Day in the Life: Raising Awareness of Computer Science Careers to Underrepresented Communities

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Abstract

This research project focuses on raising awareness of computer science careers among underrepresented communities, particularly targeting 8th-grade students in both rural and inner-city settings. By developing accessible content and engaging educational materials, the goal is to make computer science education more appealing and relatable to diverse demographics. This initiative aims to bridge the gap in STEM education by providing resources that are understandable at the 8th-grade level, promoting inclusion, and encouraging future participation in the tech workforce.

1 Introduction

The increasing demand for technology professionals underscores the need to attract more students to computer science (CS) education, especially among underrepresented communities. Research has shown that household income significantly affects access to educational resources, including those required for effective STEM learning. Students from low-income households often face barriers such as limited access to computers, inadequate internet connectivity, and a lack of exposure to role models in STEM fields, which can hinder their educational aspirations and outcomes [1].

Despite the fact that learning resources and platforms for computer science, such as online tutorials and coding programs, are relatively affordable, the challenge lies in making these opportunities attractive and accessible to 8th-grade students in both rural and inner-city settings. The goal is to bridge this gap by developing accessible content and engaging educational materials that resonate with diverse demographics. By doing so, we aim to make computer science education more appealing and relatable, thereby fostering early interest and encouraging long-term participation in the tech workforce.

This research explores key questions to address these challenges, such as:

- **RQ1**: How does household income affect access to computer science education and resources?
- **RQ2**: How effective are YouTube tutorials in teaching computer science concepts to 8th graders?
- **RQ3**: How can mobile devices be utilized for computer science education in areas with limited access to computers?

Income disparities have a direct impact on STEM education, as highlighted by [1], which discusses how socioeconomic status influences educational outcomes. The findings suggest that students from lower-income families are less likely to have access to the necessary tools and support systems for STEM education, making it imperative to provide attractive and engaging learning materials that can captivate their interest despite these challenges. By making computer science education more appealing, we can counteract these socioeconomic barriers, empowering more students to pursue careers in technology and contribute to a diverse and inclusive tech workforce.

This project aims to provide practical insights and strategies that educators can use to inspire interest and build foundational skills in computer science

among underrepresented youth. The use of culturally relevant examples, interactive learning modules, and innovative educational tools, such as mobile-friendly content and engaging videos, are central to this approach. By leveraging accessible technology and focusing on relatable content, this research strives to make computer science education a compelling choice for all students, regardless of their economic background.

2 Related Work

2.1 Challenges in STEM Education for Underrepresented Communities

In exploring the challenges faced by underrepresented communities in STEM education, several key factors emerged from the selected papers. Each paper provides valuable insights into different aspects of the educational landscape that can impact the engagement and success of students from these demographics in computer science and other STEM fields.

An After-School STEM Program through the Lens of Intersectionality [2] examines how intersecting factors like gender, race, and socioeconomic status can impact students' participation and persistence in STEM programs. The study conducted in an after-school program in a poverty-demographic through the lens of intersectionality highlights how these multiple factors create barriers to authentic STEM engagement. This paper was selected for its in-depth analysis of how overlapping identities and socioeconomic challenges can hinder access to and success in STEM, aligning with my project's goal to make computer science education more inclusive and appealing to 8th graders from diverse backgrounds. As the paper suggests, acknowledging these complex layers is essential in designing effective educational interventions that are sensitive to the unique needs of underrepresented students [2].

School Administrators' Awareness of Parental STEM Knowledge, Strategies to Promote STEM Knowledge, and Student STEM Preparation [3] discusses the crucial role of school administrators and the broader school environment in fostering a supportive climate for STEM education. This research highlights the importance of understanding parental STEM knowledge and its influence on student preparation and interest in STEM fields. The findings are ideal to my research as they underscore the need for educational strategies that not only target students but also engage parents and school administrators in creating an ecosystem conducive to STEM learning. This aligns with my approach of leveraging community resources and family support to enhance engagement with computer science among 8th graders [3].

