A Teacher for Every Learner

Scalable Learner-Centered Systems

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20-Year Vision

- Information Technology enables all learners to participate in a network of communities, where they engage with other learners, mentors and teachers in self-expression, exploration, and learning by discovery and by doing
- The learning environment continuously assesses and adapts to each learner's needs

The Social Challenge

- Create a universally well-educated citizenry that can adapt to a changing, global society
  - For economic growth
  - For social and personal well-being
  - US international leadership in education
- Greatly enhance all learners' abilities to learn, and enjoyment of learning, over their lifetime
  - All levels of learners
  - Customization for learner's needs
  - Learning to learn

Mission

Informed by advances in learning sciences, pedagogical design, and assessment theory, lower the effective student-teacher ratio to 1:1 by building the technological infrastructure to support dynamic, ad-hoc communities of lifelong learners who interact within an environment of learning objects through a creative blend of advanced computing technologies, high performance networks, authoring and collaboration tools.

System View

- Components of the learning environment are human and virtual learners, teachers, mentors, colleagues, domain experts and tutors.
- Every learner is immersed in an environment consisting of multiple communities of learning and teaching entities connected via high-performance networks.
- The learning environment assesses each learner continuously and adapts to his/her needs transparently.
- Advanced authoring tools allow all participants to enhance the learning environment through the construction of both new learning objects and compositions of interoperable ones, including software agents and intelligent avatars.

Why has IT Not Yet Transformed Learning?

- Underinvestment
  - Less than 0.1% of total spending is spent for R&D in K-12
  - Compares with 2-3% in mature industries, 10-25% in high-tech, life-sciences
  - $10/student/year for software in K-12
  - Inadequate teacher training
- Inertia in social systems
  - More pressing social problems
    - Hunger
    - Homelessness
    - AIDS
  - Lack of parental involvement
  - Archaic notions of assessment
  - Intellectual property issues

Measurable Goals

- 1-Sigma improvement in Science-Technology-Engineering-Math performance by high-school graduation.
  - 1-1, live tutor demonstrated to yield 2-sigma.
- Every child reads effectively by 4th grade.
- Average time-on-task increases by 20%
- High-school students graduate with the necessary information-technology fluency to hold a knowledge-intensive job.

Technical Challenges

- There are technical challenges in each of the following educational genres:
  1. Cognitive tutors
  2. Simulation-based, interoperable models
  3. Massive-multiplayer-gaming
  4. Collaborative authoring
  5. Learning in context/mobile learning

Cognitive Tutors

- Example: PAT (algebra tutor)
- Reducing the cost of knowledge engineering
- Interoperability and reusability of models for students, experts, and the learning process
- Adaptive and self-improving systems

Simulation-Based Models

- Example: Now --- physics of motion; Future --- digital human
- Semantics of (model) interoperability
  - Extending component frameworks to support interoperability of models at multiple levels of sophistication
    - Discovery, negotiation, graceful degradation
- Modifiability and extensibility of models, while preserving acceptable fidelity
  - Scripting by nonprogrammers
  - Programming by domain-knowledgeable programmers

Massive-Multiplayer Gaming

- Example: Quake
- Capture the motivation of “twitch” and exploration gaming in educational software
- User-developed avatars/agents
- Scalability and performance for ad-hoc collaborations

Collaborative Authoring

- Example: SQUEAK
- Interface support for complex tasks (scaffolding)
- Smooth flow for collaborative tasks among learners
- Authoring/Scripting/Programming spectrum

Learning in Context and Mobile Learning

- Example: Probeware

- Designing for small form-factors
- Ad hoc dynamic learning paradigms
  - Dynamic matching of learner and tutor
- Impedance matching small mobile devices and large Scientific Instruments
- Large-scale data fusion

Summary

- Education has remained static for 800 years. It's time to do something
- Information technology uniquely provides the means for transformation
- We need the social will, the investment, and our science to change the world of education
- Get involved! Help create a teacher for every learner