Rethinking the Design of Online Courses

Kemi Jona
Cognitive Arts
Evanston, IL USA
jona@cognitivearts.com

Abstract
Learner choice is the touchstone of the paradigm shift that needs to take place in education and in how it is delivered. We need to move from an educational model where learners are given virtually no choice (*e.g.*, in lecture halls) to one in which they are driving the learning process. This also means moving the locus of responsibility from the "teacher" to the learner by asking learners to take responsibility for their own learning. Course designers must move from a "trust me, this is important to know" attitude towards creating learning environments where the learner understands the importance of something before being asked to learn it. A critical examination of our current educational system makes it clear why this paradigm shift is long overdue.

Keywords
Design, Learning-by-doing, Online courses

The Flawed Premise of Current Educational Systems

The reason most of our education systems aren't effective is because they are based on a flawed model of how people learn. This model is so prevalent, both in academic and corporate arenas, that no one ever stops to think about it anymore. It is simply accepted as is. Understanding what this model is and why it makes no sense is a prerequisite in adopting a new – and more effective – paradigm for learning.

The flawed model that underlies our educational system can be summarized most simply as follows: "Education equals the transmission of information." This model underlies the lecture-based classroom approach used in most university courses as well as the online translations of these courses. However, if you reflect back on college courses you have taken, it is difficult to remember much if anything of what you learned. Certainly it would be nearly impossible for any of us today to pass the same tests we took in high school or college. For example, Levine & Foreman (1973) found that only 62% of medical students who passed a neuroscience class could pass a basic concepts test one year later. Unless you have used the knowledge or skills regularly since then, most of the information you had transmitted to you has not been retained. In fact, one definition of 'lecture' that captures the problem very nicely is "information passing from an instructor's notes to students' notes without passing through the minds of either."

Why doesn't the lecture approach work? Research in cognitive science, along with plain old intuition and common sense, makes it clear that people learn most effectively while in

the pursuit of specific, authentic, intrinsic goals (*e.g.*, Cognition and Technology Group at Vanderbilt, 1990). No one ever learned to ride a bike, play ball, or fix a flat tire by sitting through a lecture on it. We all learned these things by actually trying to do them, making mistakes, getting confused, asking questions, and trying again until we got it right. This, in essence, is how natural human learning takes place.

Natural Human Learning

So if education does *not* equal the transmission of information, how does learning happen? Natural human learning has three important characteristics:

- **Natural learning is *goal-directed*.**

Every child is capable of amazing feats of learning, which for the most part, take place outside of school. A growing body of research has focused on why this should be so – that is, why children learn more effectively in their everyday lives than they do in the classroom. The emerging consensus is that the basic cognitive mechanisms of attention, reasoning, and memory that are involved in learning depend on authentic learner goals in order to be properly engaged. Effective learning is driven by natural curiosity, which arises when the learner has intrinsic desire to master some area of knowledge or performance.

- **Natural learning is driven by *expectation failure*.**

The mind's learning mechanisms are invoked when the world does not behave as expected. Such a divergence from expectations makes it apparent that existing knowledge is incorrect or incomplete in some way, thus signaling an opportunity to learn. Effective learning, therefore, requires that learners be allowed, and encouraged, to attempt tasks that are somewhat beyond their abilities, to make mistakes, and to learn from those mistakes.

- **Finally, natural learning is *case-based*.**

Natural learning consists of building a base of experiences that can be called upon in real-world performance. Personal experiences are the most memorable and instructive. But learners can also profit greatly from hearing stories describing the experiences of others, if told in the right way at the right time. Good teaching involves the telling of memorable stories when the learner is in a position to understand and apply them.

These three characteristics give us a foundation from which we can build an understanding of the problems with traditional approaches to education and describe an alternative approach – one that avoids these problems and fosters effective learning and retention.

Problems with Traditional Learning Environments

Given this view of natural human learning, many classroom-based learning environments suffer from a number of problems that hurt student motivation and hinder effective learning and retention:

- **Passive learning**

The single biggest problem with many classroom-based approaches is that they place learners in a passive role where they are expected to sit in a seat and absorb knowledge from a lecturer, a set of readings, or a PowerPoint presentation. This is a problem because lectures simply don't work. Learners don't retain what they don't use. Not only do learners have trouble remembering what was said in a lecture; they also have problems trying to apply that knowledge to the "real world." For this reason, researchers have called knowledge acquired in decontextualized settings such as lectures "inert knowledge," a term introduced by Whitehead (1929).