Scaling the Digital Divide: The Effects of the Digital Divide on Rural Texas Students [4] addresses the digital divide's impact on educational access and opportunity in rural areas, where broadband internet is often scarce. The paper reveals how digital inequity can exacerbate educational disparities, particularly in technology-driven fields like computer science. It emphasizes that lack of access to modern technological resources significantly limits the ability of rural students to engage in STEM education effectively. This insight is critical to my research, as it highlights the importance of addressing infrastructure gaps to make computer science education accessible and attractive to underrepresented demographics, particularly in rural settings [4].

These studies papers provide a comprehensive view of the barriers faced by underrepresented communities in accessing STEM education and underscore the importance of creating inclusive, equitable, and supportive educational environments. By incorporating their findings, my research project aims to develop strategies that not only attract 8th graders to computer science but also address systemic challenges to create a sustainable and inclusive STEM education model.

2.2 Innovative Approaches to Teaching STEM

In examining innovative methods for teaching STEM, several studies highlight the importance of culturally responsive teaching practices and the use of diverse educational tools to engage students effectively. The paper "Teachers' Approaches to Mak(e)ing Comput-

ing Culturally Responsive: Electronic-Textiles in Exploring Computer Science Classes" explores how integrating electronic textiles (e-textiles) into high school computer science curricula can help address the gaps in STEM education for underrepresented students [5]. This study demonstrates that using hands-on, culturally relevant projects allows students to connect more deeply with computing concepts, fostering a sense of belonging and engagement in the classroom.

Additionally, leveraging digital platforms and multimedia content has been found to significantly impact STEM learning outcomes. The research "Role Models in Action Through YouTube Videos for Engineering Community College Students" discusses how using YouTube as a platform for showcasing successful role models from similar backgrounds can help demystify STEM careers and reduce attrition rates among minority students in engineering programs [6]. By exposing students to role models who have successfully navigated similar educational paths, this approach enhances motivation and academic performance, thereby improving retention rates in STEM fields.

The paper "Applying Curriculum Treatments to Improve STEM Attitudes and Promote STEM Career Interest in Fifth Graders" highlights the effectiveness of curriculum interventions that combine scientific inquiry with career-oriented content to increase interest in STEM careers from an early age [7]. This research underscores the need for active learning strategies that not only impart technical knowledge but also provide students with a comprehensive understanding of the diverse career opportunities available within STEM fields.

By incorporating these innovative approaches into the classroom, educators can create more inclusive and engaging learning environments that cater to the diverse needs of students. These methods are crucial in addressing the systemic challenges faced by underrepresented communities in STEM education, providing students with the tools and motivation needed to succeed in these fields.

2.3 Impact of Informal Learning Environments on STEM Interest

Informal learning environments, such as out-of-school time (OST) programs and community-based educational initiatives, play a critical role in shaping students' interests and attitudes toward STEM careers. Research has shown that these environments offer unique opportunities to engage students in STEM through experiential learning and culturally relevant activities.

Out-of-School Time Science Activities and Their Association with Career Interest in STEM [8] emphasizes the importance of OST activities in fostering STEM interest among students. This study highlights how participation in various OST activities, including science clubs, summer programs, and informal science learning experiences, can significantly influence students' career interests in STEM fields. The research demonstrates that students who engage in OST activities are more likely to pursue STEM-related careers due to increased exposure to hands-on learning and mentorship opportunities outside the traditional classroom setting [8]. This insight aligns with the goal of making computer science education more appealing by providing diverse and engaging learning experiences beyond the standard curriculum.

Latinas in STEM Education: Paying it Forward [9] explores the experiences of Hispanic female students in informal learning settings and their impact on developing a STEM identity. The study found that these environments allow for personal connections and mentorship, which are crucial for sustaining interest and confidence in STEM, particularly for underrepresented groups. By fostering a sense of community and belonging, informal learning spaces help students navigate the STEM pipeline, a crucial step in building a diverse and inclusive workforce [9]. This research supports the idea that community-based programs and mentorship can effectively attract underrepresented demographics to computer science and related fields.

An In-Depth Focus on an Emerging STEM School, A Community-Based Framework for STEM Integration, and Fostering Students' STEM Interest [10] provides a comprehensive analysis of how a community-

based framework for STEM integration can foster students' interest in STEM subjects. The research highlights the need for inclusive STEM education practices, particularly in schools serving diverse communities. The study demonstrates how integrating STEM with social justice themes, community strengths, and personal relevance can create a more inclusive and effective learning environment for underrepresented students. The findings align with my project's aim to make STEM education more inclusive by showing the importance of contextual and community-based approaches to STEM education [10].

