Distributed and United

Julita Vassileva
Computer Science Department
University of Saskatchewan
Saskatoon, Canada
This talk is dedicated to my 9th grade math teacher

Emil Popov
Contents

- Individualization
- Learning communities
- I-Help
- The issue of motivating participation
  - Through compassion
  - Through money
  - Through friends
- Creating a culture
What makes a good teacher?

- Mastery of material
- Ability to organize the presentation and interaction with the learner
- Pedagogical skills
- Understanding the learner

These features have been addressed by research in AI and Education
What makes a **great** teacher?

- Ability to guide “discovery”, leadership
- Ability to motivate and push
- Spontaneity and surprise
- Personality and artistic skill
- Charisma …
We have tried to simulate the teacher

- CAI in the 60’s
- Multimedia courseware continues to be “best-seller” in the 90’s
- Web-based courses – big and growing market now
- Pedagogically – not too successful
Focus on the individual

- Dynamic Courseware Generation (DCG)
- Reactive Planning of:
  - Contents
  - Presentation strategy
  - Problem-solving (coaching)
- Overlay Student Modelling
Pedagogical Planning in DCG

Instructional Tasks and Methods

- Give provoking Problem
- Present the goal
- Show task plan
- Teach concept
- Test Knowledge
- Make Exercise
- Present Exercise
- Question Solution
- Verify
- Check Response
- Inform Student
- Remedy
- Elaborate on sub-problems
- Examine
  - by example
  - by description
  - by analogy
- Give Correct Solution
- Give Hint
- Retry

J. Vassileva ICCE’2001 Invited Talk
Coaching Users in Problem Solving

\[ \frac{1}{2} \int \frac{dx}{x+2} \]

Partial Fractions

\[ \frac{1}{2} \int \frac{dx}{x-2} \]
\[ \frac{1}{2} \ln|x-2| \]

Algebraic Transformation

\[ \frac{1}{2} \int \frac{dx}{x+2} \]
\[ \frac{1}{2} \ln|x+2| \]

\[ \frac{1}{2} \int \frac{2}{x^2-4} \]

Variable under Differential

\[ \frac{1}{2} \int \frac{du}{u-4} \]
\[ \frac{1}{2} \ln|u-4| \]

Substitution \( u=x^2 \)

\[ \frac{1}{2} \int \frac{u}{u-4} du \]

Reverse Substitution

\[ \frac{1}{2} \ln|x^2-4| \]
DCG:
Adaptive Teaching: Planning contents and delivery

I too want individualized instruction!
The ultimate result?

- Instruction ultimately tailored to the individual
- A system that truly “cares” for the learner

- But maybe sometimes the learner should adapt, not the environment?
- Otherwise it would be a very lonely learner
Learning is adapting

Dialectic between Cognition and Experience (Immanuel Kant, 1781).

Maturana & Varella
Learning is communication

Conversation Theory of Cognition
(Pask, 1973)
Focus on the learning experience and communication

In the last 10 years we have seen:

- Constructivism
- Social cognition
- Collaborative learning environments
- Open learning environments
Technology development

Distributed Environments

- distributed applications: plug-ins, applets, shared object libraries
- connected users, resources, applications
- hybrid societies
Learning communities

- How to provide continuous support for a community of learners?
- How to provide a shared medium?
- How to cater to the individual?
- How to motivate participation?
- How to ensure focus and guidance?

These are some of the features that make the great teacher!
Large classes
No possibility for individualized feedback
Various levels of knowledge in the class

Students could help each other!

(Jim’s and Gord’s idea)
I - Help: a community of peers
What is the shared medium?

Public discussion forum (asynchronous)

E-mail (asynchronous)

2-line chat tool (synchronous)

Chat-rooms (synchronous)
Individualization in I-Help

In matching people with appropriate partners → depending on their

Different Matchmakers

- Knowledge
- Cognitive style
- Star-sign
- Eagerness
- Helpfulness
- Social ranking
- Relationships

From self-evaluation
From diagnostic application
From peer-helper evaluation
From diagnostic application
From self-evaluation
From diagnostic application
From self-evaluation
From agent-evaluation
Distributed learner modelling

“Active”

- No predefined behavior to be adapted \( \rightarrow \) Behavior Emerges!
- “Just in time” generated models
- Depending on:
  - The purpose of adaptation
  - The available user model information
  - The trust relationships with other agents
  - The circumstances (who is around) and resources
- Focus on the process, not representation

I - Help deployment results

- Deployed for 2 years, 2000+ users, all undergrad CS classes, in the UK, France and Colombia

- Lessons learned:
  - Usage / participation varies greatly
  - Should be perceived as adding value
    - Initial knowledge investment from instructor is crucial (apprenticeship)
    - After reaching a “critical mass” becomes self-feeding

The most important lesson

- The most exiting technology is worthless, if not embraced by a large user community
  - Example: NAPSTER, KaZaA

- A very simple technology can be invaluable, if supported by an active user community
How to motivate participation?

