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Effective Approaches to Co-Design with Neurodivergent and Historically Minoritized Youth to Facilitate Inclusive and Accessible Learning

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Abstract: This symposium explores the potential of co-design in creating inclusive and accessible learning innovations by foregrounding the expertise of neurodivergent and historically minoritized youth. Presenting six federally funded projects, the session showcases how co-design methodologies empower learners to shape tools and interventions that prioritize equity, access, and belonging. These initiatives leverage emerging technologies, including AI, AR, VR, and BCI, as well as museum- and place-based STEM activities, to address barriers to learning while fostering agency and identity development. Each project exemplifies how co-design not only creates more effective and responsive tools but also builds communities and promotes systemic change. Attendees will gain practical insights into recruiting and engaging co-designers, navigating challenges, and sustaining equitable collaborations, with a focus on scaling these practices for broader impact. Through these examples, the symposium illustrates how co-design can reimagine learning systems to better serve all learners and create more equitable educational experiences.

Symposium overview

Co-design is a process of collaborative inquiry and imagination through which people with different experiences (including lived expertise) discover problems and collectively envision, ideate, and prototype design solutions. The co-design process offers a novel approach for creating inclusive and accessible learning experiences by centering the voices and expertise of neurodivergent and historically minoritized youth. Learning interventions designed for underserved populations have often been created without substantial input from these groups, resulting in tools that may inadequately address their needs or perspectives. Co-design flips this paradigm by actively engaging learners as collaborators in the research and development process, ensuring their insights and lived experiences directly inform the design of learning innovations.

This symposium brings together six federally funded projects that exemplify the co-design methodology to create learning tools and interventions that prioritize access, equity, and belonging. Each project works with historically minoritized, including neurodivergent youth, leveraging their expertise to shape emerging learning technologies and drive STEM learning. Technologies include artificial intelligence (AI), augmented reality (AR), virtual reality (VR), brain-computer interfaces (BCIs), and place-based and museum-based engineering and STEM activities. These projects demonstrate how co-design can address environmental barriers to learning while fostering agency and identity development among participants. The symposium will include presentations from each of the following federally funded projects:

NeuroVivid: A project engaging neurodivergent 16-19 year old co-designers in the development of a BCI maker camp for middle schoolers. The co-design process not only shaped the curriculum and activities but also fostered a community of practice that empowered participants to see themselves as contributors to STEM.

iSAT: A project engaging historically minoritized youth in imagining equitable possibilities for AI in classrooms. Through workshops and speculative design activities, participants shaped both technological tools and the organizational contexts needed to sustain equitable practices.

AugmentedEF: A project leveraging AR to support executive function (EF) challenges among college students. Through iterative co-design with neurodivergent students, the project developed adaptive tools that align with users' sensory and cognitive needs, creating a supportive and engaging learning environment.

Making Mentors: A mentorship program co-designed by autistic college and high school students that integrates STEAM activities with discussions on neurodiversity and career development. The co-design process fostered mutual empathy and understanding, creating a model for empowering mentorship practices.

NUDL: A museum-based initiative where autistic youth co-designed engineering activities grounded in Universal Design for Learning (UDL). Their contributions improved accessibility, minimized sensory barriers, and enhanced visitor engagement.

Outdoor Rec: A place-based exploration project that leveraged UDL and co-design to position rural youth as co-researchers, actively collecting and analyzing data on the STEM they see and experience through outdoor recreation activities such as hunting, hiking, and snowmobiling.

Across these projects, the co-design process has proven to be more than a method for developing effective tools—it is also a means of building communities, fostering belonging, and empowering learners. Session attendees will gain insights into recruiting and engaging co-designers, addressing challenges, and sustaining equitable collaborations. The symposium will conclude with a Q&A session, inviting dialogue on scaling these practices to broader contexts. By centering co-design as a framework, this session illustrates how inclusive design practices can transform not only learning technologies but also the systems and relationships in which these tools are embedded, paving the way for more equitable learning futures.

