Overcoming Barriers To Physics: The Need For Targeted Educational Outreach For Nova Scotian Youth

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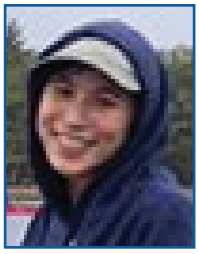

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Summary

Canadians identifying as Black, Indigenous and People of Colour (BIPOC) remain under-represented in STEM fields, particularly in physics. This article demonstrates the need for educational outreach programs geared toward marginalized youth in Nova Scotia, and the role that departments and graduate students can play in further developing existing outreach materials.

Canada is not exempt from a racist history. In Canada, Black and Indigenous communities have been subject to systemic and institutional racism, which has contributed to unequal access to education. These restrictions date back to the 1811 Education Act passed by the Nova Scotia Legislative Assembly, which established a direct financial barrier that excluded the majority of Black Canadians from access to public education [1]. The Indian Act, passed in 1867, ultimately led to the creation of government-funded Residential Schools designed to assimilate Indigenous children [1]. Educational policies today continue to determine the academic prospects of youth in Canada, particularly along the lines of race and class [2].

Under-represented minorities (URMs) continue to experience barriers to education today, as evidenced by comparative drop-out, suspension and graduation rates relative to the total population. Nova Scotia has many Black communities with histories that precede Canadian confederation, known as African Nova Scotian (ANS) communities [2]. A 1994 study by the Black Learners' Advisory Committee (BLAC) found that 60% of ANS youth had not graduated Grade 11 [2], and as recently as 2014, only 18% of those aged 25-64 years were reported to hold a university credential (compared to 22% of all Nova Scotians) [3]. Similarly, only 13.4% of Indigenous Canadians were reported to hold a university degree in 2015 (compared to 31.4% of non-Indigenous Canadians) [4]. These effects have been shown to contribute to higher rates of unemployment, and feelings of alienation and isolation among Black-African and Indigenous communities [4].

SURVEY OF TARGETED EDUCATION IN NOVA SCOTIA

Recent years have seen a growth in targeted education efforts aimed at reducing educational barriers faced by Black and Indigenous learners. We focus here on major resources and initiatives available in Nova Scotia; however, this discussion is not exhaustive.

In 1970, a Transition Year Program (TYP) was established in both Halifax and Toronto. At Dalhousie, the intention of the TYP was to provide ANS and Mi'kmaq students with the academic background and financial assistance needed to complete a university degree. The year it was established, only 35 ANS students had graduated from university [5]. In 1989, the Indigenous Blacks and Mi'kmaq Initiative (IB&M) was established with the aim of increasing ANS and Mi'kmaq representation in the Dalhousie Schulich School of Law. In addition to providing financial support to participating students, the IB&M initiative contributed to improved outreach and recruitment efforts as well as increased hiring and retention of participating graduates. Over 200 participants have graduated through the IB&M initiative, increasing Black and Mi'kmaq membership among the Nova Scotia Barrister's Society from 6 and 0 before the IB&M foundation, to 79 Black members and 64 Mi'kmaq members in 2019 [6].

Beyond the IB&M and TYP, there was an additional need for programs that increase Black and Indigenous representation among Science, Technology, Engineering and Mathematics (STEM). Dr. Kevin Hewitt recognized this deficiency, and in 1999 led a one-day workshop at Simon Fraser University. Along with Wayn Hamilton and Dr. Barb Hamilton-Hinch, he would later develop the Imhotep Legacy Academy (ILA) at Dalhousie University. Since the beginning of a pilot project at Caledonia junior high-school in 2003, the ILA has expanded into a provincial outreach initiative that strives to make STEM accessible to Black youth. The ILA offers (and continues to

develop) a combination of after-school programming, online activities, tutoring, mentorship and promise-scholarships to Black youth between grades 6-12. In 2019, the ILA reached over 1800 young learners, more than double its capacity in the previous year [7].

SHORT-COMINGS AND DEFICIENCIES IN CURRENT PROGRAMMING

Despite the growth in targeted education programs, Canadians identifying as Black, Indigenous and People of Colour (BIPOC) remain under-represented in Canadian universities, particularly in STEM fields. A 2015 "Report from the Committee on Aboriginal and Black/African Canadian Student Access and Retention" conducted at Dalhousie University, found that Indigenous and Black-African Canadian student enrollment remained disproportionately low compared with their representation in Canada. While Black-African and Indigenous Canadians each represent 4-5% of the total population in Canada, only 2% of Dalhousie students belonged to either of these populations [1]. In physics, Black-African and Indigenous representation is even lower [8]. The AIP National Task Force to Elevate African American Representation in Undergraduate Physics and Astronomy (TEAM-UP) undertook a two-year study to issue evidence-based recommendations for addressing the under-representation of Black-African students in physics and astronomy. The TEAM-UP report found that while the total number of physics bachelors degrees awarded by American universities had more than doubled in the last 20 years, the percentage of degrees awarded to Black-African students remained around 4% [8]. Similarly, the fraction of Indigenous bachelors degrees awarded remained below 1% [9].

The 2020 TEAM-UP report identified five factors to be influential in determining the success of Black-African students attending post-secondary education (PSE) for physics and astronomy: (1) sense of belonging, (2) a physics identity, (3) academic support, (4) personal and financial support, and (5) a supportive leadership structure [8]. Similar findings were also highlighted in the 2015 report conducted at Dalhousie University [1]. Specifically, student surveys and focus groups identified the following thematic barriers (among others) to PSE: (1) unawareness of scholarships and bursaries, (2) lack of centralized information sources, and (3) limited support and awareness in high school about university and funding opportunities [1].

