PROPOSAL FOR SEARLE FACULTY WORKSHOP

Indie: Building Web-based Interactive Learning Environments to Facilitate Delivering Problem-based Learning

Lin Qiu
Department of Computer Science
qiu@cs.northwestern.edu

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Lin Qiu
Department of Computer Science
qiu@cs.northwestern.edu
http://www.cs.northwestern.edu/~qiu/indie

Introduction

Problem-based learning centers learning activities around the investigation and development of solutions to complex realistic problems. However, working on realistic problems can be expensive and even dangerous for students, and supporting such projects is very labor-intensive for the faculty. Computer-based interactive learning environments provide responsive and safe settings for doing realistic problem-based learning activities, but such systems are expensive and complicated to build or customize. To address these problems, we have built Indie, a content-independent tool for authoring and delivering web-based interactive learning environments where students can practice solving problems by running experiments and using the results to support or refute possible hypotheses. This workshop will demonstrate how Indie can be used to facilitate problem-based learning and benefit both the students and faculty member.

System Description

An Indie learning environment consists of a set of web interfaces: a welcoming screen showing the "challenge" document, a "reference" interface where students can browse materials describing the scenario and domain content, an "experiment" interface where students can order tests and collect results, a “feedback” interface where students can read and respond to comments from the instructor on their activities, and a "report" interface where students can construct arguments for or against possible hypotheses. Indie learning environments automatically generate lab test results based on requests from students and provide scaffolding for students to construct arguments.

As a concrete example of an Indie learning environment, we will describe Corrosion Investigator, a module on biofilms. In this example, environmental engineering students take the role of consultants helping a paper processing company find the cause and cure for recurring pipe corrosion. Indie itself is a generic framework. All of the subject-specific material (text, pictures, the tests students can run, the results they get, and so on) is added using the Indie authoring tool.

For other areas where the Indie approach has been used, go to:
http://www.cs.northwestern.edu/~riesbeck/indie/projects.html
This shows systems built with an earlier non-web Macintosh-only version of Indie.

An Example: Corrosion Investigator

When students first enter the learning environment, a challenge page explains the problem context to the students. Students can then go to the Reference screen to read background documents (Fig. 1).

Figure 1: The Reference screen in Corrosion Investigator.

To run tests, students go to the Experiment screen (Fig. 2). Here, students can look for tests by entering test names into a textbox. Tests matching the name will be shown. Students can view the description of the tests and possible variable values for the tests.

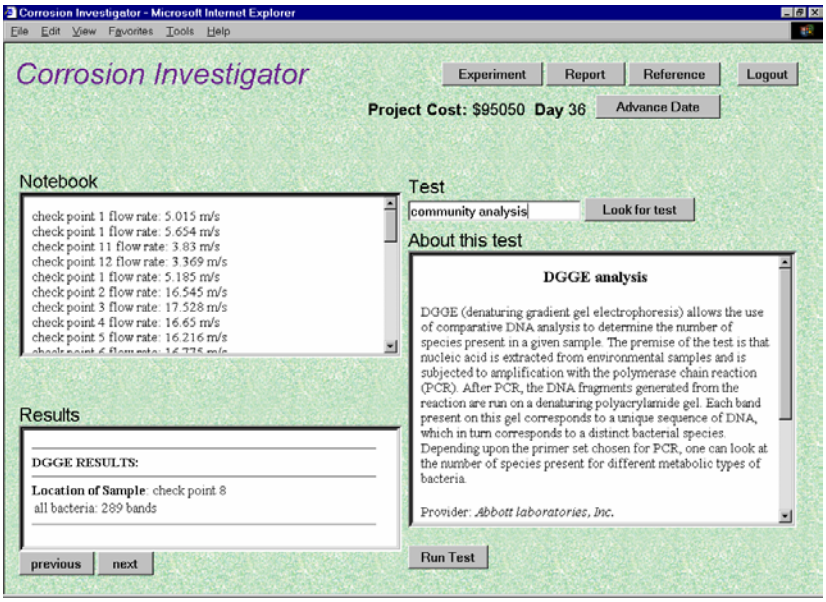


Figure 2: The Experiment screen in Corrosion Investigator.

