Title
Educational Tools for What You Wanted to do Anyway

Permalink

Journal

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Publication Date
1991

Peer reviewed

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for
What You Wanted to do Anyway

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Abstract

Approach, Technologies and Goals

This paper describes a set of educational tools designed to support central cognitive skills such as argument analysis and construction, cooperative negotiation, collaborative writing and scientific inquiry. In building these tools we drew upon multi-media technologies, interactive video and object-oriented programming techniques. Our approach however, was not motivated by the technologies but rather by a desire to embed our educational objectives in situations which were intrinsically interesting to the students. This approach, alluded to in the title of the paper, came out of our intention to have the student feel good about her personal interests, and further to have her feel good about her intellectual competence as a vehicle for furthering her interests.

Outline

Three tools will be described[1]. The first supports learning to analyze and construct arguments which are effective at both a psychological and sociological level. The second is a tool for collaborative negotiation. The third tool, supports: scientific inquiry; the building of theories/models; and the use of explanatory theories to help the student effect her environment.

Psychological and Social Analysis and Argument Construction

This application [2] was conceived of as a tool which would take the task of learning a foreign language (French) beyond the task of only learning vocabulary and syntax and into the task of learning to be effective in the culture in which the language was spoken.

In using this application the student interacts with a program in which she encounters and analyzes some powerful 'cultural icons' and then constructs arguments for the purpose of effecting their actions.

Technology and Scenario

Using the language *Muse*, (Hodges, Sasnett, & Ackerman, 89; Hodges, Sasnett, & Harward, 90) we created an interactive, multi-media tool which runs on both MicroVax and RT workstations. Students using the tool were presented via video disk[3], with a story whose protagonist was named Philippe. Although quite likeable, Philippe had, through his flakiness just lost his job, his girl and his apartment.

As a result, Philippe was faced with a set of challenges: He had to convince an appropriately sceptical realtor, M. Jacot, of the "Paradise Realty Co.", that he would be a responsible tenant. As a fallback position, he felt that he also needed to convince his aunt, a staunch pillar of the bourgeoisie, that he is the perfect choice for house-sitter during her up-coming three month African safari. Additionally, he had to deal with a plumber over the leak in the kitchen sink in the apartment he had shared with his lost love Elisabeth.

Philippe as a character is too discombobulated to deal effectively with these situations. This creates the opportunity for the student to step in and argue on Philippe's behalf[4]. The intrinsic interest here is that these are challenges which the college-age students using the program are just beginning to face in their own lives.

Student Exercises

For reasons explained below we have created two versions of the tool, each calling for analysis and explanation:

1. Direct Version:
   Here the student directly argues with the realtor, the aunt and the plumber on behalf of Philippe. As each situation arises the program presents the student with a list of topic sentences each of which could form the core of an argument. The student chooses the topic which she feels would be most effective given the station and nature of the character Philippe is currently confronting. She additionally goes on to construct an argument for Philippe. The full text of her argument is sent off to an instructor for later grading; however, the topic she has chosen has an immediate effect because multiple outcomes are stored on the disk. For example, Philippe's inability to get the plumber to come and fix the kitchen sink over the last six months has contributed to the break up of his relationship. Elisabeth has finally made the appointment herself and has asked Philippe simply to let the plumber in to the apartment and to pay him. However, Philippe has not paid attention to where Elisabeth has left the check. If the student can convince the plumber to, on this one occasion, extend credit to Philippe Elisabeth becomes convinced that Philippe has turned over a new leaf; the story therefore ends with Elisabeth giving the relationship another try. If the student is unsuccessful with the plumber but convinces either the aunt and/or the realtor of Philippe's trustworthiness Philippe writes Elisabeth a rather cool 'Dear Genevieve'. If none of the characters are convinced, Philippe is left at the conclusion of the story to face another difficult day.

2. Agent Version:
   This version differs from the Direct Version in that at the outset of the story the student

chooses an agent to argue on Philippe's behalf (Laurel, 90; Oren, Salomon, Kreitman & Don, 90). The agent is either General Charles De Gaulle or the torch singer Edith Piaf. The student chooses the agent after seeing a description both of the agent's role in French society and of the agent's (strong) character. Additionally the student sees a video segment of Piaf singing her theme song "La Vie en Rose" and historical photos of DeGaulle's imposing presence.

