Introductory Remarks to Essay 5

Walter Bender

Marvin Minsky's theories of mind are largely theories of learning. The central theme of this essay is questioning "general" education with a discussion of "cognitive towers" (levels of mental activity), a construct from the theories laid out in *The Emotion Machine*.[1] These theories encompass both machine learning and people learning and inform one another. Minsky's contributions to "learning by people" are best exemplified by his close collaboration with Seymour Papert and Cynthia Solomon. Minsky had an influential role in their efforts to use the Logo programming language as a vehicle for introducing children to computational thinking, which they define in terms of things to think with and to reflect on.

In 1971, Papert and Solomon published "20 Things to Do with a Computer," a catalog of engaging open-ended projects to explore using Logo.[2] Minsky contributed to many of the "20 things"; his contributions, ranging from robotics to music to the visual arts, directly reflect some of the personal interests that drove his own learning. Throughout the 1970s and 1980s, children used Logo as a tool for the autonomous construction of meaningful artifacts and for solving problems that were personally meaningful.

The "20 Things to Do with a Computer" memo was a harbinger of what is now referred to as the "maker movement," a largely

extracurricular collection of activities that offer an outlet for students stifled by trends in general education, which has become increasingly regimented in an era of high-stakes testing and accountability. Arguably, one difference between the maker movement and the work of Minsky, Papert, and Solomon is that *makers* tend to focus on the artifact being created, whereas Minsky and his colleagues focused on the learning associated with the construction of the artifact.

The potential impact of computational thinking on learning was made concrete in Minsky's collaborations with Papert and Solomon, but it has only recently—in the form of programming—evoked interest in mainstream educators. Learning to program is being touted as the cure-all for much of what is allegedly wrong with education: "Even humanities graduates can learn how to code in a few months and join the high-paying digital economy."[3] Through promotions such as "the Hour of Code," programming is being adopted into formal and informal school curricula throughout both the developed and developing world.[4] Although efforts to promote programming are not all superficial, even under the best of circumstances, learning to program in and of itself does not help children "to learn to develop their own, independent ideas." Further, programming at most schools is taught like other "'basic' subjects" as the accumulation of "scattered fragments of knowledge" (essay 5, "Questioning General Education").

The approach to learning to code developed by Minsky, Papert, and Solomon immersed children in problem-solving and debugging. Children were given agency to work on problems they were passionate about in a context in which there was an expectation that there were no predetermined solutions or prescribed paths to a solution. It was in the early 1970s that Solomon first talked about debugging being the greatest learning opportunity of the twentieth century. While engaged in problem-solving, children were

developing and refining the algorithms employed by the agents in the various levels of their cognitive towers.

Some of the ideas Minsky expounded are now being realized on a large scale. For example, Finland has questioned general education. Pasi Sahlberg, when discussing the decision to eliminate subject-based classes from the curriculum in Finnish schools, observed that

> integration of subjects and a holistic approach to teaching and learning are not new in Finland. Since the 1980s, Finnish schools have experimented with this approach and it has been part of the culture of teaching in many Finnish schools since then. This new reform will bring more changes to Finnish middle-school subject teachers who have traditionally worked more on their own subjects than together with their peers in school.[5]

Students will be applying tools across disciplines in a manner that better reflects learning across and between multiple mental levels. It will be interesting to observe the impact of this change on generations of Finnish children in the coming decades.

Much has changed since Minsky wrote this essay. It predates the proliferation of smartphones and "apps," Chromebooks and Google Docs, massive open online courses (MOOCs) and online reference resources such as the Khan Academy videos. Educational technology (Edtech) has become big business: selling apps and content is more lucrative and facile than the hard work of engaging teachers and learners in authentic problem-solving. In Edtech, there is a strong temptation to make things as simple as possible so as to reach the broadest possible audience. But some things are inherently complex, and though apps might be fun, the hard part of "hard fun" is in reaching toward that complexity.[6] Children should not miss out on the *playful learning* that takes place while they are learning to use tools to solve real-world problems. The potential for computational thinking and theories of mind to have a positive impact on general education has never been greater.