SUMMARY OF THE QUANTUM WORKFORCE: Q-12 ACTIONS FOR COMMUNITY GROWTH MEETING

Product of

The National Quantum Coordination Office

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About the National Q-12 Education Partnership

The National Q-12 Education Partnership[1] builds upon efforts spearheaded by the White House Office of Science and Technology Policy (OSTP) and the National Science Foundation (NSF) to develop nine key quantum information science (QIS) concepts[2] that can be introduced to and adapted for computer science, mathematics, physics, and chemistry courses throughout middle and high schools. The concepts can also be expanded and adapted for use in informal learning opportunities, such as museums. NSF has supported these efforts through the Q2Work program, which it awarded nearly $1 million, and two conferences for teachers.[3,4]

The partnership has committed to work with America's educators to ensure a strong quantum learning environment, from providing classroom tools for hands-on experiences and developing educational materials, to supporting pathways to quantum careers. By expanding access to materials and quantum technologies through this partnership, educators in classrooms and other settings will be able to develop programs, courses, and activities to introduce students to the field and open up opportunities for quantum careers. Together, these activities prepare America's next-generation workforce with the tools to succeed in the industries of the future.

Acknowledgements

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[1] National Q-12 Education Partnership Home Page, https://q12education.org, accessed July 7, 2022
[2] https://www.nsf.gov/news/special_reports/announcements/051820.jsp?et_rid=390004454&&et_cid=3349247
[3] https://www.nsf.gov/awardsearch/showAward?AWD_ID=2009351&HistoricalAwards=false
[4] https://www.nsf.gov/awardsearch/showAward?AWD_ID=2015205&HistoricalAwards=false

Workshop Overview

On February 1, 2022, the White House Office of Science and Technology Policy (OSTP) and the National Science Foundation (NSF) co-hosted a virtual event, "Quantum Workforce: Q-12 Actions for Community Growth." The meeting was hosted in coordination with the National Q-12 Education Partnership and served as a one-year follow-up to the kick-off meeting held in 2020.[5]

The meeting brought together over 200 stakeholders from across academia, early education, industry, the federal government, and non-profit organizations to discuss progress and identify challenges in quantum information science (QIS) education at the K-12 level, as well as to facilitate the expansion of public engagement in QIS. At the meeting, the Subcommittee on Quantum Information Science released its report: *Quantum Information Science and Technology (QIST) Workforce Development National Strategic Plan.*[6]

The event consisted of an opening session followed by small group breakout discussions. The opening session was launched with remarks from NSF Director, Dr. Sethuraman Panchanathan.[7]

"To accelerate growth in quantum science and engineering, we must continue to institutionalize and scale efforts that create a culture of creativity and inclusivity, one that empowers people from all backgrounds and disciplines to pursue quantum careers."
– Director of the National Science Foundation Dr. Sethuraman Panchanathan

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The Director of the OSTP National Quantum Coordination Office (NQCO), Dr. Charles Tahan, provided an overview of the U.S. Strategy for developing the QIST workforce. In his remarks, he highlighted the four big actions from the report:

- **Action 1:** Develop and maintain an understanding of workforce needs in the QIST ecosystem, with both short-term and long-term perspectives
- **Action 2:** Introduce broader audiences to QIST through public outreach and educational materials
- **Action 3:** Address QIST-specific gaps in professional education and training opportunities
- **Action 4:** Make careers in QIST and related fields more accessible and equitable

Dr. Tahan emphasized that today's conversation was focused on Action 2, but future engagements would be held that covered the other actions.

