Analysis of an online assessment on basic mathematics for quantum computing

In this note, the results of an online test prepared within the IMEDiL project will be analyzed.

In online assessments, on the one hand there are high risks of fraud (substitution of person, copying, use of unauthorized notes or books, etc...), on the other hand there is the risk of failures at hardware, software or network level. Our first goal was to propose best practices and tools for proper assessment of student work.

Initially, we designed a test for student assessment, on mathematical tools for quantum computing.

The test was administered online to eight groups of students. The students took the test online, but they were hosted in university classrooms and under the supervision of a group of overseers, whose purpose was to detect possible fraud. Students had to leave smartphones, cell phones and other connected items in a place not directly accessible from their location.

Students had their own computers at their disposal, had to have the test page in full screen option, they were not allowed to visualize other webpages different from the assessment webpage and had a limited time for each answer. To limit the possibility of cheating, students were separated from each other and had to answer, in limited time, 10 questions chosen at random and presented in random order out of a total of 20 questions.

Despite all precautions taken, seven cases of fraud have been detected. In particular, we noted the use of several non-digital means for copying, such as paper tickets with information, oral communication attempts, attempts to see the screen of other participants in order to copy their answers.

The situation is potentially more complicated to manage in the case of remote evaluation. Even if the student is under direct surveillance via the computer's camera and the student's screen is shared with a supervisor, he or she can cheat, for example by sticking small removable self-adhesive sheets of paper with course content onto part of the screen.

Additionally, the time restriction incorporated in this assessment modality constitutes a potential threat for the success of the students, since it inhibits their ability to fully explore and demonstrate a comprehensive understanding of the topics covered by the questions. This can lead to rushed or incomplete responses, hindering their true knowledge of the subject.

One possible way of dealing with this problem is to change the approach to evaluation. Unless there are clear improvements in the state of the art, we therefore suggest using online testing modalities for self-assessment rather than graded assessment of student performance, and prefer traditional evaluation methods, which allow you to evaluate not only the result, but also the strategy and arguments used to answer the questions.

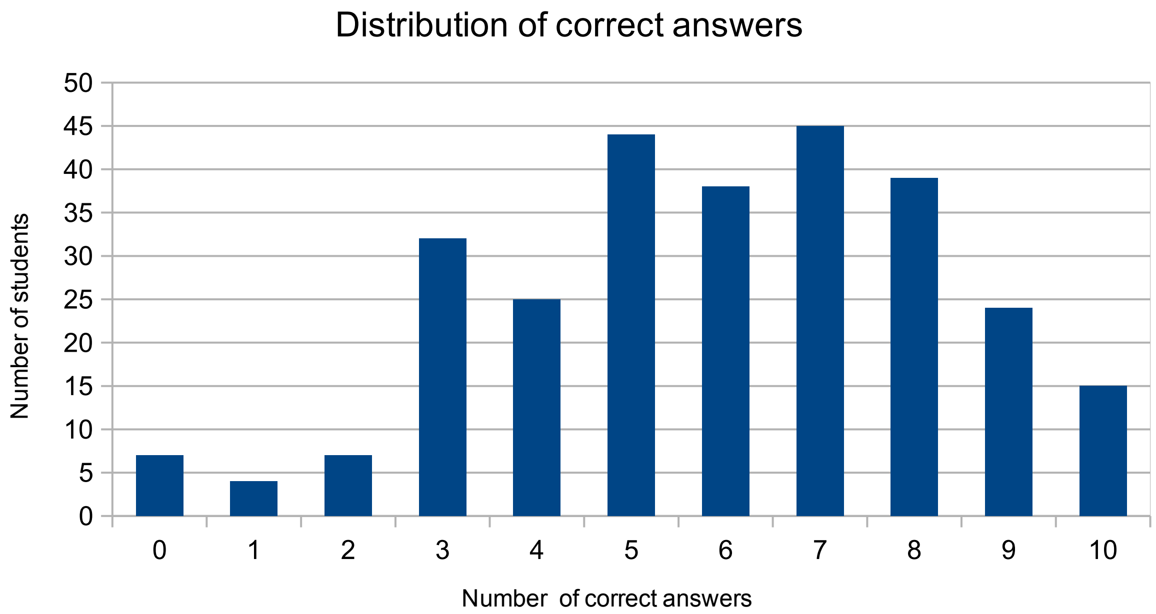

Figure 1: Distribution of the number of correct answers in the whole population.

Before the online test, students had free access to lecture notes that enabled them to progress in their knowledge of the proposed content.

Our online assessment has been tested on a cohort of 280 undergraduate students. Each student had to answer to 10 questions out of 20, randomly chosen between the 20 questions of the online test.

The graph in Figure 1 describes the distribution of answers among students. It can be observed that the majority of students answered 5 questions or more correctly. The seven grades equal to zero coincide with students who cheated and whose exam was cancelled.

If we take into account only the students who have not cheated, the average of the number of correct answers is 6.04, with a standard error of 0.13. The variance is 4.90. The Shapiro-Francia test does not allow to reject the normality of the distribution.
Despite the cheating phenomenon, the results obtained can hence be considered as a good indicator of the quality of the teaching materials produced. It is possible to conclude that the basic lecture notes, together with the online self-assessment, can be a useful tool for introducing the mathematical theory needed for quantum computing.

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