__Mind the Gap: Enhancing AI and STEM Accessibility in Rural Pennsylvania__

Vishwas Mruthyunjaya, Carnegie Mellon University Alumni, United States
Rachel Burcin, Carnegie Mellon University, United States
Catherine Evans, Carnegie Mellon University, United States
John M. Dolan, Carnegie Mellon University, United States

The IAFOR International Conference on Education in Hawaii 2024
Official Conference Proceedings

Abstract
As AI-powered tools like ChatGPT become more prevalent in various industries, it is important to develop a deeper understanding of how they work and their potential impact. There are many misconceptions about AI--often shaped by news and media, both positive and negative, which can lead to overreliance or mistrust. It is important to approach AI tools critically and understand their limitations and potential biases. As we prepare students for a future where AI plays a crucial role, it is vital for educators and policymakers to have a deep understanding of the implications and structures driving this technology. Additionally, academic understanding of computer science and AI is not always accessible to everyone, particularly those in rural areas. Research shows that rural students continue to be disproportionately underrepresented in STEM (Harris & Hodges, 2018). Persistent barriers to participation in STEM (i.e., access to resources, funding teachers, local implications & relevancy, outreach disparities) must be addressed to ensure equitable access to growing and in-demand jobs (Yettick et. al., 2014). Additional research is needed to understand how to address the interwoven and unique challenges that rural communities face. To ensure that we are preparing our future generations for success, we must work to increase accessibility and understanding of AI across all communities. This presentation discusses the outcomes of our community ChatGPT and AI workshop, teacher-centered AI educational materials, and student-facing classroom materials.

Keywords: Rural STEM, Rural Development, Collective Impact, Community Engagement, ChatGPT, Inclusive STEM Education, Social Constructionist, Barriers to STEM Participation, Appalachia, Natural Language Processing

Introduction

Research shows that rural students are significantly underrepresented in Science, Technology, Engineering & Mathematics (STEM) (Harris and Hogan, 2019; Saw and Agger 2021; and Postsecondary National Policy Institute, 2023). Yet, rural students account for approximately 30% of the public elementary and secondary education student population in the United States (National Center for Education Statistics [NCES], 2017). Students from rural areas face structural opportunities and barriers that shape their educational and occupational pathways, often tied to their geographic location (Agger et al., 2018; Hillman & Boland, 2019; Wells et al., 2019). Persistent barriers to participation in STEM for rural communities include limited access to resources, lower funding for teachers, perceived disconnection from local priorities, and outreach disparities. This must be addressed to ensure equitable access to growing and in-demand jobs for all geographic areas under-represented in STEM (Yettick et al., 2014).

Partnership Development Background & Approach: In 2019, Rachel Burcin began to build a series of partnerships in rural Pennsylvania with educators and leaders from communities underserved and underrepresented in STEM. The work led to the co-development of educator workshops, visits, and student experiences and culminated in shaping and launching the first rural STEM summit for Venango County, which Rachel co-chaired. Adjacent to the STEM summit was an opportunity to deepen and expand connections across the Carnegie Mellon University (CMU) community and collectively design and develop a rural educator workshop. Ultimately, the workshop team grew to include a wide range of expertise, backgrounds, and roles (e.g., from robotics & AI to English, social sciences, and psychology). The team came together to better understand our assets and demystify stereotypes about our respective communities. Because of a foundation of trust and engagement that Rachel and community members had built over the past 4 years and the high regard that both communities held each other, we were able to easily pivot the workshop themes to give center stage to topics, such as ChatGPT, that had burst onto the scene and were dominating US and global media headlines.

Figure 1: Adapted from Collective Impact Forum - Collective Impact

Collective Impact Principles of Practice: Putting Collective Impact into Action

1. Design and implement the initiative prioritizing equity, cultivating peer relationships, and understanding power dynamics.
2. Continually work towards a more equal structure.
3. Recruit and co-create with cross-sector partners.
4. Use data to continuously learn, adapt, and improve.
5. Identify leaders with unique place-based leadership and system leadership skills.
6. Focus on program and system strategies (but balance with addressing urgent concerns or fires).
7. Build a culture that fosters relationships, trust, and respect across participants.
8. Customize for local context.

Source: Kania & Kramer, 2011

Perhaps most importantly, we came together using a human-centered, asset-based approach drawn from social innovation and change theories (Kania & Kramer, 2011; Cooperrider & Whitney, 1999; Hammond, 2013; Neff, 2011). Appreciative inquiry is a philosophy and change process anchored by an asset-based approach (as opposed to traditional problem-solving and deficit approaches that label communities or individuals as broken, incomplete, or inadequate). The appreciative inquiry approach and growth mindset, coupled with motivation and methods, collectively create limitless possibilities (Kwik, 2023; Cooperrider, 1999). Here, we discussed teacher-centered AI educational materials, learned more about the challenges at the forefront of rural educators's minds, and began building out age-appropriate student-facing classroom materials.

Figure 2: Appreciative Inquiry change process adapted from Hammond, 2013 and Cooperrider & Whitney, 1999.