- **Artificial divide between practice and instruction**

A second problem common with traditional classroom approaches is the tendency to present learners with lists of concepts, principles, or theories and expect them to remember them and apply them appropriately. The reason this is a problem is that learners don't retain abstract concepts that they can't relate to specific cases. Practicing the application of concepts across the range of cases in which they apply is time consuming, detail-oriented, and idiosyncratic. It is little wonder that simply presenting concepts is the preferred timesaving approach.

- **Irrelevant subject matter and inappropriate assessment**

A third problem that is endemic to lecture-based courses is that the content of courses is often driven by what can be easily tested and measured. In an era of increased demands for accountability in education, many schools are driven to endlessly test students. What ends up happening is that teachers, knowing their performance will be judged by their students' performance on the final test, orient the entire course towards helping their students do well on the exam. In university lecture courses, the economics of grading hundreds of student papers leads many to use machine-scored multiple-choice tests. Because of the limitations of the multiple-choice format, students get their heads crammed full of decontextualized facts that are easy to test but difficult for them to retain and to apply to real-world situations. Teaching real skills or complex knowledge – both much harder to assess students' learning of – often gets bumped aside in the curriculum in favor of more easily testable topics.

Online Learning: Same Problems in a New Package

With the advent of increasingly powerful and affordable computer and networking technology, universities have begun to embrace the translation of courses onto the Web. Unfortunately, instead of exploiting the unique interactive capabilities of the computer, most online courses simply replicates the "education is equal to the transmission of information" model of learning that is common practice in the classroom. Most online courses are simply fancy "page turners" – online presentations of lecture notes, facts, and concepts that the learner progresses through sequentially. Usually courses include a number of quizzes and a final multiple choice test to measure the learner's absorption of the presented content.

Universities (and their online course vendors) eagerly continue to create these online courses, unwittingly falling prey to the easy delivery and flashy multimedia presentations they provide. No one stops to notice that they are built on the same dubious educational

model as the classroom version of the course they are supposed to replace and improve upon. These online courses suffer from the same three problems outlined above:

- Learners are placed in a passive role, one where they must read text or watch videos or animations. Despite what many course producers claim, just because learners now control the button that advances to the next page of material does not in any meaningful sense qualify as "active learning."
- Most online courses do not make any real attempt to provide opportunities for learners to practice skills or apply knowledge in authentic contexts. And those that do try to allow for practice usually make only a feeble attempt at it. Thus these online courses still do not do enough to help learners relate new concepts to specific cases where those concepts apply.
- Driven by the computer's ability to automatically score multiple-choice tests and readily store this assessment data for a large number of trainees, most online courseware is awash in tests, quizzes, and other assessments. This replicates the problem of assessment-driven curricula that traditional classroom environments suffer from. Designers of these courses know what kind of test questions they can administer, and this drives the type of content that learners are expected to master. Complex skills, especially those that involve professional judgement and decision-making where there are many potential solutions, are rarely included in online courses because of how hard it is to measure these skills in a multiple-choice format.

Principles for Effective Learning Environments

So given all of the problems associated with traditional classroom-based courses and their online translations, how does one go about creating effective courses online? To begin, one must replace the "education equals transmission of information" model with a model based on natural human learning processes. Goal pursuit is at the heart of natural human learning. To pursue a goal means to take action and make decisions, and this, in turn, creates opportunities for failure. This 'failure' can be a failure to execute a desired action, as well as failure of one's expectations when an action didn't have the expected result, or the world didn't behave in the expected way. Failure naturally raises questions in one's mind about why something didn't work, or what might have worked better. And it is these questions that drive learning (Schank, 1999).

This conception of natural human learning translates into three key principles for creating effective learning environments:

- **Learning by doing**

To the greatest extent possible, all learning should take place in the context of doing. Learners should be given an authentic goal and provided with an environment in which they can actively try to achieve that goal. All skills and knowledge must be acquired in the service of achieving this goal, when the learner realizes that they are needed. This means no lectures, no drill and practice, no listening until *after* trying. Presenting answers is not the key to teaching. Raising questions is the key to teaching. Creating a simulation that allows learners to try things out and make mistakes is an effective way to help learners generate the questions that lead to learning. Providing learners with a simulation means creating the opportunity for them to make choices – choices about what action to try next and when to request help. This is the essence of active learning.

- **Learning from mistakes**

Once learners have come upon the limits of their knowledge, as evidenced by making a mistake or not knowing how to proceed, they are ready to acquire the missing knowledge or skills. Not only will learners be motivated to learn, but because they are engaged in a realistic task, they will have the proper context within which to index that new knowledge or skill in memory. Because this context will be similar to the one that these knowledge and skills are used in the real world, it is more likely that learners will be able to retain and apply them effectively. Thus, a key feature of effective learning environments is that they must provide learners with a safe environment in which to learn from their own mistakes.