As the situations with the realtor, the aunt and the plumber present themselves the agent offers to make one of three arguments. The topics of the arguments are the same as the ones in the Direct Version; here however, the student sees the full argument, rather than just a topic sentence. The arguments, written by a French historical novelist, are very much in the distinctive 'voice' of the agent. The student chooses the argument which she feels would be most effective if presented by the agent. The student then *explains* her choice and sends it off for later feedback. Again the choice of argument effects the outcome of the story.

Examples of the Arguments: Cultural and Psychological Analyses To give the reader a sense of the nature of the student's task we present first some of the topics from the Direct Version and second some of the arguments from the Agent Version among which the student has to either choose or elaborate upon.

1. Direct Version: Topic Sentences from which to construct arguments for the realtor

(a) "Philippe has always paid his rent on time."

(b) "Philippe comes from an old and respected family."

(c) "Philippe is a well connected journalist."

The argument that will convince the Parisian realtor is different from the one which would be most likely to convince his American counterpart[5]. Journalists enjoy a privileged position in French society and their presence is welcome even when their credit history is shaky. The student needs to call upon this kind of knowledge of cultural differences when choosing and constructing an argument. (This is not an impossible task since cultural mores are discussed in the

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[4]The story, the tasks presented to the student, and the responses required from the student are entirely in French.

[5]Notice there is room for the student to successfully disagree with our sense of what constitutes a winning argument during the later interaction with the instructor.

French course in which the users of this tool are enrolled).

2. Agent Version: DeGaulle's arguments for the plumber

(a) "Monsier Morel, looking around, you can surely see that Monsieur [Philippe] Vitaz is perfectly capable of paying you. He clearly has the means to make good on his debt. A man born as Philippe is will not fail to discharge his debt! It is a question of honor!"

(b) "Monsieur Morel, for the French, each must trust the other. What would happen to our country? Our country without the solidarity which has always been its strength? I tell you, to trust Philippe, it is your obligation."

(c) "Monsieur Morel, your reputation is known. It is said that no plumber is better than you. Monsieur Vitaz, by all evidence, is in need of your good services. May I allow myself to ask you, in this one case, to have the goodness to make this repair?"

Again the winning argument is not obvious. Having seen the video of the plumber the student sees the degree of Plumber Morel's pride. However, from the way in which he takes command of the situation, savors the difficulties of a leaky sink and wields the tools of his trade it can be inferred that his pride in his craft outweighs his pride as a Frenchman. This kind of careful arguing from the evidence is what will allow the student to make a successful choice.

We claim that both versions of the tool ask the student to develop a type of understanding which is central in language learning. Further we believe that the activities of analysis, and careful arguing from evidence have general utility. Our hope is that the student will also gain confidence as she develops the skills associated with using the tool.

Motivation Behind the Two Versions

Both versions have the strength that they provide rich analysis and explanation tasks. However, each has a weakness. In the Direct Version the program knows which topic the student has chosen to argue on and takes a path based on that choice of topic without regard to the *goodness* of the argument. We were uncomfortable with the possibility of the students noticing this limitation. That is, if a student was unable (or unwilling) to create an explanation which she felt was adequate and the outcome of the situtation was still positive the tool would suffer in the student's eyes. For this reason we constructed the Agent Version where,

complete and well formed arguments were provided within the program. In order give the students using the Agent Version an equally rich task we asked them to *explain* their choice rather than construct the argument[6].

The possible limitation of the Agent Version is that since the student effects the outcome of the story in a less direct way she may feel less engaged and therefore she may learn less. Currently we are comparing the two versions of the tool to assess the relative strengths and weaknesses of each.

Collaborative Negotiation Tool

Here we describe a tool which allows parties to negotiate in a non-adversarial way. It is implemented in Object Lens (Lai, Malone, Yu, 88; Malone, Grant, Lai, Rao, Rosenblitt, 89), an object-oriented system running on both Apple and Xerox machines.

The tool guides collaborators through a cooperative (as opposed to an adversarial) negotiation. At the same time, it provides a sort of spread sheet for keeping track of the state of the negotiation. The tool purposely does not make any decisions for the parties since the goal is to have the parties develop those skills for themselves.

The process is cooperative in that the two (or more) parties *jointly* build a solution by considering the needs as well as the resources which they bring to the table. They can assume cooperative positions because they are allowed to back off from any initial unilaterally proposed solutions as they are prompted through the following stages (Susskind & Cruikshank, 87; Brockner & Rubin, 85; Raiffa, 82; Fisher & Uri, 81; Fisher & Brown, 88):

1. Problem Statement: Both parties state the problem as they see it.

2. Initial Solution: Both parties propose an initial solution which is satisfying to their side.

3. Underlying Needs and Resources: Based on their 'Problem Statement', *rather* than on their 'Initial Solution', the parties jointly construct a list of what they need from the situation and what resources are available.

