Worldfolios

Collaborative Problem Solving for AI&K12

Executive Summary

A national crisis that U.S. is facing is to sustain excellence in STEM disciplines as these disciplines have significantly lower rates of retention than do the social sciences and humanities, and many students who leave STEM majors express dissatisfaction with the ways STEM classes are taught.

A shift from the traditional lab-based courses to discovery based research courses is inevitable to motivate students to stay in, and enjoy, STEM courses. With a very high student-to-faculty ratio in most STEM majors today, we believe only technology can help to achieve this transition. We use the term "AI&K12" to designate an evolution from traditional STEM education to its next generation.

The core of AI&K12 consists of three basic concepts that are complementary to each other: Personalized, Trans-disciplinary, and Collaboration:

(A) ***Personalized:*** Traditional education is modular and structured - Students need to learn (all) basics of a subject before continuing to the next subject. A major problem with this approach includes:

1. Students who are stuck in one subject cannot proceed to the next subject.
2. Students often do not see real-world problems until in the latter stage of education.
3. Students may waste time on learning parts of a subject that are less useful in solving problems.

We believe a personalized, problem-driven approach can solve the above problems. Students are more motivated in solving real-world problems, where the problems may come from a library or posed by students themselves. Students who learn how to solve a problem may generalize his knowledge to solve similar problems. By solving multiple problems students are expected to cover the same set of subjects following a more effective path.

(B) ***Transdisciplinary:*** Traditional education is standardized, that students are trained in one discipline. This model unfortunately may create boundaries in supporting interdisciplinary problem solving. Trans-disciplinary education differs from the traditional education model in that the boundaries between disciplines are eliminated.

Trans-disciplinary education may be facilitated again by a problem-driven approach, as described in (A), where resources (data, knowledge, skills, etc.) from different disciplines are synthesized to solve a problem.

(C) ***Collaborative:*** Collaboration is of fundamental importance to achieving excellence, as everyone is limited in knowledge: Teachers can collaborate to improve teaching, students can collaborate to improve learning, and, of course, teachers and students can collaborate to maximize the benefits of education. Collaborative education includes group-based projects, sharing of resources and knowledge, and incentive-based collaboration.

Among others, an important technological foundation is *Semantic Computing* (SC), that addresses computing technologies allowing users to search, create, manipulate and synthesize computational resources (including data, documents, tools, people, devices, etc.) based on semantics ("meaning", "intention").

We propose to provide a semantic problem solving platform, called *Worldfolios*, to facilitate personalized, trans-disciplinary, and collaborative problem solving where "resources" for problem solving (including data, knowledge, tools, people, devices, etc.) can be dynamically connected to solve problems. The connection between resources can be made via (1) semantic interfaces, which interpret and understand problems; (2) semantic analysis, which analyzes the resources available; and (3) semantic synthesis, which integrates multiple resources into a solution. The "domains" in *Worldfolios* are organized and connected both horizontally and vertically, based on the structure of knowledge at all granularities.

The first objective of the project is to integrate AI tools into a STEM curriculum for continous evolution. The second objective is to provide the next generation Wikipedia that everyone can contribute. It will work with leaders of each industry and K12 teachers to develop the content of transdiciplinary problem solving. The project will start with a series of short courses that educates teachers about the components of AI, how AI can help solving problems, and a tutorial of *Worldfolios*. The short courses will lead to a working group that adminstrates the development of the project.