- **Learning from stories**

Another key result from research on natural human learning is that people remember cases, not abstract principles. While people learn effectively from their own mistakes, people can also learn from other's mistakes, if provided with the context needed to understand them. Thus, in addition to a simulation, an effective learning environment should provide learners with first-person lessons told by the right person at the right time. When people need help and advice in the real world, they often seek out experts who can tell them stories of similar situations and how they worked out. Effective learning environments should provide learners with the same sort of access to the stories and advice of experts.

These principles for effective learning environments are applicable to the design of both classroom and online courses. Online delivery, however, offers the potential for greater individualization of the learning experience, and the ability to be deployed more conveniently and cost-effectively for large numbers of learners throughout a university or corporation.

Goal-Based Scenarios: A Framework for Developing Effective Online Courses

Researchers at the Institute for the Learning Sciences (ILS) at Northwestern University under the direction of Roger Schank have developed the concept of Goal-based Scenario's (GBS's), a framework for developing computer-based learning environments that are structured according to the principles for effective learning outlined above (Schank, Fano, & Jona, 1994). ILS and later Cognitive Arts – a corporate spin-off of ILS – have created GBS simulations for organizations including Fortune 500 corporations, government agencies, the US military, schools and universities. By putting users in a realistic role, GBS simulations allow them to "learn-by-doing" and make mistakes in a safe environment. The user is typically given a problem to solve and the resources to try to solve it, with the system providing helpful guidance and coaching along the way.

More specifically, a GBS is a learning-by-doing simulation where the learner is given one or more authentic tasks to achieve along with the tools to perform those tasks. All of the core skills and knowledge to be learned are embodied in the scenarios themselves. Hence, rather than *telling* the learner about a concept, the learner must master it because understanding that concept is needed in order to accomplish the task set forth in the simulation. Of course, this means placing the learner in a situation where he or she is missing key knowledge and skills, and hence is likely to make mistakes. When a mistake

is made, an on-line coach intervenes, identifying the learner's error and suggesting a corrective action, or pointing the learner to resources that contain relevant explanations or information. Again, this coaching and advice is not delivered in a vacuum, when the instructor has decided it fits into a preconceived agenda. Rather it is provided in the context of the learner trying to accomplish a specific task or solve a particular problem (the exact point at which the learner is most receptive to this input, most able to utilize it, and most likely to retain it).

In addition to an on-line coach, another key component of the support provided to learners in GBS is the expert resource – a library of expert stories and explanations captured on video. Learners can "ask the experts" a series of questions related to the current task and receive relevant advice and anecdotes from expert teachers and practitioners in the field. Instead of the 30:1 student-teacher ratio typical of traditional classrooms (or 300:1 in some university lectures!), a GBS reverses the ratio, providing multiple teachers for a single student. Moreover, allowing learners to get help and advice from recognizable experts in the field – instead of solely from a fictitious on-line coach – increases the credibility and authenticity of the coaching provided.

Examples of Learning-by-Doing Online Courses

The best way to make the above description of a GBS more concrete, and to illustrate how this type of learning environment fosters learner's choices, is to explore several examples of online courses built using the GBS design methodology. These examples come from the work being done at Cognitive Arts in partnership with Columbia University.

Two types of courses are being built. The first type, called web-mentored courses, is used when the student's key work products are difficult or impossible for a computer to evaluate effectively. Computer programming and business writing are two examples. In web-mentored courses, students are given a series of realistic tasks to complete and submit their work products to a human coach via the web. The coach then critiques their work and sends it back to the students for further work if needed. The second type of course is called simulation-based. In these courses, the learner progresses through a series of simulated scenarios, creating structured reports and engaging in simulated interactions, and receiving feedback and coaching from the system itself.

Business writing for non-native english speakers: An example web-mentored course

When non-native English speakers from outside the United States wish to do business with, or seek employment at, an American company, they face several hurdles. First, and most obviously, they need to be able to communicate effectively in English. But they also need to become familiar with American business culture, particularly as it impacts communication, both written and verbal. And if their focus is on written communication, they must also become proficient at organizing and writing a variety of common business documents.

