learning-disabled individuals who successfully navigate the process; and a more diverse workforce with the potential to advance projects while meeting or exceeding cost/schedule/quality requirements. Institutions supporting such projects may also derive secondary benefits, such as a more favorable public perception both of their work as a whole and as a place to work, and could potentially use their support as a selling point when promoting further growth opportunities or pursuing wider market penetration. From a broader perspective, such inclusive efforts help to promote and strengthen elements of the social contract that underlies all great civilizations – elements that remind all of us that each of us has a role and purpose.

4. **Additional Comments** (optional):

   I wish to commend Mr. Maharaja for his initiative and insight in preparing this proposal. It recognizes and champions those who almost certainly would otherwise be overlooked when considering candidates for employment in space-related fields, and presents an embryonic solution to address it. By definition, repeated implementation will expand and refine this solution, with each iteration achieving more beneficial and more fruitful results. Powerful and lasting change often begins with a single person pursuing a seemingly small goal – Mr. Maharaja may be this person, and this project may be just the start….
5.2 **Reviewer Name: Dimitra Neonakis**  
**Reviewer Title and Organization:** Professor: Chemistry, Environmental Science, Biology  
**Specialist:** Special Education with a focus on STEAM education

Please provide your candid remarks concerning the following aspects of this project:

1. **Originality:** To what extent does the paper present an original and creative approach to addressing an international policy challenge?

   This project makes experiential learning in a highly technical field accessible to neurodiverse students. Using the expertise of a technical expert, special educator and peer mentors with past successes in space science and engineering this project presents rigorous challenges in a supportive framework. The project respects the unique neurology and insights of special needs students and guides them to realize a highly technical product with useful applications. The project includes realistic but challenging metrics and deadlines to help students achieve the best possible result.

2. **Viability:** Does the paper outline a viable strategy for making progress toward implementing the project over the next several years?

   As this project draws on the skill sets of experts in engineering, space science and special education students are provided supportive scaffolding to realize their ideas. Peer mentors give students age appropriate role models and realistic and achievable goals. Students are guided to collaborate and bring the unique strengths and perspectives to bear on the project. Deadlines are realistic and firm. Students are provided rubrics to guide achievement at each step along the path from brainstorming, to concept to prototype to build to test to flight. Recently students successfully completed a rigorous Critical Design Review for the Rocksat program.

3. **Potential Value:** If successfully implemented, what significant benefits might this project provide?

   This project opens doors to opportunities in STEAM education and employment that may not have previously been as accessible to neurodiverse populations. Successful continuation of this project will serve as a pilot project which sets a precedent that creates opportunities for more students in the future.

4. **Additional Comments** (optional): As a leader Rishabh has shown kindness and gentle guidance that students respond readily to. His guidance of special educator, neurodiverse and neurotypical students has been deft and effective. Rishabh shows a good balance between setting rigorous challenges, establishing concrete metrics and allowing members of the project at all levels to contribute fully, capitalizing on their strengths.