NeuroVivid: Co-designing a BCI maker experience with and for neurodivergent youth

Ibrahim Dahlstrom-Hakki

Purpose

This presentation highlights the co-design process behind the development of a BCI maker camp for neurodivergent middle schoolers, driven by the insights and creativity of a neurodivergent co-design team. Funded by NSF, the project centers on authentic collaboration, fostering a community of practice while addressing the unique needs of its target audience. This session will cover co-designer recruitment, engagement, community formation, reflections, and impacts will be shared. NeuroVivid leverages advances in neuroscience and Human-Computer Interaction (HCI) in the convergent field of BCI. The NeuroVivid project has designed an adaptable BCI experience in makerspaces to increase interest in STEM among a broad range of learners.

Theoretical framework

EF challenges are common across communities of neurodiverse learners. EF includes the abilities to sustain and shift focus, initiate work, regulate emotions, self-monitor, and effectively access short- and long-term memory (Brown, 2006). Organizational capacity, previewing, emotional regulation, and working memory are all features of EF that are central to the successful execution of academic work (McKee, 2017). Helping students understand their own unique cognitive strengths and challenges may reveal strategies that are particularly useful for improving their STEM learning. Neurodivergent learners' self-identity may have a strong impact on their success in academic endeavors (Kercood et al., 2017). Learners who see their neurodiversity from a "difference" perspective—where neurodiversity is seen as a difference incorporating a set of strengths and challenges—have greater career ambition and academic self-esteem than those who take a "medical/deficit" view that focuses on disability (Griffin & Pollak, 2009).

Exciting new STEM fields such as HCI and BCI may be particularly conducive to engaging a wide range of neurodiverse learners in STEM. BCI involves the development of devices that acquire brain signals, analyze them, and translate them into usable information. BCI can be used to design learning aides informed by the learner's own brain activity, such as a real-time visualization that shows when a learner's brain is over- or under-stimulated (Xiong et al., 2020). Makerspaces afford opportunities for self-directed project work to develop products that have real-life connections and applications (Capraro, Capraro, & Morgan, 2013; Kokotsaki,

Menzies, & Wiggins, 2016). Project-based Learning (PBL) in makerspaces shows particular promise for engaging neurodivergent learners in differentiated STEM learning (Hughes, Laffier, & Reiterer, 2021). Within PBL, neurodivergent learners are best supported when these learning experiences are carefully structured and when guidance is provided to help students set and monitor progress towards realistic and relevant project goals (Armstrong, 2012). Well-designed PBL helps learners break larger problems into smaller, manageable tasks and use metacognitive strategies to help students stay aware of their own progress (Zentall et al., 2001).

Data sources/methodology

A team of eight neurodivergent young adults (ages 16–19) participated in a paid internship, actively shaping the camp's curriculum, tools, and activities. By working with a team of professional designers and researchers, NeuroVivid resulted in a week-long maker camp that introduces middle schoolers (ages 11–14) to the basics of neuroscience, block coding, and circuit building. Participants ultimately create BCI devices that used brainwaves to control simple outputs like LEDs and motors. By embedding neurodivergent voices at every stage, from conceptualization to implementation, the project ensured accessibility, engagement, and alignment with participants' lived experiences.

The co-design process culminated in a deployment of the camp at the New York Hall of Science in April of 2024. Data collected from camp participants as well as the co-design team will be shared in this session. This includes observational data, interviews, surveys, and artifacts. Feedback from the camp is being used to address identified issues and refine the content in preparation for further testing in 2025. Updates from these additional camps scheduled for the first half of 2025 will be provided.

Findings and discussions

The co-design process extended beyond shaping the camp's logistics; it created a supportive counterspace for the co-designers themselves (Case & Hunter, 2012). Reflecting on their participation, co-designers reported developing a stronger sense of STEM identity, empowerment, and connection. These findings, derived from interviews and community reflections, underscore the value of creating collaborative environments that prioritize inclusion and belonging. For many co-designers, the project served not only as a creative outlet but also as a pathway to deeper engagement with STEM and self-advocacy.