One approach to helping non-native English speakers improve their business communication skills would be to offer them separate courses on English as a second

language, American business culture, and business writing. But teaching each of these topics separately removes important contextual cues that help students actually put the skills and knowledge from each of these topics into practice. For example, consider the situation of receiving an email from your boss asking, "Do you think you could draft a preliminary proposal?" To correctly interpret this email as a politely phrased directive rather than a simple yes or no question – and craft an appropriate response – requires an individual to bring to bear relevant knowledge of American business culture and communicative practices along with the ability to read the English itself.
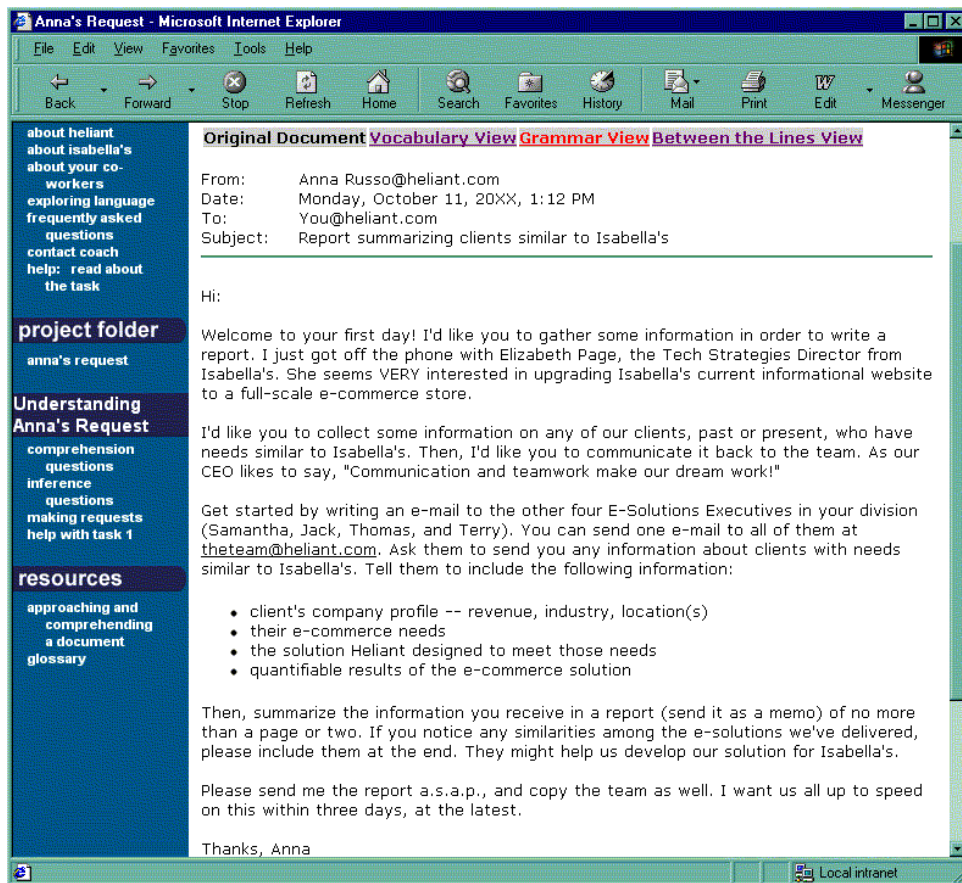

Figure 1. Student tasks are presented in an authentic context, in this case as an email from their fictitious boss in a simulated scenario

Thus the approach we are taking in creating business writing courses for non-native English speakers in conjunction with Columbia University's American Language Program is to create an authentic business context and ask students to perform a set of realistic writing tasks with that context. Thus, in one course, the student is placed in the role of a client solutions executive in a large, full service e-commerce consulting firm who is pitching their e-commerce solution to a large, upscale, American department store called Isabella's. Students receive their tasks by way of simulated email requests from their fictitious boss.