The Appreciative Inquiry Approach

- In every place (whether it be a school, organization, or community), something works.
- What we focus on is internalized and becomes our reality.
- The act of inquiry influences a community in some way (we are not neutral observers).
- Change is difficult, when the best parts of our traditions and history are acknowledged and carried forth in some manner, we become less fearful.
- It is important to value differences.
- Our language must be collective and intentional, as it shapes our future.

The following paper pairs rural educational data with an overview of the workshop's execution in Franklin, PA. Below, we offer a comparative analysis of Venango County and Pittsburgh (Allegheny County) data to introduce the specific conditions surrounding our rural collaboration, shed light on the barriers discussed in the referenced papers, and provide empirical confirmation through tangible quantitative insights.

Background and Motivation

The majority of innovative educational intervention research focuses mainly on urban barriers to higher education and may therefore exclude rural communities and engagement. (Fulkerson & Thomas 2016). For decades, rural has been defined by what it is not (urban) and from its distance to urban centers. This disregards the unique assets, contributions, and opportunities that rural communities hold. For example, the Census Bureau defines rural as any population, housing, or territory NOT in an urban area (Census). Rural spaces remain understudied and underserved and are at high risk for further exclusion from participating in the innovation economy and imagining and creating their own pathways. However, STEM education in rural areas is garnering increased attention due to significant disparities identified in the enrollment and preparation of students for postsecondary STEM degree programs. Several studies, including Saw and Anger's exploration (2021), have underscored the pronounced challenges rural and small-town students face. Notably, these students are considerably less likely to enroll in postsecondary STEM programs than their suburban counterparts. The limited access to advanced coursework, extracurricular STEM programs, and lower STEM teaching capacity in schools attended by rural students contribute to this gap.

Recognizing the importance of STEM education in producing a scientifically literate citizenry and addressing workforce demands, a focus on rural areas is vital. The introduction of programs like Project Engage (Rogers & Sun, 2019) signifies a proactive approach to overcoming the challenges faced by STEM education in rural areas. A shift in focus to acknowledge and engage rural students' potential enhances STEM opportunities and helps meet workforce needs.

The exploration of rural schools as nurturing grounds for academic talents, especially in STEM, is addressed in studies such as (Lakin, 2021). While rural schools offer substantial opportunities for cultivating academic talents, students with STEM potential face specific obstacles. The STEM Excellence and Leadership project aims to equip rural teachers with the necessary skills to recognize and foster STEM talent, acknowledging the unique challenges faced in rural educational settings.

Furthermore, the severe gap in access to STEM educational benefits for students in rural areas is a central theme in Rachel S. Harris and Charles B. Hodges' study (Harris & Hodges, 2018). The implications of funding disparities, lack of financial support affecting access to well-qualified teachers, and the need for education to apply to local conditions are crucial aspects highlighted. Importantly, the call for more research specifically addressing rural STEM education is echoed, emphasizing the necessity for comprehensive understanding and targeted solutions to bridge the existing gaps.

Without proper resources, access, and guidance, rural students will continue to be barred from contributing to STEM fields--workforce and education. This has profound significance for an already fractured society. Consider this:

- The technology sector is the largest and most valuable industry in the world, a position it has held for at least half a decade (Silicon Republic, 2016).
- The technology sector boasts high job growth. The US Bureau of Labor Statistics (BLS) reports that employment growth in computer and information technology occupations will outpace all other career categories in the next decade (U.S. Bureau of Labor Statistics, 2019).
- Technology sector salaries are among the highest. According to the BLS, the median annual wage for computing and tech is twice that of any other career category. BLS reported that in the computer and information technology occupations, the "median wage was $88,240 in May 2019" (U.S. Bureau of Labor Statistics, 2019; Burcin, 2023).

There is already a disparity between the STEM workforce and the larger workforce. Disparity continues to grow, at an accelerated rate, between the rural workforce and STEM workforce in general. In examining the population changes over the past two decades, Allegheny County, categorized as an urban area, and Venango County, identified as rural, present distinct trends that contribute to a nuanced understanding of the challenges discussed in earlier studies.

From Figures 3 and 4, Allegheny County experienced a notable population decline of -4.55% from 2000 to 2010, followed by a recovery with a positive growth of +2.23% from 2010 to

2020. This pattern suggests a level of urban resilience as the county rebounded from an initial decline, showcasing the dynamic nature of urban populations.