Through this presentation, attendees will gain actionable insights into recruiting, supporting, and engaging neurodivergent co-designers. Key strategies include building community, fostering open dialogue, and creating iterative, flexible design processes. Guidelines for authentic collaboration will highlight how co-design not only enhances the effectiveness of educational interventions but also strengthens relationships and nurtures future neurodivergent leaders in STEM.

The presentation will conclude with a discussion of future directions, focusing on sustaining the co-design community and scaling the maker camp model to additional contexts. Attendees will leave with practical tools and strategies for applying co-design to develop accessible, engaging, and empowering learning experiences for all learners.

iSAT: Co-designing and Infrastructuring AI-Ed through Theatro

Michael Alan Chang & Thomas Breideband

Objectives

We describe our efforts to co-design – with historically minoritized youth – the organizational conditions for equitable uses of AI in K-12 contexts. Deeply entrenched inequities in US K-12 schooling have closed off opportunities for learning and designing for historically minoritized youth (Garcia & Mirra, 2023; Gutierrez & Jurow, 2016); we have an ethical obligation to engage their hopes, dreams and concerns around the use of AI in schools. However, imagining new possibilities for technology alone is insufficient without considering the contexts where those technologies will be embedded within. In particular, we are interested in how to create co-design contexts where youth participants can surface the oft-invisible infrastructures (Penuel, 2019; Star & Ruhleder, 1996) that will guide the eventual uptake of technologies in classrooms. Here we tackle this through a modified Theatro (Boal & McBride, 2013) activity, an activity where participants can experiment with different interventions to address everyday injustices. Thus we ask, how does a Theatro activity used within co-design contexts support historically underserved youth to surface relevant infrastructures for their ideal uptake of AI-Ed?

Theoretical framework

Our framework begins with the question of how historically minoritized youth have been positioned within their schools today and then within the co-design context itself. Participatory design research (Bang & Vossoughi, 2016; Chang et al., 2024;) highlights how deficit oriented ideologies shape learning tools imagined for historically minoritized youth, and attunes us to considering subject-subject relations as the object of co-design contexts. These subject-subject relations are often reified in organizational contexts materially through infrastructures which are the oft-invisible relational spinal cord of organizational contexts (Penuel, 2019; Star & Ruhleder, 1996). Precisely because they often operate below the surface, they can be difficult to interrogate within a co-design context. To address this, building on the concept of infrastructural speculation from human-computing interaction (Wong et al., 2020), which brings forth the practices, norms, and values that support the use of an artifact in schools, we conjectured that a Theatro Activity that featured youth-created AI-Ed tools would help participants speculate on those infrastructural possibilities.

Data sources/methodology

We describe two co-design workshops conducted between 2021-2024 that engaged minoritized youth in imagining new possibilities for in-school collaboration and AI learning tools. In both these workshops, youth participants first envisioned expansive possibilities for learning and AI, before finally engaging with a Theatro Activity to surface the infrastructural conditions. Our workshops engaged many of the same high-school aged youth over a multi-year engagement. We transcribed video recordings and field notes conducted during the workshops, noting when intended uses of the AI bumped up against infrastructural shortcomings and also how student participants proposed transformations (Gutierrez et al., 2019) to those shortcomings. Finally, we created analytic memos.

Findings and discussions

Over the course of both workshops, youth described wanting to feel cared for and nurtured within schools. At the same time, to address those wishes, youth participants conceived of a number of possibilities for AI in education, some that fit within dominant school practices (e.g., AI that kept students on-topic during collaboration) and some addressing more expansive ends (e.g., AI that supports students in sharing their suffering with receptive teachers). In both cases, we conducted Theatro Activities after those technologies were proposed. Regardless of the expansiveness of the AI proposal being evaluated within the co-design context, youth participants identified infrastructural elements of schooling that they saw as inhibiting their desired uses of the technology. For instance, in our second workshop, one youth participant employed a public address system to show how it serves as administrators' channels into classroom to control teachers' efforts to care for their students. Youth participants then proposed new infrastructures in schools, which facilitated reciprocal care between students and teachers, and argued that such tools might be able to counteract the relational hierarchy embodied by the public address system. Our findings demonstrate that Theatro Activities in co-design contexts can help researchers and participants in surfacing AI tools for education, *and* modifications to taken-for-granted infrastructures that participants envision to be supportive or inhibiting of their hopes for their tools.

