ABSTRACT

Designing, Integrating, and Evaluating Blockchain Assignments in the Undergraduate Computer Science Program

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Blockchain technology offers an interesting opportunity for computer science educators. Blockchains rely heavily on a wide range of computer science topics. These topics include: cryptography, networking, data structures, and algorithms. Many of these topics are explored in undergraduate computer science programs either in core or elective classes. The challenge here is that integrating blockchains into these courses is not easy or straightforward.

The main limitation is in how compact the undergraduate program is. There is not much room for making room for topics as big as blockchain, and creating a standalone elective introduces other logistical overheads not all departments can accommodate. This is where dedicated assignments can come in and provide instructors with a way of including blockchain related topics without excessive overhead. To best align with the undergraduate courses four topics were chosen: application of blockchains, networking, data structures, and algorithms. This work sets out to answer three research questions:

1. Do blockchain assignments fit into the course curricula?

2. Are blockchains effective in demonstrating applications of computer science concepts?

3. Do students feel more confident in their understanding of blockchains?

Designing standalone assignments is a nontrivial exercise. The challenge faced right away is the diversity of skill-sets present in the classroom. Students come into the undergraduate program with vastly different support structures. Students with good support structures enter the program with a comfortable understanding of programming basics as well as exposure to a wide range of topics. On the other hand students also come into this field not knowing anything about coding. The other reality is that courses present in the undergraduate program are also cross-listed for other majors and may not require coding experience as a prerequisite.

To address this diversity of skill-sets two types of assignments were introduced: implementation based, and exploratory assignments. Implementation based assignments follow the traditional assignment structure. Students are expected to implement a solution to a problem using a specified programming language. Exploratory assignments on the other hand focus on high-level concepts that are too big or complex to effectively explore in a standalone assignment. These concepts often explore topics related to industrial applications of blockchains as well as cybersecurity surrounding blockchains.

After creating a small repository of assignments we began working with instructors on integrating them into existing courses. Between 2022 and 2025 our assignments were run

in 6 courses at Marquette and 2 courses at Creighton. In the Fall of 2023 student feedback surveys were introduced. The feedback survey consisted of a Start of Assignment Survey and End of Assignment Survey. In total 133 Start of Assignment surveys were collected and 70 End of Assignment Surveys were collected.

In 2024, we began working with Creighton University. Two classes used one of our assignments. In the first class the assignment was used in its entirety. In the second class the main aspect of the assignment was preserved; however, a different set of expectations and submission requirements was created by the instructor. We collected survey data from the students in those courses, and they showed similar patterns to those collected at Marquette.

The data collected across the study showed favorable results in our efforts in integrating blockchains topics. Implementation based assignments were much more dependent on proper levels of abstraction. This was especially true when it came to complex problems such as designing peer-to-peer applications in C.

Finally, the Likert values collected from the students showed that the assignments were teaching students more about blockchains. At the same time the feedback from the students about the assignment confirmed how well the assignment fit in with the course topics and difficulty. With these answers we can say that teaching students about blockchains through embedded assignments is a successful strategy, and can be refined to be more efficient and target even more classes.