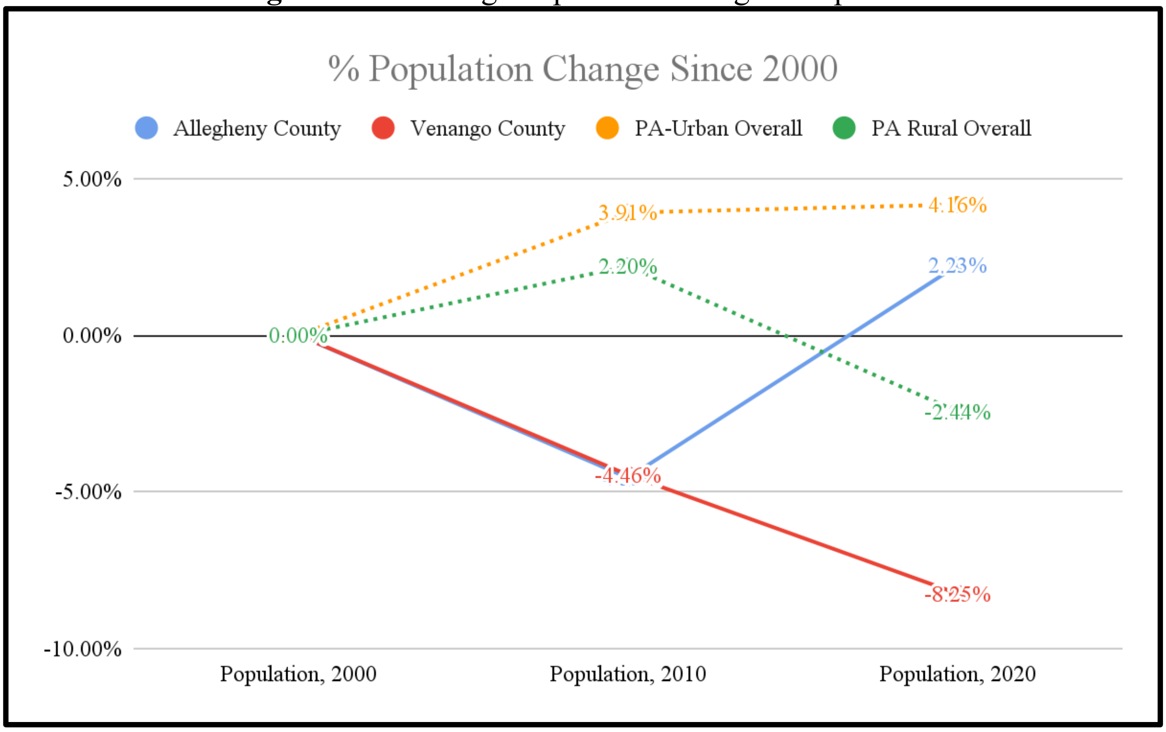
Conversely, Venango County, classified as rural, faced a continuous population decrease over the same periods. The decline was -4.46% from 2000 to 2010, intensifying to -8.25% from 2010 to 2020. This sustained negative growth highlights the challenges confronted by rural areas, potentially influenced by limited economic opportunities and educational resources.

Comparing the urban Allegheny with the rural Venango yields further insights. While Allegheny County, despite an initial decline, managed to recover, rural Venango exhibited a persistent negative trend. This dichotomy underscores the resilience of urban areas in attracting diverse populations and economic activities, contrasting with the challenges faced by rural communities.

Relating these population trends to the claims made in earlier studies reveals correlations. The declining population in rural Venango suggests challenges in providing advanced STEM coursework, aligning with the notion of limited access to educational resources in rural areas. Similarly, the negative population growth may indicate limitations in offering extracurricular STEM programs and lower availability of qualified STEM teachers, supporting prior research findings (figure 6).

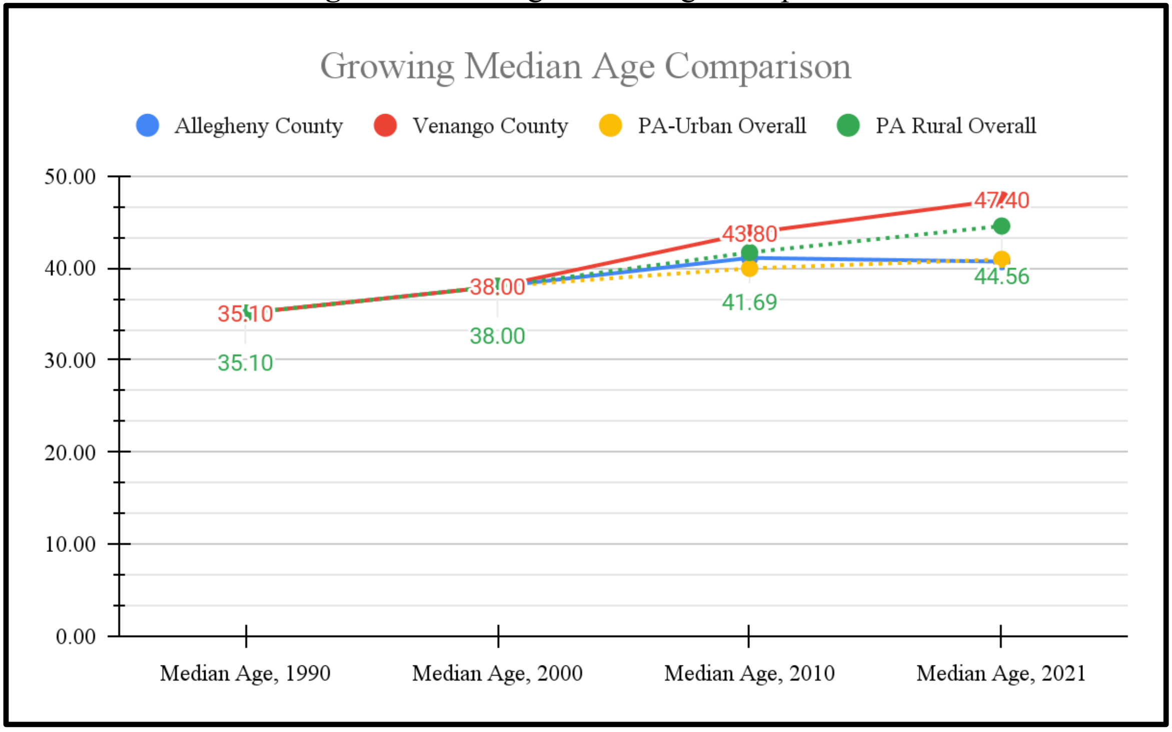
Furthermore, these demographic changes in Venango County may contribute to the challenges in postsecondary STEM enrollment (figure 5), reflecting the need for targeted interventions in rural areas. As urban areas like Allegheny showcase more resilience in population dynamics, policy efforts should consider tailored strategies for addressing STEM education disparities in declining rural populations.