AugmentedEF - Working with neurodiverse co-designers to develop augmented reality interventions for executive function issues

Zachary Alstad, TERC

Objectives

The AugmentedEF project at TERC is focused on developing an AR tool designed to support students with EF challenges. This project employs a co-design framework that involves neurodivergent individuals throughout all stages of development. By incorporating the perspectives of those with firsthand experience, the goal is to create a tool that effectively addresses the needs of students for whom traditional educational supports are often insufficient. This project is developing an open source tool designed with and for neurodiverse learners to productively shape patterns of engagement during independent work time. This presentation will report on the co-design work and the latest iteration of the prototype tool being developed.

Theoretical framework

AugmentedEF is co-designing a "Smart Pomodoro" with neurodivergent learners. The pomodoro technique (Dibia, 2016) requires a user to work for a predetermined amount of time, often 25 minutes, followed by a short break, often 5 minutes. Brown (2006) identifies six key areas of EF challenges faced by neurodivergent students: initiation or activation of a task, maintaining focus, sustaining effort, regulating emotions, memory difficulties,

and difficulty executing actions. The traditional pomodoro method is often used to address aspects of these barriers, but the approach is at times inadequate. First, it requires the initiation and utilization of EF capabilities to address one's own EF barriers. AugmentedEF, on the other hand, does not require the user to self-monitor and self-intervene. Furthermore, the traditional pomodoro timer often interrupts on-task behavior just as frequently as it would interrupt off-task behavior. AugmentedEF, by contrast, detects *when* a student is engaged, and only intervenes when appropriate.

Methods and data sources

In order to meaningfully address the challenges faced by this community, perspectives from neurodivergent co-designers from Landmark College have been incorporated. Landmark is an institution known for its work in educating students with learning disabilities, ADHD, and other forms of neurodivergence. These students represent a range of neurodiverse conditions that also include sensory and motor differences, as well as EF and social capabilities. These co-designers contribute their experiences and perspectives, which inform all aspects of the tool, such as its core features, interventions, and user interface. This collaborative process includes regular meetings, brainstorming and feedback to the developers to help ensure that the AR tool is informed by the needs and experiences of its intended users.

The first major category of data is qualitative feedback from the co-designers. The insights provided by neurodivergent students are substantively incorporated into each phase of refining the tool's functionalities. Their involvement helps identify the types of support that are most useful, such as audio and visual task reminders and how these should be used to re-engage the students attention. These inputs are translated into practical features by the software developers that can be integrated into learning contexts to help address the challenges that neurodivergent students often face.

The second major source of data is the sensor information related to the students' head position, head orientation and eye tracking information. Two-hour sessions of students using the headset were human coded as either "on task", "off task" or "null" over time. Each instance of this coded behavior was then verified by a second huma coder. This data was then used to train a machine learning model that attempts to predict the attention state of the user in future sessions.

Findings and discussions

For the co-design aspects of this study, neurodivergent students provided robust insights into the design and usability features of AugmentedEF. This approach ensured that AugmentedEF was shaped by the input of its intended users, promoting relevance and usability. Furthermore, developing such an intervention with the neurodiverse community upholds the principles of "nothing about us, without us".

For the machine learning aspects of this study, a quantitative comparison of the machine learning model against the simple directional model to explore effectiveness is ongoing. Using sensor data alone for this aim may not entirely capture the nuance of on and off task behavior patterns. However, It is evident that nascent tools that are capable of quickly categorizing on and off task behavior, such as multimodal LLMs, from a forward facing camera will be impactful in this space and may prove to be more robust in these aims than sensor data alone. Ongoing work has explored the potential utility of this approach. In this presentation, we will discuss key findings and implications of this work.