For example, in your first task as a student, your boss asks you to send the other four executives in your division e-mail, soliciting information about recent e-commerce solutions for clients with needs similar to Isabella's (see Figure 1). Then she would like you to summarize the information and send it back out to the four executives and her. The student must read and interpret the boss' email correctly, and write a clear, well organized "email message" which they submit to the coach. Having successfully completed this task, their next task presents them with the simulated email replies from their colleagues and asks the student to create a memo summarizing the information in a concise and organized fashion.
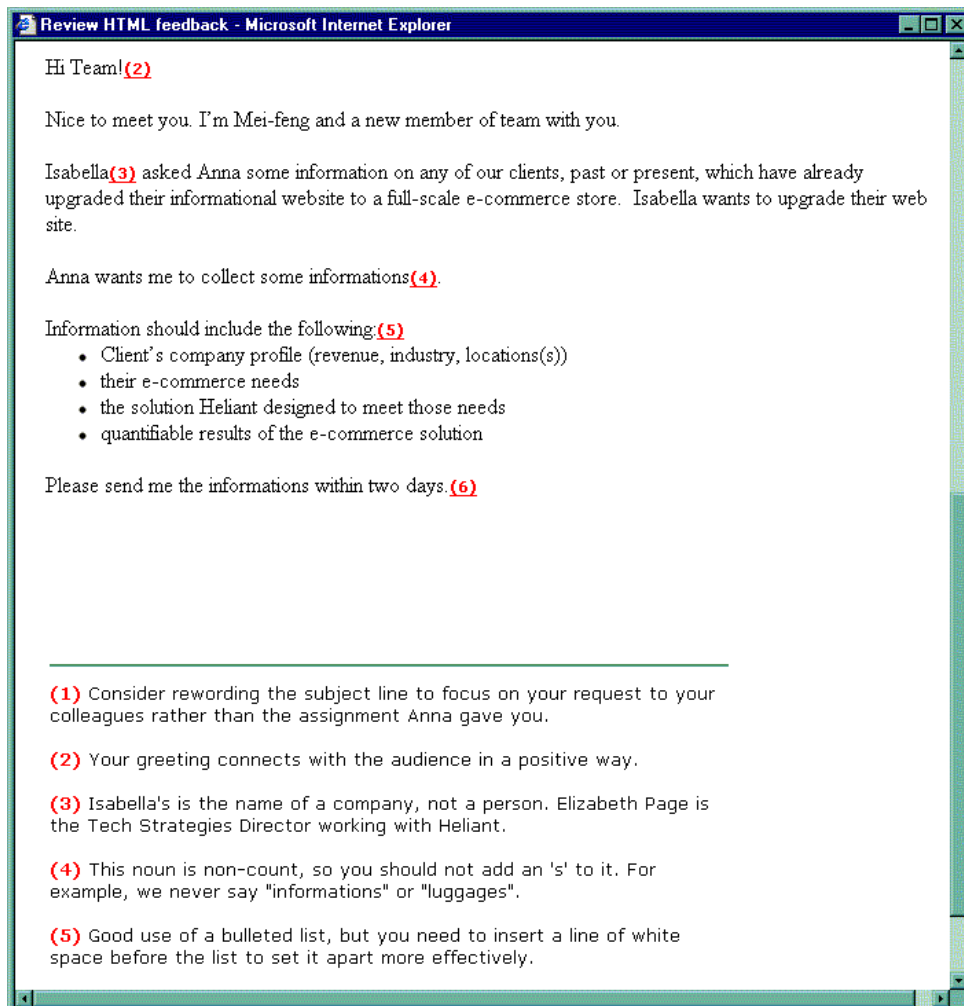

Review HTML feedback - Microsoft Internet Explorer

Hi Team!**(2)**

Nice to meet you. I'm Mei-feng and a new member of team with you.

Isabella**(3)** asked Anna some information on any of our clients, past or present, which have already upgraded their informational website to a full-scale e-commerce store. Isabella wants to upgrade their web site.

Anna wants me to collect some informations**(4)**.

Information should include the following:**(5)**
- Client's company profile (revenue, industry, locations(s))
- their e-commerce needs
- the solution Heliant designed to meet those needs
- quantifiable results of the e-commerce solution

Please send me the informations within two days.**(6)**

(1) Consider rewording the subject line to focus on your request to your colleagues rather than the assignment Anna gave you.

(2) Your greeting connects with the audience in a positive way.

(3) Isabella's is the name of a company, not a person. Elizabeth Page is the Tech Strategies Director working with Heliant.

(4) This noun is non-count, so you should not add an 's' to it. For example, we never say "informations" or "luggages".

(5) Good use of a bulleted list, but you need to insert a line of white space before the list to set it apart more effectively.

Figure 2. Student receiving detailed personalized feedback on their submission from a human coach

The course continues to follow this story line, requiring the student to create a variety of emails, sales letters, business proposals and other common document types. For each submission, the student receives detailed personalized critiques and suggestions from

their (human) coach (see Figure 2). Unlike traditional courses, the student does not receive grades on their submissions. As in the real world, they must continue to revise their documents until the coach approves and gives them the OK to proceed to the next task. Thus, each student progresses through the course at their own pace, receiving individualized feedback tailored to their demonstrated level of proficiency.