"Our future prosperity depends on expanding the capacity of our Nation to inspire, educate, train, and empower the next generation of talent."
– NQCO Director and OSTP Assistant Director for QIS Dr. Charles Tahan

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[5] https://www.quantum.gov/wp-content/uploads/2020/12/SummaryQ12KickOffEvent.pdf
[6] https://www.quantum.gov/wp-content/uploads/2022/02/QIST-Natl-Workforce-Plan.pdf
[7] Information on February 1 Meeting on the Quantum Workforce, NSF Director Panchanathan's Opening Remarks Video, https://q12education.org/announcements/44665, accessed July 7, 2022

Following Dr. Tahan's remarks, Deputy Assistant Director Dr. Tie Luo of NSF Mathematical and Physical Sciences and Assistant Director Dr. Sylvia Butterfield of NSF Education and Human Resources spoke about efforts to both build capacity and provide more educational opportunities to engage with QIS. As part of the remarks, NSF discussed their most recent solicitation, *Expanding Capacity in Quantum Information Science and Engineering (ExpandQISE).* The objective of ExpandQISE is to help launch QISE research and education activities at new institutions through grants up to $5 million over five years, with a particular focus on those where more than half of students are from groups under-represented in the sciences.

Next, Senior Policy Advisor at OSTP, Dr. Quincy Brown, moderated a panel consisting of experts with portfolios in STEM education. Panelists articulated challenges and recommendations for engaging teachers and students in QIS.

Following this, a series of lightening talks were given that covered community efforts to connect with students in K-12 on future quantum careers and educational materials.

Subsequently, participants joined one of six breakout sessions on (1) career pathways in QIS, (2) informal educational activities and lessons in QIS, (3) formal education activities and lessons in QIS, (4) QIS communication and outreach, (5) QIS educational policies and programs, and (6) growing a diverse quantum workforce. In each breakout session, participants identified challenges and priorities, drafted follow-up action items, and invited continued work on each theme.

Key Takeaways

Key takeaways from breakout discussions included:

1. **Increasing Awareness of Careers in QIS to Students, Teachers, Counselors, and Parents:** Participants noted that materials have been created by a variety of stakeholders, but there is a need to populate a repository with these materials. This information needs to be connected with centralized sources of content that are used by stakeholders. Participants recognized that career awareness is an area for industry, academia, and professional societies to collaborate. They identified the need for marketing efforts to identify and match the audience.
2. **Create Readily Accessible Quantum Educational Materials:** The conversation on informal QIS educational materials centered the lack of accessible quantum educational materials that teachers could use without installing software or taking some type of professional development. Possible approaches include games, hands-on activities, and other activities that convey some aspect of quantum mechanics without belaboring the details, and activities that put kids in the "driver's seat." It was also noted that the entertainment industry and media outlets could be partners in providing first exposure to quantum concepts.
3. **Development and Curation of Formal Educational Materials:** Efforts to tie quantum information science into existing K-12 curricula and standards from the physical sciences, computer science, and mathematics exist, but expansion is needed for subjects and lessons with no identified tie-ins and for culturally inclusive materials. Discussion also noted the need for curating existing educational resources, lessons, and professional development to train pre- and in-service teachers, and the need for more professional development at local and regional levels.

4. **Increase Engagement in and Awareness of Quantum Science:** The conversation noted that many avenues of public engagement, such as social media, schools, museums, libraries, farmers markets, movie theaters, television shows, festivals, and games were needed to increase engagement in and awareness of quantum science, including its potential impact and career opportunities. The need to portray quantum science as fun rather than abstract was reflected in several comments, and as was the need for hands-on activities
5. **Developing Standards and Policies to Support Quantum Education at the K-12 Level:** The discussion on QIS educational policies and programs included educating, informing, and supporting educators. This could include the development of content standards, which could stimulate professional development opportunities for educators and promote buy-in from administrators.
6. **Expanding Paths into QIS and Addressing Retention:** The diversity discussion recognized the need for increased DEI in QIS, including geographic diversity. Challenges include that students are dropping out of STEM in middle or high school, and the "broccoli first, dessert second" approach to teaching drives away many students. Full-engagement teaching practices and creating a number of onramps to QIS can help expand participation. Efforts should consider supporting schools that are already doing diversity well.

Next Steps and Conclusion

Each of the breakout sessions invited participants to continue working toward implementing the key takeaways that were identified. NQCO will continue to connect with the QIST ecosystem, including the Q-12 Educational Partnership, to better understand how the actions laid out in the Workforce Development National Strategic Plan align with the community's priorities, as well as coordinate K-12 educational and outreach activities to prepare the next-generation quantum workforce.