Making mentors

Wendy Martin, Ariana Riccio Arista, Sam Tumolo, Kristen Gillespie-Lynch, Dora Onwumere, Kristie Patten, Andrew Yan, Nicole Wang, Lyra Barrow

Objectives

The Making Mentors project pairs autistic college mentors with autistic high school mentees to a) create technology-enhanced STEAM projects b) learn about the neurodiversity movement and c) explore educational and career trajectories together. Mentors co-design the program, deciding on and creating content together processes and co-creating the materials they use, thereby taking ownership of the program. Mentees are also invited into summer co-design sessions to provide feedback on program activities that incorporate their perspectives. The goal is to establish a model process for co-developing mentorship programs with autistic high school and college students that support STEAM, college and career interest, self-determination, and self-efficacy through making.

Theoretical framework

Our program is rooted in two theoretical frameworks: the neurodiversity movement (Kapp, 2020) and the double empathy problem (Milton, 2012). Our program uses a participatory approach. By prioritizing the full participation of autistic students in program design and implementation, we can develop programs that are more likely to be beneficial than non-participatory programs (Botha et al., 2022a; Gillespie-Lynch et al., 2022). A growing body of research examining the double empathy problem suggests that autistic people often establish stronger rapport and communicate more effectively with one another than they do with non-autistic partners (e.g., Botha et al., 2022b; Chen et al., 2021; Chen et al., 2022; Crompton et al., 2020). These studies describe the important phenomenon of a shared experience among autistic people. This program utilized these phenomena wherein autistic mentors and mentees have empathy and social reciprocity with one another that can make within-neurotype pairings uniquely beneficial for both parties.

Methods and data sources

The pilot study included ten mentees from two urban high schools and ten mentors from two urban universities. The mentorship structure was flexible and adapted to the needs of participating schools as well as participants' schedules, interests, strengths, and challenges. Based on these adaptations, two program models arose. Model 1 was primarily in-person with 1:1 mentor-mentee pairs working on technology-enhanced STEAM projects and having informal conversations about college and life experiences. Model 2 was primarily virtual, with all mentors working with all mentees, discussing topics such as self-advocacy, college life, and the neurodiversity movement and doing short STEAM activities. At the end of the year, we conducted surveys, focus groups and interviews with mentors and mentees about the experience and what needed to change.

Results and significance

Our analysis of the feedback from the mentors and mentees showed that the Model 1 group enjoyed working on projects together but wanted more structure and content, and the Model 2 group liked the content but wanted more in-person interaction and project work. Both groups wanted more college/career prep information to prepare for a transition out of high school. Moving forward, we needed to combine elements of the two models. Thus, 10 mentors and 4 mentees worked on that new structure together last summer, creating materials and designing a revised program which was informed by the mentor's personal experiences. The revised materials are now being used and further adapted for Year 2 of the mentorship program. We will survey participants at the end of the year to gather their feedback on that process and resulting outcomes.

Although many programs for autistic youth focus on self-advocacy, these may be disempowering if they position youth as people who need help from non-autistic professionals. Instead, it is important to empower autistic youth to be leaders who share their experiences and help other autistic students become leaders themselves which this program aims to achieve. Making Mentors was established to build knowledge about how to create such opportunities.

Using universal design for learning to guide create neurodiversity-affirming engineering design programs in museums and science centers

Susan Letourneau, Wendy Martin, Sam Tumolo

Purpose

This presentation will examine the co-design process being used to adapt the UDL guidelines into informal STEM learning environments. Centering the ideas, feedback, and lived experiences of autistic teen co-designers, this project investigates how museum-based engineering activities can be designed to support belongingness for neurodiverse audiences. Three museum sites are working with autistic teens to develop a modified set of UDL guidelines to help museums create more accessible environments and activity designs for all types of learners. Findings from this investigation will be shared during this session, including strategies and processes for systemizing and supporting authentic co-design with a diverse team of stakeholders.