OUTLINE OF THE ARTICLE

In this article we demonstrate the need for targeted outreach efforts that address these deficiencies and inspire under-represented young learners to pursue a career in STEM, with an emphasis on Physics. We begin with a structural examination of existing academic excellence programs and suggest a framework through which these can be modified to develop outreach initiatives that target marginalized BIPOC youth in Nova Scotia. We outline a pilot program to be implemented at Dalhousie University, and discuss its long-term benefits for under-represented youth, the academic community, and the province.

Summer camps as an outreach model:
It is widely understood through the success of STEM outreach programs like Shad Canada [10], and Dalhousie's SuperNOVA [11], that education is critical to empowering youth. Shad Canada is a national collaboration between academic institutions and communities, with the objective to diversify youth skillsets in STE(Arts)M and entrepreneurship [10]. The program is a month-long immersive experience on a university campus where grade 10-11 students are given opportunities to tackle real-life issues. Dalhousie's SuperNOVA has a similar objective delivered locally, however these week-long day camps are organized into specific disciplines and offered at a variety of levels between grades 1-12 [11]. While these programs have diversified their outreach initiatives, there may be additional barriers (*e.g.*, incidental costs, travel, etc.) that limit the accessibility of these programs to BIPOC youth. These programs allow prospective students to envision themselves on university campuses, one of the main tenants discussed in the TEAM-UP report [8]. To support these efforts, the physics community needs to be willing to offer their expertise to improve representation in academic departments, and more importantly, retention in fulfilling physics related careers. In physics we must demonstrate inclusion, open-mindedness, and be welcoming to all students. There is a belief that physics is "too difficult" or "only for specific people" [12]. It is imperative that these beliefs do not become barriers to entry for our field, dissuading prospective students. Having this kind of approach to recruitment will aim to address the physics-identity related aspect of the TEAM-UP report [8].

Interfacing with programs such as Shad Canada and SuperNOVA has the potential to expand the outreach of physics departments, specifically at Dalhousie. Here, we propose a short (3-5-day) research project based on a student's interest in STEM, in combination with current research at Dalhousie. We aim to give students the experience of working in a lab, understanding the necessary skill sets, and answering questions regarding pursuit of careers related to their research project. The goal would be to address the "academic support" aspect discussed in the TEAM-UP report.

PILOT PROJECT - BIPOC STEM RESEARCH PROJECT

28 BIPOC Nova Scotian students will be selected to participate in a summer research project from 7 different

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STEM labs at Dalhousie. Principal investigators (PI) and their (under)graduate students will choose/design a research project that can be performed by students in grade 11-12. Teams of 4 students will be allocated to each lab and supervised by Dalhousie (under)graduate students. Workdays will consist of students performing research tasks and preparing for a final conference style research symposium. At the end of the week students will communicate their scientific ideas to their peers, and to a panel of leaders in the field. The work that students perform for their research project and the symposium event will allow students to build peer and mentorship networks, which may facilitate their transition into an academic career. Nights will consist of community engagement exercises with youth advocacy groups, to bring forward the importance of giving back to the community. The goal here is to put STEM in a global community perspective.

In this format, we address the "supportive leadership structure" discussed in the TEAM-UP report, where the education is peer-based with support from the PI when needed. This differs from Shad and SuperNOVA programming in that we are specifically targeting BIPOC youth to empower them and address the real systemic differences in STEM, particularly concerning Black and Indigenous peoples in Canada. It should be noted that all faculty, supervisors, (under)graduate students and camp-counsellors, will be mandated to participate in anti-racist and cultural development training as an annual requirement to partake in this summer research camp.

To address the final aspect of the TEAM-UP report, we aim to fund this camp through external sources. First-stage planning efforts estimate between $7,500-10,000 in expenses for a 5-day research camp with 28 participants. These costs are based on camps with similar formats held at Dalhousie. We will be applying for external funding in the up-coming months to offer this program at no cost to participants, thereby addressing the financial barriers that may traditionally inhibit BIPOC students from attending these programs. This agrees with the Dalhousie Diversity of Nature initiative [13], a targeted experience led by women of colour, with a similar mandate.

DISCUSSION AND CONCLUSION

There are numerous potential benefits for targeted outreach in STEM fields. In this article we have discussed a pilot project at Dalhousie that applies outreach formatting that has been successful in the past. This is evidenced through Dalhousie's ILA, Shad Canada, and Dalhousie SuperNOVA programs. Enabling URM students to envision themselves in an academic setting has the potential to profoundly impact their sense of belonging and career choice. It is paramount that this benefits the student, but it inherently benefits the academic community as well. With more diverse representation in the physics community, we have better opportunities to empower a wider range of voices and perspectives. Discussed in the TEAM-UP report [8] is not only belonging but being able to identify with physics and strengthening this identity. Moreover, being able to clearly understand and articulate the importance of STEM research is important for the individual and the community.

Finally, it is important to ensure continuity of these types of outreach initiatives. Given the success that Shad Canada, and SuperNOVA have had, we are confident that effective collaboration can realize the desired continuity and community engagement. In conclusion, in effort to address systemic racism in STEM, specifically barriers to access in physics, we have detailed a pilot program that aims to empower BIPOC students through an intensive research project that will allow for skill development and networking opportunities. This program will be fully funded to address financial inequalities that may be faced with similar non-targeted youth outreach efforts.

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