Figure 3: Percentage Population Change Comparison



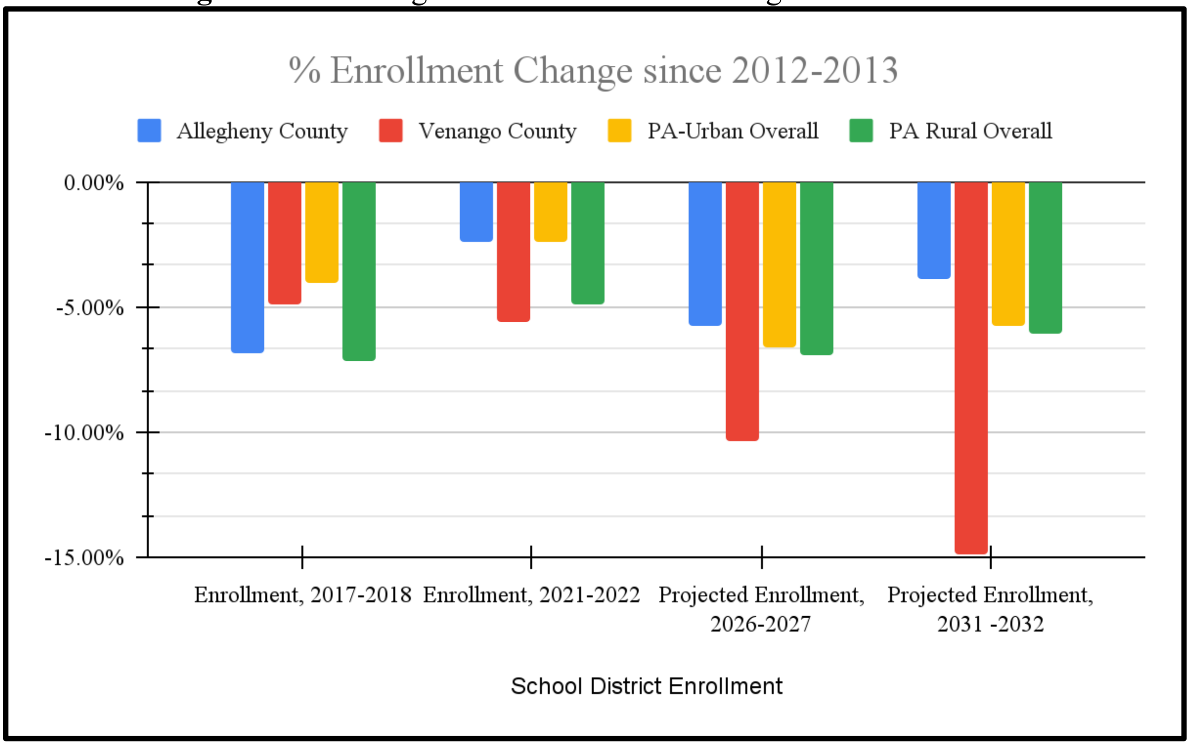
Note: Figure 3 is a comparative analysis of population changes in Allegheny County, Venango County, and overall urban and rural populations in Pennsylvania over three census periods (2000, 2010, and 2020). (US Census Bureau, 2023 and Center for Rural Pennsylvania, 2024)