Theoretical framework

The neurodiversity movement describes neurological differences as integral to people's identities, and diverse ways of thinking as beneficial to creative problem-solving in many STEM fields (Asbell-Clarke 2024, Botha & Gillespie-Lynch, 2022). This movement advocates for dismantling structural barriers to allow neurodivergent and neurotypical people to learn from and with each other, rather than offering ad-hoc accommodations that can isolate or marginalize neurodivergent learners. The emphasis on changing the environment to explicitly value diverse

ways of learning aligns closely with the principles of UDL, which focuses on providing all learners with multiple means of engaging with, representing, and expressing ideas (CAST, 2018). The current project is exploring the impact of UDL-based approaches on neurodivergent learners' sense of belongingness and engagement in engineering design activities in museums.

Methods and data sources

This co-design team consists of researchers, museum educators, exhibit developers, and paid autistic teenagers from three museum sites (24 teens, 4-14 per site). Co-design sessions focused on generating strategies to support belongingness for neurodivergent learners, with co-designers sharing their experiences and ideas through multiple modalities. Co-design cohorts examined existing engineering and design activities from each museum site, and suggested revisions, identified barriers to inclusion, and offered new ways to enhance the activity and support learners. Co-designers then developed re-designed prototypes for each activity, and tested their designs with museum visitors. Data gathered during the co-design process includes pre and post interviews with co-designers, artifacts from co-design sessions (including notes, brainstorming exercises, transcriptions from discussions, drawings, photos), and reflections from museum staff after facilitating each session. Museum staff and researchers worked together to synthesize the ideas, revisions, and strategies that co-designers generated, categorizing key ideas and creating an initial set of UDL-based guidelines that addresses the priorities of neurodivergent youth and their families.

Results and significance

The guidelines created through this work include suggestions for modifying the physical environment, materials, facilitation approaches, and goals of engineering design activities, as well as guidance for structuring social interactions among museum visitors and between visitors and museum staff. This presentation will also examine how to scaffold the co-design process so that each stakeholder, regardless of age or experience, is able to authentically contribute to the end product. Lessons learned include specific strategies for generating diverse ideas that reflect mutually decided goals, offering multiple modalities for participation, making decisions as a team, and translating co-designer ideas into feasible and sustainable activity designs for museum visitors. This presentation will include stories and examples of how co-designer ideas and experiences are being directly incorporated into engineering activities and the adapted UDL guidelines, and will highlight how these interventions have impacted the learning experiences of neurodiverse visitors.

Outdoor rec: Strategies for empowering rural youth co-researchers to support STEM learning and STEM identity development

Amanda Bastoni, Jayson Seaman, Andrew Coopens, Cindy Hartman

Purpose

While "almost any environment *can* support informal science learning" (National Science Foundation, 2020, emphasis added), research shows that anchoring STEM learning in environments that learners care about and are familiar with increases learning and achievement. The project team from CAST (the creators of UDL framework) and the University of New Hampshire, leveraged the outdoor recreation ecosystem—specifically recreational activities and the employment opportunities that support these activities— to investigate the connection between outdoor recreation (OR) activities and STEM for three essential reasons: 1) STEM is instrumental to outdoor recreation in many ways including the management of its resources, the conduct of its activities, and the support of its users; 2) outdoor activities and experiences are the very places where rural youth already have strong positive (current and historical) connections (Seaman & McLaughlin, 2014); and 3) rural are historically marginalized from STEM, having less access to STEM learning and mentors, they are subsequently less likely to pursue post-secondary STEM learning or consider STEM careers. The purpose of this presentation is to highlight how youth were effectively engaged as co-researchers to identify STEM in outdoor recreation activities and develop STEM career thinking.

