Towards a Faculty Learning Community in Quantum Education for High-School and Middle-School Teachers in the State of Indiana

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***Abstract*—In the US quantum topics appear on the high-school (HS) curriculum standards in just two states: OH (Computing) and TX (Physics). Reaching out to HS and even middle school students (and their teachers) presents obvious long-term benefits in terms of workforce development for the quantum industrial ecosystem. Challenges associated with outreach to HS and middle school teachers are modulated by the short-term imperatives of upskilling and reskilling. While HS teachers are very resourceful and dedicated individuals they are also notoriously overworked and underpaid. Standing in the way of successful and widespread introduction of quantum computing (QC) and quantum information science and engineering (QISe) topics in HS and middle schools are three obstacles: (a) lack of materials at the right level for both students and instructors, (b) funding and opportunities/support for professional development for teachers, and (c) lack of state standards. With help from the QED-C we have had success in proposing a quantum architectures knowledge unit [1] for the new ACM/IEEE-CS/AAAI curricular guidelines CS2023. In 2021, with assistance from Indiana University's Quantum Science and Engineering Center (IU QSEc, [5]) we established a boot camp for incoming students in our accelerated Master's in QIS program (an interdisciplinary program aimed at STEM graduates not majors of Physics.) This year with support from the Center for Quantum Technologies (CQT, [4]) and with assistance from the Indiana Computer Science Teachers' Association (IN CSTA) we have successfully repurposed the Boot Camp for the dual target of establishing a Faculty Learning Community (FLC) for HS and middle school teachers in the state of Indiana. A boot camp designed to engage, educate and support can bootstrap itself into a community. We report on this year's cohort experience that included 9 HS teachers (one middle school) from the state of IN and one HS teacher from the state of GA (along with 13 other IU graduate and undergraduate students). The class was six weeks long, met daily, the delivery was hybrid (teachers/students were spread all over IN and the US). Lectures and office hours were held in person for those in Bloomington and via Zoom for everybody else. There was one guest lecture by John McNally (from the Wolfram Academic Innovation Group) and three guest lectures from Maria Violaris (Oxford University, UK). Support for the course included materials freely available online from Thomas Wong and Martin LaForest as well as a set of materials developed expressly for this class [2], [3] based on (and extending) the remarkable rewriting system introduced by Terry Rudolph in "Q is for Quantum" [6].**

***Index Terms*—quantum computing education, middle school, high-school, rewriting system, misty states formalism, introduction to quantum advantage, superdense coding, Grover's algorithm, W-entangled states, quantum teleportation, Deutsch-Josza, GHZ game, phase kickback, Bernstein-Vazirani.**

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