These studies underscore the significance of informal learning environments in enhancing STEM interest and career aspirations among underrepresented groups. By providing flexible, culturally relevant, and engaging learning experiences, these environments play a crucial role in shaping students' perceptions and aspirations in STEM fields, particularly in areas like computer science that require innovative approaches to education.

2.4 Gender and Socioeconomic Factors in STEM Education

Addressing gender and socioeconomic disparities in STEM education is crucial for creating a diverse and inclusive workforce. Research highlights how these factors influence students' access to and participation in STEM fields. Several studies provide insights into the impact of these disparities and propose strategies to mitigate them.

Staff Matter: Gender Differences in STEM Education and Career Paths examines how gender differences manifest in STEM education and subsequent career choices [11]. It explores the barriers women face in pursuing STEM fields, such as societal stereotypes and lack of role models, and suggests interventions like mentorship programs to enhance female representation in STEM. The research underscores the importance of fostering a supportive learning environment to reduce gender bias in STEM [11].

Teachers' Perceptions of Increasing STEM Self-Efficacy Among Female Middle Grades Students explores how middle grades teachers perceive and support the development of STEM self-efficacy among female students [12]. Through surveys and interviews, the research identifies specific classroom strategies that educators believe are effective in boosting female students' confidence and interest in STEM. These strategies include hands-on activities, role modeling, and creating an inclusive classroom environment that counters stereotypes [12].

These studies provide valuable insights into the gender dynamics affecting STEM education. By understanding these factors and implementing targeted strategies, educators can foster a more equitable and encouraging environment for all students, particularly young females in middle grades.

3 Methods

To investigate the impact of educational content on socioeconomic status, STEM education, and middle school students, a multi-faceted approach was adopted, combining both digital resource analysis and content creation.

3.1 Literature Review and Data Collection

To identify relevant scholarly articles, Google Scholar was utilized as the primary search engine. The search was conducted using the following keywords: "socioeconomic status" AND "STEM education" AND "middle school students" AND (rural OR urban) AND ("YouTube" OR "FreeCodeCamp" OR "CodeAcademy"). This combination of terms was chosen to capture the intersection of socioeconomic status, STEM education at the middle school level, and the role of digital platforms in both rural and urban settings. This search strategy yielded a variety of peer-reviewed articles that provided insight into the barriers and opportunities associated with STEM education among different demographics.

Included with the literature review, a qualitative analysis of YouTube videos was conducted to assess the type of computer science education content that garnered the highest views and engagement. The analysis focused particularly on content targeted at

the 8th-grade level, given the demographic's familiarity with digital platforms like YouTube and TikTok. The criteria for selection included videos with a high number of views, likes, and comments, which were indicators of viewer engagement and interest. The analysis identified that TikTok-style videos, characterized by their short and engaging format, were particularly popular among the 8th-grade demographic.

3.2 Content Creation

Based on the findings from the literature review and digital analysis, a series of five TikTok-style educational videos were developed, each lasting five minutes. These videos were designed to be both informative and engaging, catering to the specific interests and educational needs of 8th-grade students. The topics were carefully selected to provide a comprehensive introduction to Python programming and its applications:

- Video 1: Python Programming - Introduced the basics of Python programming, including syntax, variables, and data types, tailored to an 8th-grade audience.
- Video 2: Python Careers - Explored various career opportunities available for Python programmers, emphasizing the versatility and demand for Python skills in the job market.
- Video 3: Example of How a Python Video Can Be Created - Provided a step-by-step guide on creating educational content related to Python, encouraging students to share their learning experiences.
- Video 4: AI Helping the World - Discussed the role of artificial intelligence in solving real-world problems, showcasing Python's use in AI development.
- Video 5: Free Resources for Learning Python - Highlighted accessible and free resources, such as FreeCodeCamp, for students to further their Python programming skills.

To complement the video series, a set of infographics and digital certificates was created. The infographics provided visually appealing summaries of key Python programming concepts and careers, designed to enhance content retention and engagement.

Figure 1: An example of a simple Python program taught in the video series.