Figure 4: Growing Median Age Comparison



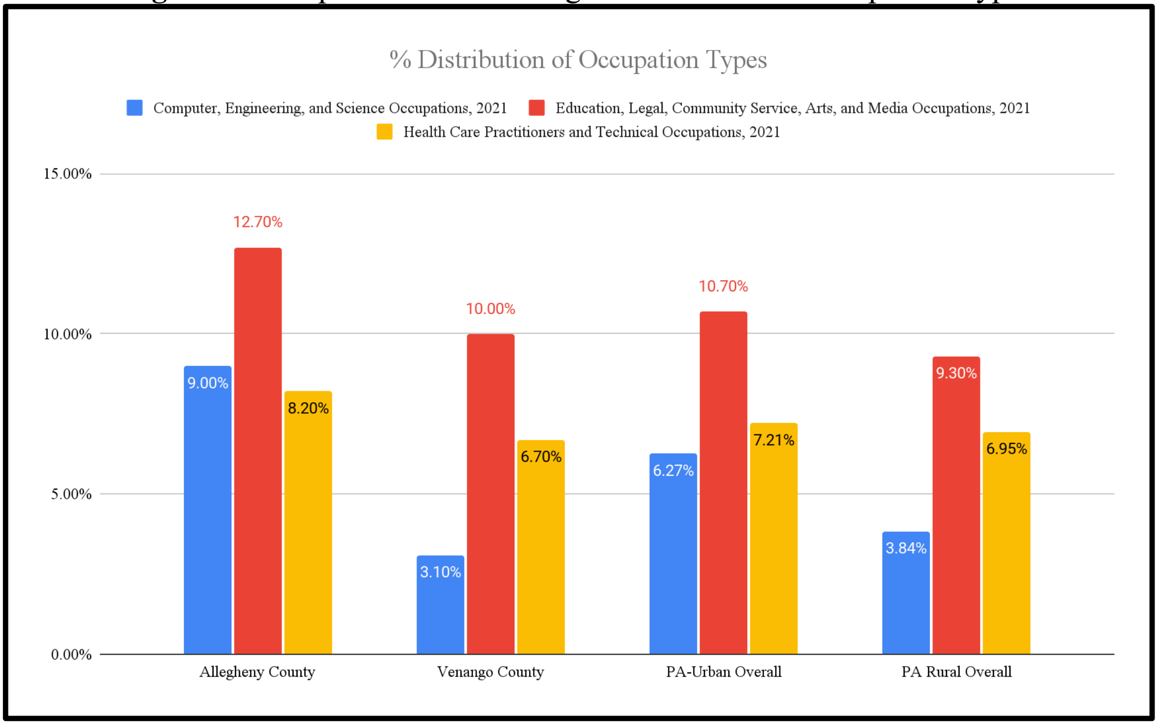
Note: Comparative analysis of median age changes in Allegheny County, Venango County, and overall urban and rural populations in Pennsylvania over four census periods (1990, 2000, 2010, and 2021). (US Census Bureau, 2023 and Center for Rural Pennsylvania, 2024)

Figure 5: Percentage School Enrollment Change Since 2012-2013



Note: Comparative analysis of school district enrollment changes in Allegheny County, Venango County, and overall urban and rural populations in Pennsylvania over several academic years (2017-2018, 2021-2022) and projected enrollments for future years (2026-2027, 2031-2032). (US Census Bureau, 2021a and Center for Rural PA, 2024)

Figure 6: Comparison of Percentage Distribution of Occupation Types



Note: Comparative analysis of occupational distribution in specific sectors within Allegheny County, Venango County, and overall urban and rural populations in Pennsylvania in the year 2021. (US Census Bureau, 2021b and Center for Rural Pennsylvania, 2024)

In summary, these data show the urgency of addressing the challenges faced by rural STEM education. Despite being so physically close, the rural community perception of Carnegie Mellon as "not for rural students" continues as R1, very high research activity designated universities according to the Carnegie Classification system, spaces overlook the rural communities in equity and justice initiatives. The limitations, disparities, and untapped potential in rural areas underscore the need for concerted efforts to make STEM education accessible, relevant, and equitable for all students, regardless of geographic location. This background is the foundation for our work and research, which focuses on enhancing AI and STEM accessibility in rural Pennsylvania, aiming to contribute to the broader discourse on inclusive STEM education. Rural access and inclusion are urgent to reverse widening gaps—rural matters.

Workshop Design, Onsite Curation, and Implementation

The workshop was held on June 12, 2023, in Franklin, PA, in collaboration with a local not-for-profit organization, the Innovation Institute for Tomorrow. Titled "PA Rural Educator Technology Workshops: Let's Explore Robotics & AI," the event brought together rural educators, administrators, and community leaders from across the region with Carnegie Mellon scholars and field experts. "Leveraging AI Tools for Learning: ChatGPT in the K-12 Classroom" was one of two delivered workshops, and specifically aimed to "equip K-12 educators from across fields with background information and vocabulary to enter into conversations on artificial intelligence (AI) and begin to effectively explore and incorporate AI tools, such as ChatGPT, into their own classrooms" ("PA Rural Educator Technology Workshops Program," 2023). This language was used in the marketing, program, and workshop itself. Our approach in piloting the workshop is built on research that shows through conducting a pilot study researchers will be "better informed and prepared to face the challenges that are likely to arise in the substantive study and more confident in the instruments to be used for data collection" (Malmqvist et al, 2019). The following provides an overview of the "Leveraging AI Tools for Learning" workshop in terms of development, content, and provided resources.

The "Leveraging AI Tools for Learning" workshop consisted of two main components: 1. Social and Cultural Integration with Technical Education: An Introduction to NLP/ChatGPT and 2. Shifting Technical Jargon into Transferable, Culturally Informed Vocabulary. Below, we elaborate on the key points of these two sections as implemented in Venango.

A) Social & Cultural Integration With Technical Education: Introduction to NLP/ChatGPT

The materials aimed at integrating social and cultural contexts with technical education, particularly focusing on rural Pennsylvania participants, to make AI education relatable. Emphasizing the societal relevance of AI, relevant examples were integrated to showcase its applications within familiar community contexts. The introduction commenced with a comprehensive overview of Natural Language Processing (NLP) and ChatGPT, aimed at demystifying core AI concepts. By simplifying complex technical details, this module provided a digestible understanding of NLP principles and the role of ChatGPT in language generation. Figures 7 and 8 were utilized to visually aid this introduction, with Figure 5 depicting the NLP application architecture and Figure 6 providing a breakdown of the NLP process from text to tokens.

