INSTITUTION: Massachusetts Institute of Technology
NSF PROGRAM: CDI TYPE II
PROPOSAL TITLE: CDI-Type II: Collaborative Research: Preparing the Next Generation of Computational Thinkers: Transforming Learning and Education Through Cooperation in Decentralized Networks

PANEL SUMMARY:
Panel Summary

Panel Summary Template

Objective of the proposed work:
This application proposes to explore how cooperation in decentralized networks can be the basis for fundamental changes in learning and education. It will be based on the NSF-funded Scratch learning network, which uses a specially-designed graphical programming language. The proposers will study how young people cooperate in such a virtual organization, what attitudes and motivations are related to their cooperation and what computational thinking skills and capacities are necessary for productive cooperation. Its Broader Impact would be design principles for cooperation in decentralized networks that can be used in a variety of other contexts. More directly, millions of young people in the Scratch learning network will have enhanced experiences in acquiring computational thinking skills.

Overview of reviews: E,V,V,F

Panel Discussion:

Intellectual Merit:
STRENGTHS
The intellectual merit of this proposal is high. Investigators are gathered from a broad, yet complementary, range of disciplines, including computer science, education, organizational science and economics and position themselves as having the capabilities to address complex problems in an interdisciplinary fashion.

The proposed conceptual framework, covering design levers for cooperation, collaborative learning, computational thinking, and broader participation, appears to be well developed and thoughtfully integrated. The framework draws from the individual expertise of PIs while presenting a holistic perspective on the theoretical undertones of the proposal. One of the strengths of the proposal is a useful taxonomy for cooperation and methods that can track how each of these manifests itself in the Scratch network.

The findings would contribute to a better understanding of the design of virtual organizations, particularly large virtual communities. For example, the tone of notification messages and their influence on attitudes and behaviors are applicable outside the Scratch environment. In addition, the results would provide insights into the ways in which online environments can motivate young people to participate in a technical resource such as Scratch.

This proposal describes a broad set of studies for investigating cooperation in decentralized networks in the context of the Scratch learning network. While the proposers are interested in studying the current structure of the Scratch network, they are also interested in considering how to modify its structure so that they can leverage the availability of more knowledgeable peers rather than a totally unstructured network. This is an interesting question both in the specific case of the Scratch network and for the more general virtual organization community.

WEAKNESSES

Although the panel recognized the advantages of working within an already-existing network, there was some concern that the creation of Scratch 2.0 was an incremental step, not a transformational one as expected in CDI. The proposal didn't make clear what were the changes that would be part of Scratch 2.0, so it was difficult for the panel to judge its scope or significance.

The panel was concerned that the research questions in the proposal are numerous and large-scale, but the research methods are underspecified. The panel was concerned that the research questions in the proposal are numerous and large-scale, perhaps a wider research scope than can be achieved in the time and budget; perhaps as a result, the research methods are underspecified." The proposal would be stronger with a more detailed and concrete research plan, including some examples of data collection and analysis that they have carried out in the past. In that context, more detail on IRB issues would be helpful.

Log file analysis is hard, but the project/advisory board doesn't have anyone with significant expertise in that field. The project should add someone who can support their work in log file analysis.

Broader Impacts:

STRENGTHS

The proposers point out that there has been a significant drop in women in computer science over the past decade, a serious concern about the computer science pipeline. There is some evidence that computer science education using software like Scratch in a cooperative environment can support increased participation by women and other populations sometimes "turned off" by traditional approaches to computer science education. Thus, their work has the potential to increase girls' involvement in computer science.

Given the wide distribution and usage of the Scratch environment, it seems likely that even incremental

improvements to Scratch will have a broad impact. The proposers already have significant presence in youth culture, so there is a built-in audience for the results of their work.

CDI Responsiveness: The proposal is clearly potentially transformative in the field of learning sciences, in particular with regard to computational thinking.

This work will also advance the agenda of the Berkman Center at Harvard, where one of the PIs works. Significant knowledge about how design choices in decentralized networks affect their cooperative characteristics can be an important contribution to the science of virtual organizations.

Panel Ranking: Competitive

This summary was read by/to the panel, and the panel concurred that the summary accurately reflects the panel discussion.

PANEL RECOMMENDATION: Competitive
PANEL RECOMMENDATION KEY:
:, NC:Non-Competitive, C:Competitive