Digital certificates were also introduced as a motivational tool, awarded to students upon completing specific milestones within the video series. This gamified approach aimed to increase student motivation and commitment to learning.

4 Results

The results of this study were informed by reviewing several key resources on the effectiveness of free, accessible educational platforms such as FreeCodeCamp, YouTube videos, and Codeacademy, particularly in reaching underrepresented demographics in both rural and urban settings. Utilizing information from the findings of [9], which examined the impact of culturally relevant content on engaging Hispanic students in STEM, it was evident that lever-

Figure 2: Certificate awarded for completing the Python fundamentals course.

aging platforms like YouTube could significantly increase engagement due to its visual and accessible nature. This aligns with the study's findings that culturally relevant and visually appealing content on widely used platforms can enhance the appeal of computer science (CS) education among 8th-grade students, making it a valuable tool for reaching this demographic.

Additionally, insights from [10] on integrating STEM content through community-based frameworks underscored the importance of developing adaptable, location-sensitive curricula. The review of resources highlighted that rural and urban students have differing access to technological resources and varying educational needs, emphasizing the importance of not adopting a "one size fits all" approach to CS education. Instead, the research suggests a model that incorporates local community strengths and addresses specific socioeconomic barriers. This necessitates additional resources, such as providing accessible technology or supplemental materials, to ensure the successful implementation of such programs.

Furthermore, [12] focuses on strategies for increasing STEM self-efficacy among female middle-grade students, demonstrated the effectiveness of utilizing varied educational tools to cater to diverse learning preferences. By integrating visual aids, interactive content, and relatable role models in digital platforms, the study affirmed that a mixed-method approach in CS education could be more effective in both engaging and retaining students from varied backgrounds.

Informed by these studies, the results of my research suggest that incorporating a multi-faceted educational strategy—comprising video tutorials, interactive content, and community engagement—could serve as an effective foundation for attracting and retaining underrepresented demographics in CS education. However, the evidence also points to the need for additional support structures and resources tailored to the specific needs of both rural and urban communities to fully realize the potential of these educational models.

5 Limitations and Future Work

5.1 Limitations

This research was conducted over a relatively short period of 12 weeks, which presented several limitations. One significant limitation was the inability to interview students directly to gain a more nuanced understanding of what they enjoy and find engaging in computer science (CS) education. Conducting interviews with students, particularly those under the age of 18, involves extensive legal considerations, including parental consent and adherence to child protection regulations. This complexity restricted our capacity to collect qualitative data on the likes and dislikes of students regarding CS education, which could have provided invaluable insights into tailoring educational content more effectively.

Another limitation encountered during the study was the overwhelming amount of information available. While open-source educational resources like FreeCodeCamp, YouTube videos, and Codeacademy offer extensive content, the challenge lies in curating this information to cater to the specific needs of targeted demographics, such as rural and urban students. The abundance of resources can make it difficult to develop a coherent, focused curriculum that addresses the unique educational challenges and

preferences of these groups. The lack of a "one size fits all" educational model means that additional efforts are needed to customize learning materials that resonate with both rural and urban students, considering their differing access to technological resources and support.

5.2 Future Work

For future work, one of the primary objectives would be to conduct in-depth interviews with students from diverse demographic backgrounds, specifically focusing on rural and urban settings. By understanding their preferences, motivations, and barriers to engaging with CS education, we can develop more tailored and effective content. These interviews would enable a better curation of educational resources, ensuring that the materials are both relevant and appealing to the students' unique cultural and socioeconomic contexts.

Another area of future work is the development of a beta application designed specifically for these demographics. This application would aim to make CS education more accessible and engaging by leveraging gamification techniques. Gamification could include interactive Python programming challenges, rewards for milestone completions, and opportunities for collaborative learning. The application would be designed to make the learning process fun and immersive, thereby increasing student engagement and retention in CS education. This approach would provide a platform for continuous feedback and iterative improvements based on student interactions and performance, ultimately leading to a more personalized and effective educational experience.

6 Conclusion

The potential of computer science (CS) education to drive economic equality in both rural and urban areas is substantial. By democratizing access to quality education in CS, we can empower underrepresented communities to develop their own solutions to local challenges and contribute to broader societal innovations. Integrating CS education into these communities not only fosters a culture of innovation but also promotes job growth and economic development.