Figure 7: Example of NLP Application Architecture

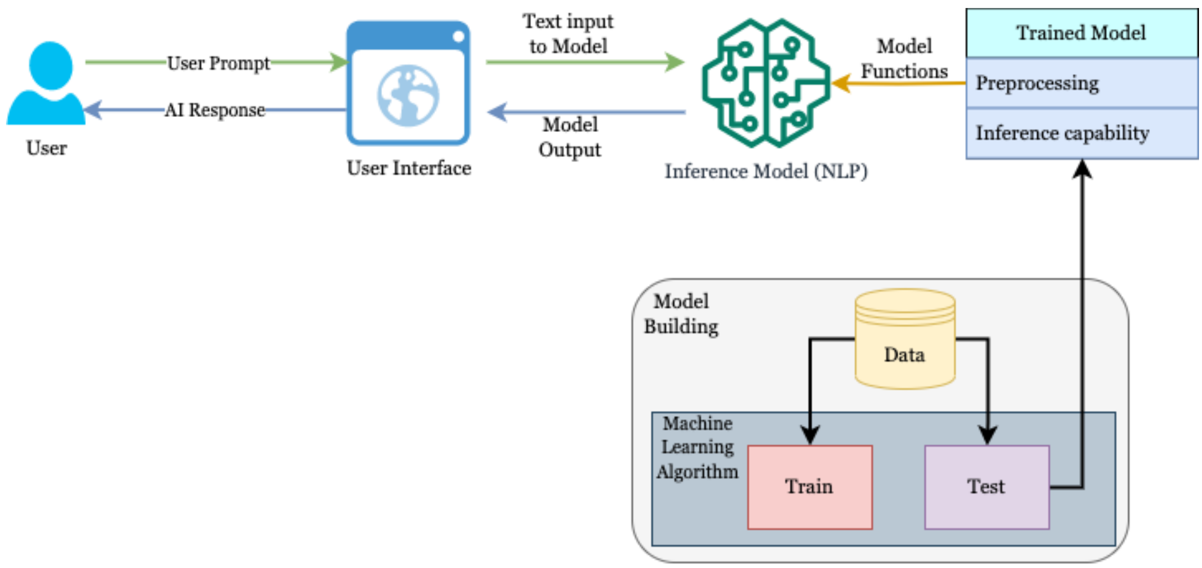
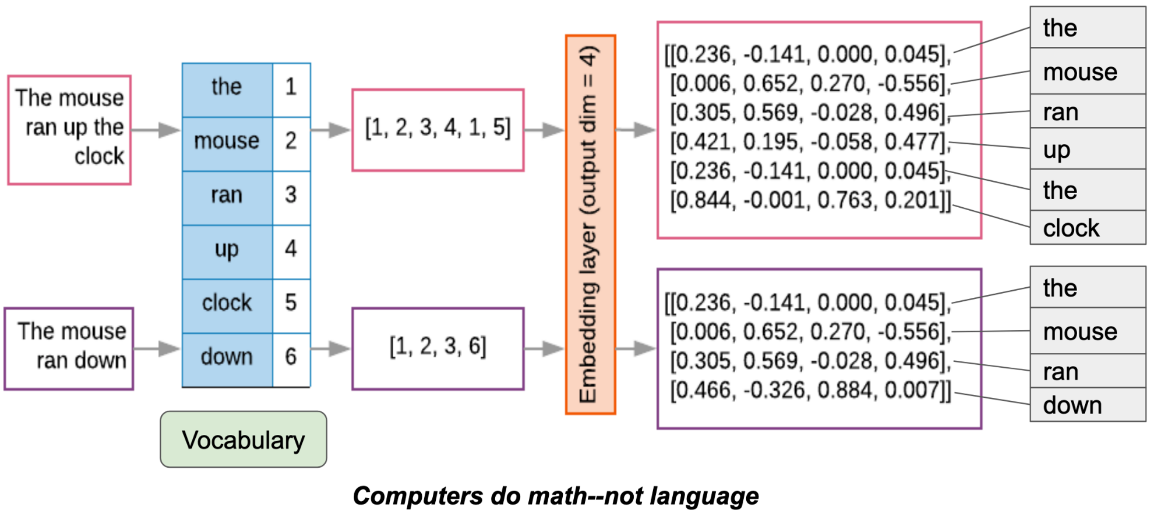


Figure 8: Example of Text to Tokens to Numerical Representation in NLP Models



B) Shifting Technical Jargon Into Transferable, Culturally Informed Vocabulary

A key aspect of the methodology involved reframing intricate technical jargon into transferable, culturally informed vocabulary (Scott, Nagy, and Flinspach, 2008). This process required a careful selection of words and terms that resonated with a diverse rural audience, including those without a technical background and those educators working across the K-12 space. Analogies, real-world examples, and relatable metaphors were incorporated to convey complex concepts in a manner that was easily comprehensible. For example, when discussing the types of texts ChatGPT is trained on, we distilled field research, such as "Language Models are Unsupervised Multitask Learners," (Radford et al., 2019) through digestible examples. This included a discussion of why ChatGPT is more knowledgeable about topics such as Miley Cyrus and *Lord of the Rings* than more obscure texts not accounted for in the learning set.

