Milestone 2: Teaching Quantum Computing

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***Abstract*—**Quantum Mechanics and Quantum Computing is an extremely complex field, challenging even the brightest minds of the last century such as Albert Einstein and Richard Feynman. The technology is on the cusp of broad general market availability and the need for professionals to utilize the machines will be needed in the near term. Two surveys conducted on OMSCS students intend to d

1 MILESTONE SURVEY 1 PRELIMINARY RESULTS

The survey released for the previous Milestone, concentrated on determining best practices, teaching methodologies, and study materials that students have preferred. The preliminary survey results showed most students preferring interactive classes with hands-on problem solving and lab exercises. Video lectures do well to provide background resources but are insufficient in providing well rounded understanding of advanced concepts.

Interestingly, the feedback from the students included notes that the questions were too random, not relevant to Quantum Computing, or too confusing to get to the bottom of what is being asked. As such, a second survey was constructed to further focus on Quantum Computing and drive the surveyors to really think about Quantum Computing and the teaching methods involved in the subject.

2 MILESTONE SURVEY 2 QUESTIONS

- What is your Age?
- What is your highest level of education?
- In a MOOC class, what balance of human to technological interaction do you prefer?
- If you had to rate the importance of feedback from these 3 groups, from Most Important to Least Important, which would you prefer?
- Superposition is the ability of a quantum system to be in multiple states at the same time until it is measured. Would you like to learn more?

- Quantum entanglement occurs when two particles become inextricably linked, and whatever happens to one immediately affects the other, regardless of how far apart they are. Would you like to learn more?
- Quantum logic gates are rudimentary quantum circuits analogous to classical logic gates for conventional digital computers. Would you like to learn more?
- Decoherence is the process by which information of a quantum system is altered by the system's interaction with its environment. Would you like to learn more?
- If you were to research any of the topics above, which method would you most likely use?
- Which structured coursework in Quantum Computing would you be interested in studying?
- If you were to learn a new subject in Quantum Computing, what delivery method would you feel most comfortable with?
- If a Quantum Computing "Virtual Reality" world was created, what should the role of the players?
- Please provide any feedback you would like to give.

3 MILESTONE 2 SURVEY PRELIMINARY RESULTS

From preliminary results, it is interesting to notice that while 50% of the responses, so far, require only modest interaction with peers, Tas or the professor, an interesting second majority of 33% require significant interaction with software assignments which simply serve to solidify knowledge. It would be interesting to conduct a follow up how much, exactly, does the Piazza forum board fulfill that need for significant peer interaction as it is obviously limited compared to a live classroom or lab.

Similarly, 50% of the respondents would prefer only a broad survey course of the class. A 3-class minor or an entire Quantum Computing master's program would not be of interest. What this implies is that any curriculum on Quantum Computing should cover the bases, making sure a broad range of students can gain useful knowledge, without too much detail since most will not dig deeper either way.

Over 55% of the respondents prefer a virtual classroom, led either by an intelligent AI or a Teaching Assistant. More specifically, the idea of a Virtual Reality

classroom was of significant appeal. Specifically, students responded favorably (50%) to engaging in a Virtual World where the user is a quantum particle and is given the ability to control the virtual world to explore the phenomena being studied in class.

4 ANALYSIS AND DELIVERABLE

To wrap-up this research, each survey should have at least 50 respondents. The final analysis will consist of a section in background research conducted as part of the first three assignments, a section with a hypothesis and "Qualifier Question", a section with the questions and results of the two surveys, and finally a comparison of the results to the hypothesis. It is the goal of this study to provide a sort of guideline for educators how to structure a Quantum Computing course and what material to include in it. If there is no clear rubric, at the very least a section with suggested features and must-haves should be included as the fruit of this research. After all, the goal of this effort was to gain insight into the student's preferences, capabilities, and goals for learning Quantum Computing. B combining what the students want, with what the professors can offer a truly well-made course on Quantum Computing can be crafted.

5 VIDEO LINK

https://youtu.be/1P1K3VOH_dU