Introduction to developmental psychology: An example simulation-based course

When most people think of introductory courses at the university level, it usually evokes the images of large lecture halls filled with hundreds of students listening to a lecturer try to cover the entire breadth of a field in one semester. Students madly scribble notes and, at the end of the semester, try to regurgitate the relevant facts on a multiple-choice exam. Is this really the most effective way for students to learn? What would it mean to completely rethink this approach and redesign introductory university courses in an educationally sound and more engaging way?

The simulation-based courses being developed by Cognitive Arts in partnership with Columbia University's College of Arts and Sciences are an attempt to realize this vision through the application of the GBS framework described above. We are developing initial versions of introductory courses in developmental psychology, abnormal psychology, macroeconomics and microeconomics.

In the developmental psychology course, for example, the student plays the role of a developmental specialist working at a child development research center, and progresses through a series of 8-10 simulated scenarios. In this role, the student acts as a consultant to parents, teachers, schools and child care centers, and government agencies who come to the student for advice on how to handle a range of issues which are informed by developmental psychology research. The students' task is to investigate the issue raised in each simulated scenario by interviewing the parents, teachers, or children, conducting assessments, observations, and tests, consulting with real-world experts captured on video (see Figure 3), and assembling their findings in a report or recommendation. The students then submit their report and receive feedback on it from a coach built into the system itself.

In the scenario of the developmental psychology course that focuses on the types and causes of aggression in children, the student is asked to investigate why Lance, one of the children at the child development centre, has been getting into fights with his peers. The student's fictitious supervisor – the centre director – provides the student with some initial hypotheses that might explain Lance's behaviour. The student is asked to investigate each of the hypotheses and determine which seems best supported by the available data and relevant psychological research on aggression. The student is provided with a range of investigational activities and other resources, and must identify evidence that supports and contradicts each of the hypotheses. Once they have collected enough evidence, they indicate which hypothesis is the one they believe best explains Lance's behaviour (see Figure 4). They submit their report to their supervisor, and then have the opportunity to present their findings in a simulated meeting with Lance's mother (see Figure 5). If the student has done a thorough job investigating Lance's situation, and can answer the mother's questions adequately, the meeting goes well. If not, the mother becomes quite upset, and the student is asked to go back and do more work to complete a more comprehensive and accurate report.
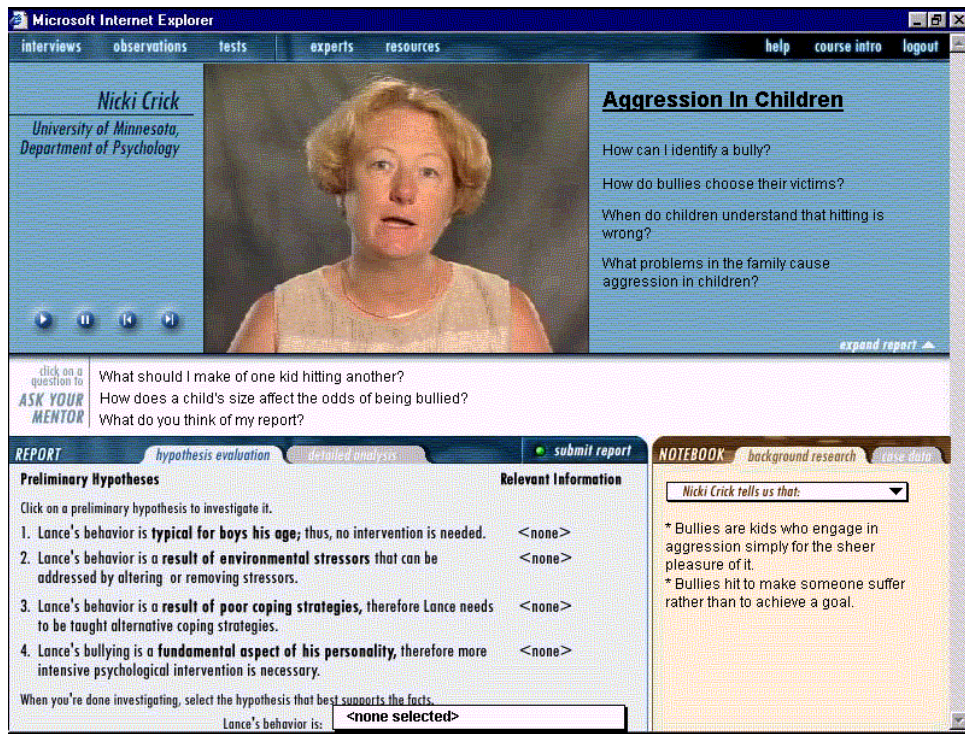
Figure 3. The student consults the expert resource to learn more about aggression

Once the student successfully completes the first part of the report and addresses the mother's questions and concerns in the meeting with her, they are asked to complete a more detailed analysis of Lance's situation. In this second part of the report the student must identifying the underlying causes of Lance's aggression, the interventions that would be most helpful in addressing his behavior, and the potential short and long term consequences for Lance if no interventions are made. This part of the report is also submitted to the center director, and if adequate, the student proceeds to a second meeting with Lance's mother to explain the detail findings.