Table 1: Basic Definitions

Term	Definition
AI (Artificial Intelligence)	Decision-making capabilities in machines that traditionally required human intelligence.
NLP (Natural Language Processing)	Short for Natural Language Processing. It is a branch of AI centered around enabling machines/computers to understand text and spoken language.
Machine Learning (ML)	A branch of AI where algorithms work on identifying patterns in data by simulating human learning approaches.
Language Models	A type of statistical/ML model that possesses probability distribution over a sequence of words.
Conversation AI	Branch of AI and NLP that simulates human-human conversation between humans and machines.
GPT	Short for Generative Pre-trained Transformers. A type of language model.
Prompt	A command or an action sentence used to communicate with ChatGPT and other AI.
End-user	Humans interacting with the AI tool.

Note: Table 1 presents fundamental terms and their corresponding definitions in the field of artificial intelligence (AI) and natural language processing (NLP). These definitions serve as foundational knowledge for understanding key concepts related to machine intelligence and language understanding.

Table 2: Applications Definitions

Term	Definition
Text classification	A machine learning technique that categorizes a given text into a predefined class.
Sentiment analysis	NLP technique to identify the human emotion from a given text.
Translation	NLP technique to automatically translate a text from one language to another.
Question answering	Uses NLP techniques and information retrieval approaches to answer natural language questions by human users.

Note: Table 2 delineates essential terms and their respective definitions pertaining to applications of artificial intelligence (AI) and natural language processing (NLP). These definitions elucidate the practical implementations and functionalities of AI and NLP technologies in various domains.

Table 3: Terms in Natural Language Processing (NLP) Building Process

Term	Definition
Corpus	A collection of text, which can include various sources such as movie reviews, internet comments, or conversations between individuals.
Vocabulary	The entire set of terms used in a body of text.
Documents	Refers to a body of text, with examples including movie reviews or emails. A collection of documents make up a corpus.
Preprocessing	The initial step in any NLP task, aiming to clean the text by removing noise. Preprocessing techniques include handling noise, parts-of-speech tagging, normalization, etc.
Noise	Irrelevant or unnecessary information in the text that should be removed during preprocessing.
Parts-of-speech tagging	Identifying the syntactic function of a word within a sentence.
Normalization	The process of reducing similar tokens to a canonical form to simplify analysis.
Stop-words	Commonly used words that are ignored during preprocessing or modeling tasks.
Lemmatization/Stemming	Techniques to reduce inflected terms to their base forms to improve analysis.
Tokenization	Breaking a large chunk of text into smaller pieces (tokens) to map each piece to a meaningful unit of information.
Word embeddings (vectors)	Representing each token as a vector before passing it to a machine learning model for analysis.

Note: Table 3 presents key terms related to Natural Language Processing (NLP) processing techniques and their corresponding definitions. These terms encapsulate various stages and methods involved in processing and analyzing natural language data.

By further integrating relevant examples and case studies additional efforts will be made to expand classroom-ready materials to cater to diverse learners across K-12 levels, offering adaptable learning experiences. Moreover, incorporating discussions on the social implications of AI into classroom settings through news links and visually engaging presentations will be emphasized to underscore the practical applications and societal impact of AI.

Conclusion

While much of our team's workshop in Venango was focused on communicating technical terms in accessible language and constructing classroom materials, the engagement also shifted narratives, challenged stereotypes (both those held by workshop presenters and members of the local community), and minded the supposed gaps that keep R1 institutions out of reach for rural communities despite their geographic proximity. At the end of the workshop, Venango participants noted their excitement of engaging with the AI tools and vocabulary in their classrooms and expressed a shifted understanding of who Carnegie Mellon was for. Those from Carnegie Mellon also spent portions of the visit engaged in local culture in addition to their presentations, and their understandings of rural spaces, outside of their statistical representations, deepened.

The ultimate takeaway from our ongoing collaborative work is that rural students, educators, and communities *must* be a focus of STEM accessibility work. From our combined experiences of over 30 years at R1 institutions, we know that R1 institutions and elite STEM education institutions continue to overlook and invisibilize rural spaces, and our set of research presented here is only the start. If STEM education and accessibility initiatives continue to overlook rural students, the impact will be devastating on local, regional, national, and global scales. We know that identified patterns of decreasing population in these regions are coinciding with a rise in the median age, resulting in a dwindling pool of young learners. The work in co-creating pathways into STEM is never done, and we call for further research that centers rural communities. At the same time, challenges remain to be addressed, including preserving trust, time, money, and alignment of interests, and we recognize that all rural communities, although facing similar barriers, bring unique assets and perspectives into the conversation. Moving forward, it's imperative to delineate concrete correlations among the multifaceted barriers hindering STEM education in rural areas. By delineating these correlations and implementing targeted interventions, like our workshop, we can effectively begin to mitigate barriers and cultivate a conducive environment for fostering STEM education in rural communities. Together, rural communities and R1 institutions can empower the next generation of rural students to thrive in the increasingly technology-driven world. In short, rural matters.