4. Collaborative Solution: The parties jointly construct a new solution by considering how the 'Resources' match the 'Needs'.

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[6]Of course the problem still remains that the students could construct half-hearted explanations but we felt that this was less serious. That is, it would still make sense to the student that the story was being positively affected by the agent's cogent argument, even if the student's explanation of the argument was less than it should have been.

5. Iterating: Both parties can now examine the fit between their needs and the new collaborative solution. They may accept the solution, further clarify their needs or rework the solution.

At each stage in the process the system offers the parties a workspace which is designed to make it easy to enter and consider the needed information. The work spaces are object-oriented windows.

Because the solution process involves making the resources of the situation explicit, the result is often a solution which more fully meets both parties' needs. However, a different kind of result may also obtain. On reflection, it too is desirable; because the parties have made their needs explicit, they can quickly see when they are in a situation which does not allow a joint resolution. This allows them to retreat from the particular effort, thereby preserving the collaborative relationship for future ventures (Fisher & Uri, 81; Fisher & Brown, 88).

Example of How the System Guides and Supports Negotiation: 'Hiring Henry Staller' One negotiation example on which our system has been run proceeds as follows[7]:

- **Scenario:**
  Two managers, Carl Creative and Edgar Efficient have received funding for a propsal which has put them in charge of the development of a new system. The system is potentially hot enough to put their company on solid footing. They are at the point of making some staffing decisions and have reached a deadlock over a prospective candidate. The system prompts them to state the following:
  1. Problem Statement:
     - Carl: "We have funding for the big new system. Our group has a chance to save the company if we can come up with a breakthrough. Staller would be perfect for lead programmer. He's full of ideas. And he only wants half of what we budgeted for, so the financial pressure is off".
     - Edgar: "If we can get the new system out the door by the dead line we can save the company. Staller is brilliant but he doesn't follow through."
  2. Initial Solution:
     - Carl: "Hire Henry."
     - Edgar: "Over my dead body."
  3. Underlying Needs and Resources:
     - Needs
     (a) Carl: Get a creative breakthrough
     (b) Edgar: Get the system built on time
     - Resources
     (a) Money saved on Henry
     (b) Henry's creative ability
  4. Collaborative Solution:
     - Hire Henry, and with the money saved hire a second less creative, less expensive, more reliable programmer to make sure the work gets done.

Clearly the collaborative solution reached here is better than either of the initial unilateral solutions. But to what extent did the negotiation tool help? Coming up with the collaborative solution is easy if (and only if) the parties can perceive that 'Needs' (a) and (b) can be met by 'Resource' (a).

Matches between needs and resources which may initially be non-obvious become clear because the system prompts the parties to make both explicit, and then asks the parties to consider how the resources can provide for the needs.

Additionally, the system facilitates the discovery of successful solutions because it asks the parties to retreat from their adversarial 'Initial Positions' and then find alternative ways to satisfy their 'Underlying Needs'. That is, the system allows solutions and needs to be listed separately and therefore to be decoupled.

Implications of the Negotiation Tool
The negotiation tool is intended to build *ongoing* collaborative relationships among the parties. It does so by allowing the parties to back off from adversarial positions while saving face by turning their attention to their needs and resources. Additionally the tool helps in the building of continuing relationships because it allows for early and graceful exits from situations in which collaboration has a low probability of success.

In terms of anecdotal data, within our research group we have reached successful agreements on, for example, division of labor and work schedules, using this negotiation process.

Teaching Scientific Inquiry

The goal here was to devise a course of study[8] in which seventh grade students would: gain some scientific inquiry skills; increase their understanding of theories and models and the the relation of these abstractions to the physical

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[7]The example is taken from a domain outside of collaborative authoring and shows the generality of the negotiation tool.

[8]Thanks to the kids, teachers and administrators of Boston Latin School

world; learn about the tension between affecting and being affected by their environment; and see that science and technology can help them in this resolving this tension.

Constructing the Course of Study

Again we took the approach of attempting to embed the educational tasks within a framework which was intrinsically interesting to the students. Therefore, to obtain the goal of teaching scientific inquiry we devised a curriculum which called upon students to conduct inquiries in the course of learning geography. What is notable about the curriculum is that it takes the form of exercises which are carried out for the purpose of working out issues, such as increasing their basketball skill, making new friends, etc; issues which *they* had defined as being important.