This approach to an introductory course contrasts sharply with the traditional approach characterized above:
- The student an active participant in the learning process rather than sitting passively listening to a lecture,
- The simulated scenarios create an engaging and motivational learning environment;
- The simulation-based approach embeds the learning in a context that makes the relevance of the content clear to the student at all times; and
- The authentic tasks illustrate how the topics are relevant to real-world situations the student might encounter.
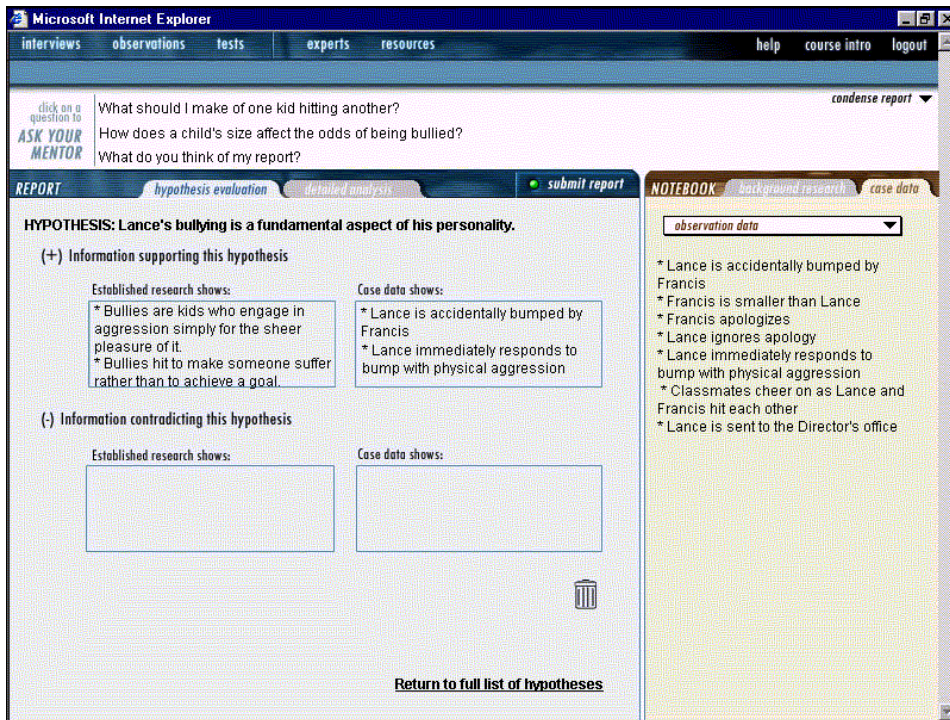
Figure 4. The student assembles collected evidence to support or refute each hypothesis

The simulated scenarios also motivate the student to explore the expert resource, learning about developmental psychology first-hand from the leading experts and researchers in the field. Because the student is working individually on the computer, there is no social onus against appearing stupid in front of a professor or one's classmates by asking "stupid" questions. Moreover, the student can ask the experts their own questions and don't have to sit through listening to responses to other students' questions. This creates a much more individualized and efficient learning experience, one in which the student makes the decisions and is responsible for their own learning.

Principles for the Design of Online Courses

As I've argued, creating truly effective online courses means seriously reconsidering the underlying assumptions that those courses are based on. This paper has sought to explain why much of the education being delivered today is so often ineffective, and to provide examples of how to improve its effectiveness. Here are some principles for rethinking the approach to designing online courses.