Why do people offer their time and resources?

- Different people have different motivations
- Some are altruists (intrinsically motivated)
- Some would help their friends and hope to make new friends through helping
- Some seek glory
- Some seek attention
- Some seek high marks
- Some seek money (extrinsically motivated)

We need to provide a mechanism that appeals to every individual, depending on his/her motivation.
Appealing to the compassionate

- Animated, believable interface Agents
- Personal agent as a persona
- Goal:
  - to invoke emotion (compassion) in the user
  - to persuade user to help
- Study:
  - the persuasive power of an “emotional” agent

J. Vassileva ICCE’2001 Invited Talk
Experiment with Emotion

**Goal:** to find if integrating *emotional qualities into personas* impacts the student’s *performance* and *perception* of learning

- Experiment:
  - An introductory interactive course on C++ delivered by an animated persona
    - material presented by human voice
    - users have to answer test questions
    - persona responds to test performance with facial expression

- Two test conditions:
  - Emotional engine = “on”
  - Emotional engine = “off”
Emotional Engine in the Persona

Valenced Reaction To

- Consequences of Events (Pleased, Displeased etc.)
- Actions of Agents (Approving, Disapproving etc.)
- Aspects of Objects (Liking, disliking etc.)

Emotion States

- Happy
- Sad
- Pleased
- Surprised
- Neutral
- Angry

Facial expression for six major emotional states (Ortony, 1988)
Preliminary Results

Girls felt a pressure to perform better in order to please the persona!

• all participants preferred the emotional persona

• no significant difference in the student’s performance

Appealing to the materialistic
The I-Help economy

- Human help has costs (time, effort)!
  - It shouldn’t be misused!

- Market regulates the supply and demand
  - help in exchange for currency
  - rate of pay negotiable (by agents)
  - users can set parameters of agents
  - pay a penalty if agent’s deals are ignored
The agent negotiation

Each agent decides to counter-offer or accept an offer by calculating a utility function with factors:

- money importance (greediness, stinginess of user)
- importance of the current goal
- importance of the relationship between the users
- risk attitude
- perceived utility function and factors of the other agent → agents model each other
The currency

- A bit like Sun java’s “Duke Dollars”
- Everyone gets an initial allotment
  - helpees pay, helpers earn
  - what happens when someone runs out?
  - finding useful course resources pays
- Redeemable for “prizes”
How to cash in the end?

- Depends on the values of the community
  - Marks – in a real classroom setting
  - Real money – in a workplace setting /distance educ
  - Reputation (top 10 list) – always useful
  - Visibility in the society based on reputation – Slashdot.com, thewines.com

- In our case
  - Marks – not allowed
  - Souvenirs not stimulating
  - Reputation, visibility – a better way
How to steer the economy?

Simulations:
- Electronic marketplaces
- Agent society, emerging norms
- Emerging groups

Real world evaluations:
- Real rewards
- Monitoring user activity
- Comparing with agent models
- Reconstructing scenarios
- Questionnaires

Emerging cooperation among agents
- Ethical vs. non-ethical agents
- Looking for equilibrium states
- What measures effect the emerging behaviour and equilibriums

Social systems simulation

Users

"Big Brother"

All money out by rewarding student with marks / items

Allowance or "salary"

Free instructional
Supporting social relationships

- Agents can take into account interpersonal relationships
  - In seeking help
  - In negotiation
- Agents can help in building new relationships among users
  - Agent coalition formation
  - Trust-based mechanism
- Forming user groups

Simulation results

- In the agent world, simulation shows that coalition formation brings:
  - stability and predictability in the agent society
  - increased benefits for the agents

- In the human world, still to evaluate:
  - Can people become friends through their agents?
  - Does agent coalition help build stable and productive learner teams?
Create a learning culture!

The 5 “R”s (Hilarie Davis):

- **Roles** – people who sustain the community
- **Rules** – ethics of behaviour, reward system
- **Rituals** – routines, predictable things, to make the participants feel safe
- **Rounds** – regular events, customs, things to expect and look forward to
- **Rings** – surprises, interesting unexpected things, “be always there or you’ll miss it!”
How to ensure focus and guidance?

- Rituals – How to make users feel safe:
  - “Anonymous” users
  - One user → different roles
  - But then how do you find your new I-Help friend in the real classroom?

- How to plan surprise?

- How to make them come back again?
Conclusions

- Ultimate Individualization ➔ Distributed, Lonely Learners

- Learning Communities ➔ United Learners
Conclusions

Supporting Learner Communities

- **Multi-Agent Architectures** provide a lot of useful tools and metaphors
- **Individualization** is important
- **Motivation** is important (individualization here too!)
- Research into **heterogeneous agent economies** is needed (differently motivated agents)
- **Studying the culture** of the user population and creating a productive learning culture is vital!
Questions?

More Information:
http://julita.usask.ca/
http://bistrica.usask.ca/madmuc/
http://www.cs.usask.ca/projects/aries

Contact: jiv@cs.usask.ca