The presentation will highlight approaches, findings and outcomes from this work, an exploratory NSF Advancing Informal Science Learning (AISL) - *STEM Pathways for Rural Youth: Developing STEM Identity Through the Outdoors* (#2213919) -which utilized UDL (CAST, 2018) approaches throughout the data collection processes (including using a mobile application) and through the positioning of youth as co-researchers - a meaningful, inclusive, and asset-based approach that prioritizes learner voice and community values (Bastoni et al., 2024; Seaman et al., 2024). By using the co-researcher model we were able to situate rural learners at the center of the

research, elevate their perspectives (Martin et al., 2019), and leverage their identities, while providing them with the knowledge and skills they needed to engage in STEM discovery and data gathering. While multiple factors contributed to the 96% retention rate of youth participants in this project, the use of the UDL-based mobile app and co-researcher approach was significant, novel, and holds promise as a future strategy for increasing rural youths' engagement in STEM career and identity development activities (Bastoni et al., 2024).

Theoretical framework

We used a participatory design research approach (Bang & Vossoughi, 2016) to understand the outdoor recreation (OR) experiences of rural youth - as sources of cultural knowledge and STEM expertise. By positioning youth as co-researchers we were able to develop a theory on how we can connect these experiences to more conventionally recognized STEM learning. As the investigators, rural youth, created their own ideas of what STEM is and identified where STEM was happening within a variety of OR activities and roles, developing knowledge about the range of perspectives on STEM and STEM understandings as they appear in different activity settings and contexts, and identified new STEM opportunities and relationships that could serve as additional STEM pathways. These insights were combined to contribute understanding of what we are calling the Outdoor Recreation STEM Ecosystem.

Methods and data sources

The study examined an informal STEM learning (ISL) intervention in rural northern New Hampshire involving an interactive mobile web platform, *ORfolio*, that enabled youth to document observations of STEM skills and knowledge in OR activities they expressed interest in or pursued in their free time. The *ORfolio* platform was initially developed for use in career and technical education (CTE) settings through NSF funding (#1620904). It is unique in its ability to asynchronously track competency development in youths' independent activities, and for its integration of UDL; (Gordon et al., 2014; Kelly et al., 2022), a curriculum design approach that maximizes accessibility across learning differences. It was adapted for this project to fit an Outdoor Recreation (OR) context. The project launched in January 2023 at a daylong retreat where youth were trained to use *ORfolio* as co-researchers, including the ethics involved in photographing human subjects. In each subsequent month, youth received researcher-designed "challenges" in their *ORfolio* accounts prompting them to record experiences and reflections on their recreational activities with friends or family, in youth programs, or alone, where they believed STEM was involved, or other prompts tied to STEM use in OR settings and careers. Youth completed a pre/post survey at the start and end of the project and completed fourteen challenges throughout the ten month project period. The project ended with a final wrap-up during which youth provided feedback on the work they completed, assertions made by the adult researcher team, and reflected on the overall experience of serving as co-researchers.

Results and significance

"I feel like my visions and overall look at life have improved since starting this project. I am more motivated, and I am thinking more about careers in STEM and outdoor recreation. This makes me wonder what my future will look like, and if it will look different now that I've done this project," AISL youth participant. The project design highlights the importance of building interventions for rural youth that leverage community resources, mentoring, and infrastructure to support integrated STEM learning ecosystems, including cultural ways of knowing STEM. Leveraging the outdoors as a site of interest in the Northeast's rural regions gives relevance to STEM learning while also affording an expanded range of identity possibilities, for rural youth across a range of relative predictors of marginalization, through its association with community history, recreation, and future work. The project also shows that STEM identity development can be positively impacted when projects highlight workforce pathways (career and technical education, apprenticeships, STEM workforce development) for youth and connect youth with activities that allow them to engage in data collection and analysis as co-researchers. When these supports are utilized, youth are able to synthesize their "future self" with a STEM identity, while still honoring local rural values, reducing the "stay vs. leave" dichotomy that rural youth often experience in pursuing STEM careers."

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