- **Think carefully about what the course should cover.** The curriculum for many courses is often based on factors that have little to do with learning. A course may be tailored to the length of a semester, which may no longer be relevant in an online version. Some courses are organized to follow the table of contents of a particular

textbook even though the authors of that textbook never intended the book to be used in that way.
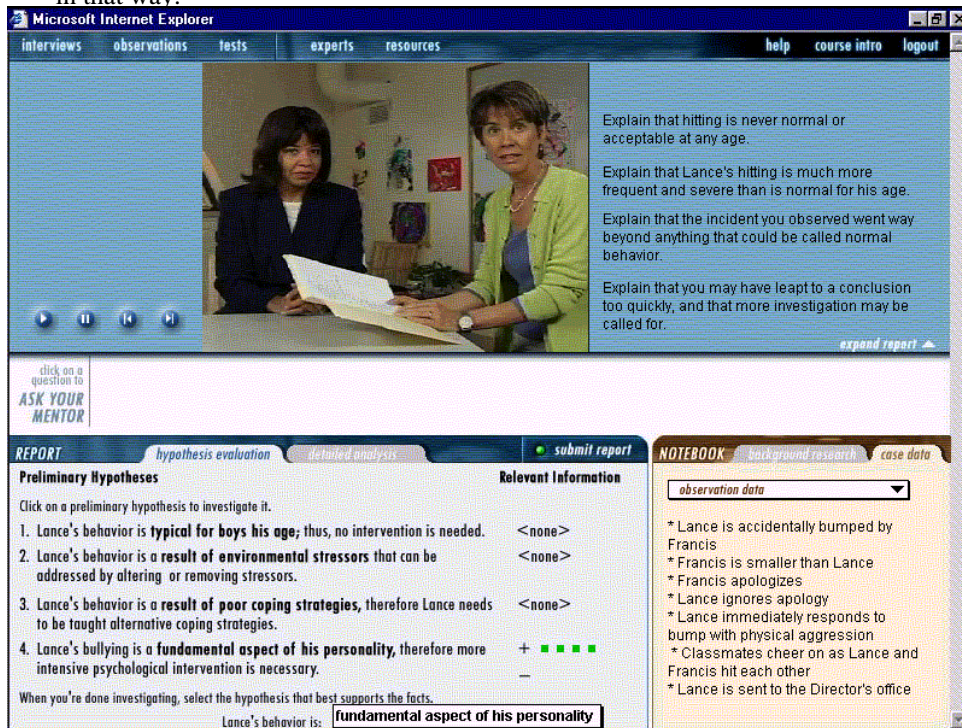

Figure 5. The student meets with Lance's mother to answer her questions and address her concerns

- **Organize what you teach in a way that makes sense to learners.** Think about the content of your course from the learners' perspective. How will the issues you cover arise in the course of their daily lives? Taking this functional viewpoint will help you create a course whose relevance and utility is clear to learners. Also, many introductory courses are "a mile wide and an inch deep," sacrificing depth for breadth in the futile attempt to cover everything in a particular field in one semester. Avoid creating a "checklist" curriculum that covers a long laundry list of topics that have little relationship to each other.

- **Put the learner in control.** Design your courses such that the learner is given control over their own learning experience. Make sure that it is clear to the learner at all times why he or she is being asked to do something.

- **Only teach at the appropriate moment.** Fight the urge to force the learner to listen to anything until after trying something and failing. Provide adequate and well-organized mechanisms for the learner to ask questions and get answers as needed, on a just-in-time basis. This will insure that the information presented is relevant to the learner's needs.

- **Avoid blind choices.** Make sure that you provide ample opportunities for learners to make decisions and that they have a rich set of resources available to help them make those decisions. These decisions must be meaningful and aligned with the task the learner is performing. Asking the learner to make blind choices – where they have no information available to allow them to make an informed judgement – do not foster real learning and detract from the realism and effectiveness of the course.

- **Situate learning in authentic contexts.** Creating authentic task environments not only helps learners relate what they learn in a course to their lives, but also makes for a more motivating and engaging learning context. Seek out real-world experts and practitioners to help you design your courses and include their insights and stories in the course itself.

- **Provide a rich set of resources and support to your learners.** Creating an effective learning environment means raising questions in your learners' minds. But if you are going to raise questions, you must also accept the responsibility of helping the learners find answers to those questions. A rich, well-organized, information resource containing the content you are trying to teach is a hallmark of a high-quality course. Try to include first-person stories told by experts if possible.

- **Use the most appropriate course structure and delivery mechanism.** Not all courses fit the same design mold. Matching the course structure to the content and skills to be taught is the first step in developing an effective course. The web-mentored and simulation-based course structures described here are but two points on a spectrum of approaches. Some courses can be delivered effectively with students working individually; other courses rely more critically on collaboration and teamwork among learners. Some courses may not be suitable for online delivery. Factors to consider when choosing a delivery mechanism include: the number of learners to be taught, how distributed they are geographically, the number of times a course will need to be offered, the availability of teachers and other resources, and of course, the specific learning goals for the course.

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