Acknowledgments

The success of this work was enhanced by a diverse, intergenerational, and interdisciplinary team from over four US states, five countries, and five universities. We especially thank the RISS Scholar Alumni partners: Willa Potosnak, Jasmine Jerry Aloor, Kaleb Ben Naveed, Conner Pulling, Arnab Dey, and Jan-Malte Giannikos, plus Tim Heffernan, Chip Abramovic, Jodi Lewis, Jill Foys, Angela Keiser, Nicholas Burcin, Danielle Benson, and John M. Dolan.

References

Agger, Charlotte, Judith Meece, and Soo-yong Byun. (2018). "The Influences of Family and Place on Rural Adolescents' Educational Aspirations and Post-Secondary Enrollment." *Journal of Youth and Adolescence* 47(12):2554–68. doi:10.1007/s10964-018-0893-7

Basic classification. Carnegie Classifications of Institutions of Higher Education. (2023, March 30). https://carnegieclassifications.acenet.edu/carnegie-classification/classification-methodology/basic-classification/

Carnegie Mellon Robotics Institute Summer Scholars. (2023). "PA Rural Educator Technology Workshops Let's Explore Robotics & AI." Retrieved January 25, 2024. https://docs.google.com/document/u/1/d/1Rs2tAxpZiDqYkbzJm5MVRcI5QTQ945Po7TTlUkh-Sb0/edit?pli=1&usp=embed_facebook

Center for Rural Pennsylvania. (2024). *County profiles*. County Profiles - Center for Rural PA. https://www.rural.pa.gov/data/county-profiles.cfm

Cooperrider, D. L., & Whitney, D. (2005b). *Appreciative inquiry: A positive revolution in change*. Berrett-Koehler.

Hammond, S. A. (2013). *The thin book of appreciative inquiry*. Thin Book Publishing Co.

Harris, Rachel S., and Charles Hodges. (2018). "STEM Education in Rural Schools: Implications of Untapped Potential." *National Youth at Risk Journal* 3(1). doi:10.20429/nyarj.2018.030102

Hillman, Nicholas, and William Casey Boland. (2019). "Geography of College Choice." Pp. 22–34 in *Contemporary Issues in Higher Education*. Routledge.

Kania, J., Kramer, M., & John Kania is a managing director at FSG. (n.d.). *Collective impact (SSIR)*. Stanford Social Innovation Review: Informing and Inspiring Leaders of Social Change. https://ssir.org/articles/entry/collective_impact

Lakin, J. M., Stambaugh, T., Ihrig, L. M., Mahatmya, D., & Assouline, S. G. (2021). Nurturing STEM talent in rural settings. *Phi Delta Kappan*, *103*(4), 24–30. https://doi.org/10.1177/00317217211065823

Malmqvist, Johan, Hellberg, Kristina, Möllås, Gunvie, Rose, Richard, & Shevlin, Michael. (2019). "Conducting the Pilot Study: A Neglected Part of the Research Process? Methodological Findings Supporting the Importance of Piloting in Qualitative Research Studies." *International Journal of Qualitative Methods*. https://doi.org/10.1177/1609406919878341

The National Center for Education Statistics (NCES). (2016). "Selected Statistics From the Public Elementary and Secondary Education Universe: School Year 2015–16." Retrieved January 21, 2024. https://nces.ed.gov/pubs2018/2018052/index.asp

Neff, K. (2021). *Self-compassion: The proven power of being kind to yourself*. Yellow Kite, an imprint of Hodder & Stoughton.

Postsecondary National Policy Institute. (2023). “Rural Students in Higher Education.” Retrieved January 21, 2024. https://pnpi.org/factsheets/rural-students-in-higher-education/

Radford, Alec, Jeffrey Wu, Rewon Child, David Luan, Dario Amodei, and Ilya Sutskever. (2019). “Language Models Are Unsupervised Multitask Learners.”

Saw, Guan K., and Charlotte A. Agger. (2021). “STEM Pathways of Rural and Small-Town Students: Opportunities to Learn, Aspirations, Preparation, and College Enrollment.” *Educational Researcher* 50(9):595–606. doi:10.3102/0013189X211027528

Scott, Judith, William Naggy, and Susan Flinspach. (2008). “More than Merely Words: Redefining Vocabulary Learning in a Culturally and Linguistically Diverse Society.” Pp. 182–210 in *What Research Has to Say About Vocabulary Instruction*. International Reading Association.

US Census Bureau. (2021a, November 19). School Enrollment Data. Census.gov. https://www.census.gov/topics/education/school-enrollment/data.html

US Census Bureau. (2021b, November 21). Industry and occupation data. Census.gov. https://www.census.gov/topics/employment/industry-occupation/data.html

US Census Bureau. (2023, September 19). Decennial Census (2020, 2010, 2000). Census.gov. https://www.census.gov/data/developers/data-sets/decennial-census.html

Wells, Ryan, Catherine Manly, Suzan Kommers, and Ezekiel Kimball. (2019). “Narrowed Gaps and Persistent Challenges: Examining Rural-Nonrural Disparities in Postsecondary Outcomes over Time.” *American Journal of Education* 126(1). doi:https://doi-org.cmu.idm.oclc.org/10.1086/705498

Yettick, Holly, Robin Baker, Mary Wickersham, and Kelly Hupfeld. (2014). “Rural Districts Left Behind? Rural Districts and the Challenges of Administering the Elementary and Secondary Education Act.”