Below we sketch out the curriculum and then present two student-inspired exercises for working through the curriculum.

Geography Curriculum We would want students who had learned about the geography of a given place to have learned what that place was like both physically and culturally. We would also want them to have gained an understanding of the relationship between the physical and the cultural elements. In some sense, here we want the students to have formed a *descriptive theory* of the place.

Additionally, we would want the students to look at how this description was changing. Further we wanted them to be able to ask why the change was occuring; whether they liked the change; and, if not, what could they do about it. To address these questions the students would need an *explanatory theory*.

Developing the Exercise/Inquiry

In order to develop an exercise for learning scientific inquiry and geography skills we visited Boston Latin School and interviewed a number of seventh grade students on the subject of the interests and challenges which they faced outside of school. Many of the stories had a common element; the students were trying to deal with issues of loneliness and popularity. We chose one story as both striking and representative and built two exercises around it. Clearly the exercises generalize.

Mike's story:
Mike told us that he was particularly lonely since not only was it his first year at Boston Latin, but he had also just moved to a new neighborhood and was sorely

Descriptive Theory: Wed. 5 PM Norfolk St. Game
1. Forwarding is weak
2. Many shots missed
3. Potholes on North boundary of court
4. Half court game

Elements of the Explanatory Theory: Wed. Game
1. Forwarding is weak because
   the Essex St. team can't get around the strong guarding by Sam & Bill of the Broadway team.
2. Many shots missed because
   both teams are shooting as if they had the nets which they have in the school gym.

Elements of the Practice Plan
1. Getting thru Sam & Bill :
   They don't expect your left hand approach.
2. Not missing shots:
   Practice netless shots.

Figure 1: Descriptive & Explanatory Theories (top & center). Practice Plan (bottom).

lacking friends. He also told us that he loved to play basketball and was pretty good at it.

Exercise 1: Creating a Descriptive Theory Mike's story prompted us to create an exercise in which he could make friends by excelling in the 'pick-up' games around his neighborhood. The exercise was designed so that he would excel because of his scientific inquiry and geography skills. That is, we wanted to have Mike ask what the neighborhood basketball courts were like through the use of survey and observation techniques. This would result in his forming a descriptive theory of the neighborhood games (Figure 1, top).

We claim that simply reading about theories does not allow students to understand what they are. We believe that they have to be built and used before they can be understood. We hope therefore, to give these students an early insight into what a theory is.

Once the students are back in the classroom they will be provided with map-making and data base tools that will allow them to record their measurements and observations.

By sending students out into the field and then having them record their measurements back in the classroom we hope to decrease the kind of behavioral problems which the teachers of

these bright,[9] energetic students are noticing. That is, we plan not only to burn up the students' healthy energy but also to reinvest it in the technology we are providing in the classroom. Our hope is that this investment of energy will make these technological skills personal and desirable to the students.

Exercise 2: Creating an Explanatory Theory and a Plan of Practice Recall that our second goal in teaching scientific inquiry was to allow students to have an effect on their environment. In this context that means building a plan of practice for the skills which are needed in each of the pick up games. In order to derive a plan of practice Mike will need to derive an explanatory theory from his previously built descriptive theory. This can be done by systematically asking what underlies or causes each element in the descriptive theory (Figure 1, top).

After generating the explanatory theory (Figure 1, center) and entering it into the appropriate data base, the student can generate a practice plan (Figure 1, bottom). This is done by systematically asking how to affect each element in the explanatory theory. Our intention here is to have students gain an understanding of the relationship between a model and the world. That is, by using the explanatory theory to create a plan which will have an effect on their lives the students will come to see that these abstractions can bear on reality.

Future work on Scientific Inquiry

Some parts of the scientific inquiry process are well understood. For example, explanatory theories lacking in detail need to have possible mechanisms proposed and tested. It is not too difficult to envision the exercises that would teach these scientific inquiry skills. However, much of the scientific inquiry process is not understood. Here we plan to look at the great empirical scientists and ask what phenomena grabbed their attention and how did they notice them? We will then look for the analogous phenomena for our students and attempt to engage their curiosity.

Summary

We have described three projects involving educational technology. Our goal in each of these projects was to create educational situations which grew out of the students' interests so that the students' would feel good both about their lives and their intellectual abilities.

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[9]Students are admitted to Boston Latin School through a competitive city-wide test.

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