Learning-by-Doing in a Computer-Based Simulated Environment

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Two activities this week

Today:
• What has been done in this field
• What I have done in this field
• Objective: show you that this is a useful idea/tool for learning

Friday:
• Workshop, What tools can be used, how
• Objective: show you that you can do it
Outline of presentation

- On current virtual learning
- Schank and learning by doing
- Novices and experts performing tasks
- Main postulates in learning by doing in a simulated environment
- Examples in forensic engineering
- Adding tech, concepts
- Adding virtual tutors
Good news

- New tools are available for virtual learning
- Every university student has a laptop/internet access
- There are new opportunities to learn in a computer-based environment.
  - Different learning styles
  - There is no local expert to teach special topics

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Bad news

Most current implementations are very similar to the old ones:

- Read text, turn page, read more text, ... take multiple choice test...
- Old books in new designs...

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Learning in a simulated environment

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Roger Schank and two old ideas

Learning by Doing

Doing in a computer-based simulated environment

Case-based reasoning

Simulated cases solved by the learner

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From case-based reasoning to e-learning
Schank: Coaching for a job

IBM Coach - Microsoft Internet Explorer

"I'll be in this weekend"

You caught me at a bad moment! Actually, I love the job and I feel it's going well. I am a bit overextended now, but things are under control. The team's not working effectively yet, but things are getting done.

Lisa looks matter-of-fact.

Ask Lisa to elaborate on her comment about the staff not working effectively

Pros and Cons

Ask Lisa if she is concerned about balancing her work and personal priorities

Pros and Cons

Ask Lisa what you can do to support her in working with the team

Pros and Cons

Remark that Lisa has been putting in a lot of hours for some time now

Pros and Cons

Acknowledge the frenetic pace of the project and suggest Lisa consider taking some time off

Pros and Cons

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Main postulates

Training that is carried out on a computer should involve some form of simulation, in which the learner plays a role in doing something.

Failure is an essential part of e-learning.

The environment should be designed so that it can provide the learner with several ways to support the learning.

A learning environment may be effective if it is related to the interests of the students.

The learner should be able to ask questions to an expert when she needs it more.

In Schank’s approach
Main concepts

- Active learning
- Simulation
- Expectations
- Failure
- Experts and novices
- Constructivism
Activities this week

TODAY:
- Our field of interest: SMET, Science, Mathematics, Engineering and Technology
- Implementation in Engineering, graduate school

FRIDAY:
- Schank does not indicate how the computer-based system is organized
- This may discourage a newcomer to the field
- Workshop attempts to show ways to implement Schank’s approach in (your) practical situations
What is an expert?

- ...  
- Experts solve problems by considering the **main principles** that are relevant to the problem, and they think about the reasons why they are relevant and the **procedure** required to apply those principles.  
- ...
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Novices performing in a case

- Problematic case
- Perform task on case
- Outcome for learner
- Outcome for case
Novices performing in a case

- Failure to perform up to a standard has severe consequences and may lead to undesired consequences
- A young student should not learn in the real world

Various possibilities:
(a) An accompanied performance, in which the student is the assistant to an expert and learns in the field from her master.
(b) A simulated situation, in which the student may perform and there are no consequences if she makes a wrong choice or follows a wrong path.
Present strategy

- The learner is placed in a role.
- She learns about the problematic situation to be solved
  - through a communication with a simulated character,
  - who requests the help of the learner to perform an action.
- Details of the problem are provided once the learner has explicitly accepted the job.
Understanding the causes of failure of a structure
Understanding the causes of failure of a structure

• The learner is placed in the role of an independent consultant who is called by a firm to start an investigation on the causes of a failure.
• Story centered learning
• Low use of multimedia

• GO TO SIMULATION
Adding audio and video

- It is now possible to include audio and video files in compressed format, to make a more realistic story

- GO TO MISSION ASSIGNMENT USING VIDEO
The objectives of this activity are:

- To introduce a historical perspective into a technical engineering course. It is important that students recognize that knowledge has not been developed recently.
- To familiarize students with the use of sources written centuries ago.
- To improve argumentation skills.
- To learn how to write a white paper.

GO TO SIMULATION

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Virtual tutors

• If the student does something without supervision, maybe he/she will not learn to do it right, or it will take a long time.
• Experts are not always locally available.
• Experience should be captured from real tutors in order to build virtual tutors.
• Not just one type of virtual tutor, but several, each with a specialized function: Storyteller, Analyzer, Teacher,...
Adding a Storyteller

- This character tells a story that is relevant at the for the solution of the problem.
- The story may be similar to the story that served for the construction of the simulation.
- The Storyteller tells cases, not general knowledge.
- The interaction with the student may be simple or complex, including that the Storyteller only tells things if he is asked to do so.

GO TO STORYTELLER
Adding a Teacher

- The Teacher is introduced to tell knowledge that is required for the solution of the problem.
- The Teacher tells general knowledge, not cases.
- Emphasizes contents.

GO TO TEACHER
Adding an Analyzer

The Analyzer provides an analysis of a situation so that the student can make a better informed decision.

The Analyzer provides information in the form of rules, not cases.

Emphasizes criteria.

GO TO ANALYZER
Adding a Computer Center

- In a limited time, calculations usually have to be carried out beforehand and given to the participant in row format, so that he/she has to make sense of it.
- Alternatively, special purpose software may be developed to carry out the computations.
SIGREs: Solid Waste Management

- SIGReS: “Simulacion del Manejo de Residuos Solidos”, developed with Dr. Nora Valeiras

- Objective 1: To generate a computer simulation to enhance scientific skills in students.
- Objective 2: To visualize the consequence of decisions of stakeholders in handling solid waste.
System elements

Residuos generados

Separación en origen

Separación fuera de origen

Separación Municipal

Incineración

Relleno sanitario

Cielo abierto
Future work

- We are developing more modules (once you start, you do not stop).
- Incorporate multimedia instead of written text.
- We believe that there is potential for learning by doing in engineering courses, using simulated environments.
- Engage more people in this effort.
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