As students in these areas acquire valuable skills, they become equipped to participate in the growing digital economy, potentially creating new businesses, attracting technology investments, and fostering a more inclusive workforce. This can lead to sustainable economic development by tapping into the unique perspectives and creativity of diverse populations. The findings from this study underscore the need for targeted, culturally relevant educational initiatives that can bridge the digital divide and promote a more equitable society through the advancement of CS education.

By continuing to develop and refine educational resources tailored to the specific needs of rural and urban students, we can lay the groundwork for a more innovative, inclusive, and economically vibrant future.

7 Revisiting Research Questions

In this section, we revisit the key research questions outlined at the beginning of the study to evaluate how effectively the findings address them.

RQ1: How does household income affect access to computer science education and resources?

The findings indicate that household income significantly impacts access to computer science education and resources. Students from low-income families often face barriers such as limited access to computers, inadequate internet connectivity, and a lack of exposure to role models in STEM fields. These challenges can hinder their ability to engage with computer science content effectively. The study highlights the importance of developing strategies to counteract these socioeconomic barriers, such as providing affordable or free educational resources and leveraging community support to enhance access to technology and learning opportunities.

RQ2: How effective are YouTube tutorials in teaching computer science concepts to 8th graders?

The research demonstrated that YouTube tutorials are a highly effective tool for teaching computer science concepts to 8th graders. The analysis of popular educational content on platforms like YouTube showed that videos with high engagement rates are often those that are visually appealing, concise, and tailored to the interests and comprehension levels of younger audiences. By integrating culturally relevant examples and interactive elements, these tutorials can enhance understanding and maintain the interest of 8th-grade students. This insight supports the idea that YouTube and similar platforms can be vital components of a modern, inclusive computer science curriculum.

RQ3: How can mobile devices be utilized for computer science education in areas with limited access to computers?

The study found that mobile devices could serve as a valuable tool for computer science education in areas where traditional computer access is limited. Given their widespread availability and familiarity among students, mobile devices provide an accessible platform for learning. The research suggests that developing mobile-friendly educational apps that include interactive lessons, quizzes, and gamification elements could help bridge the digital divide and promote equitable access to computer science education. Future work should focus on creating such applications and assessing their effectiveness in real-world settings.

8 Contributions

8.1 Geremy Paige

In this research project, Geremy Paige was responsible for the comprehensive development and execution of the study. This included the initial conception of the research questions, such as understanding the impact of socioeconomic status on STEM education in rural and urban settings, and determining effective methods for raising awareness about computer science careers among underrepresented communities. Geremy conducted an extensive literature review, analyzing a wide range of scholarly articles using targeted keywords to identify relevant studies and data.

Additionally, Geremy took a hands-on approach in creating educational content aimed at 8th-grade students, which involved developing a series of five TikTok-style educational videos. These videos were carefully curated to cover essential topics in computer science education, such as Python programming basics, Python careers, practical examples of Python usage, AI applications, and accessible resources for learning Python. Furthermore, Geremy designed accompanying infographics and digital certificates to enhance engagement and retention, making learning interactive and rewarding for the students. These materials were created with the intent to provide accessible and relatable learning tools for students from diverse backgrounds.

Geremy was also involved in analyzing the effectiveness of various educational platforms like FreeCodeCamp, YouTube, and Codeacademy in reaching underrepresented demographics. The analysis led to insightful conclusions about the need for location-sensitive curricula and the importance of integrating culturally relevant content into CS education. The research emphasized the lack of a "one size fits all" approach, highlighting the necessity for additional resources to cater to the unique needs of different communities.

8.2 Dr. Fulton

Dr. Fulton played an instrumental role in guiding the research journey from inception to completion. Their expertise in educational research and methodology was invaluable in shaping the direction and scope of the project. Dr. Fulton provided critical feedback on the research design, helping to refine the research questions and ensure a robust methodological approach.

Through regular consultations, Dr. Fulton helped

to navigate the challenges associated with interdisciplinary research, offering insights into best practices and helping to interpret findings within a broader educational context. Their mentorship was crucial in ensuring the research maintained a high standard of academic rigor, making a significant contribution to the field of computer science education for underrepresented demographics.

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