When the test results become available, they appear in both the Notebook and Results area (see Fig. 2). The Notebook records all the test results that the student has received in a list that can be used for constructing a report.

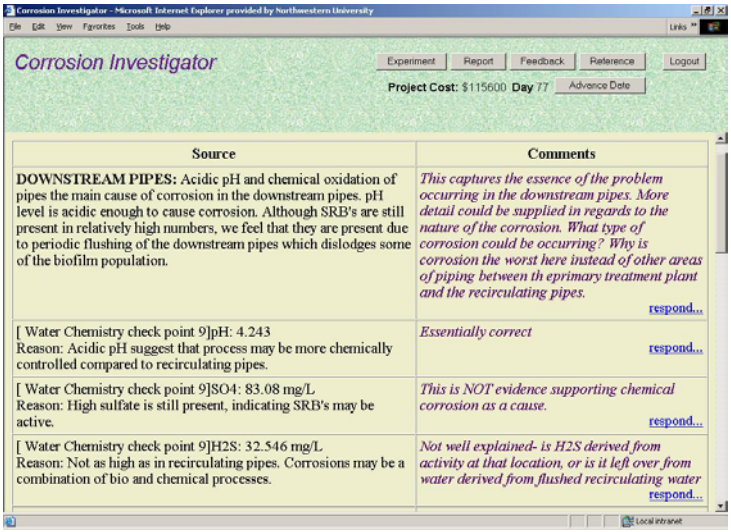


Figure 3: The Feedback screen in Corrosion Investigator.

On the Feedback screen (Fig. 3), students can read and respond to comments from their supervisor on their work.

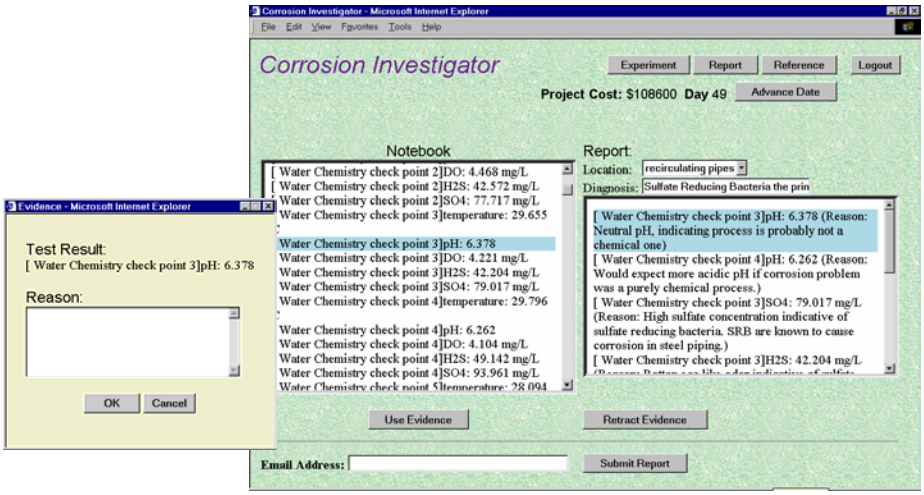


Figure 4: The Report screen in Corrosion Investigator.

When students feel they have gathered enough information, they can go to the Report screen (Fig. 4), make claims, and apply evidence in the Notebook towards those claims. Students need to specify the reason for using a test result as evidence. After finishing constructing the report, students click the Submit button to submit their report.

Authoring Tool

The Indie authoring tool provides a form-based web interface (Fig. 5) that allows teachers to describe the content of an Indie learning environment, e.g., a scenario challenge, the tests students can run, test result generation methods, background information, and so on, with no programming.

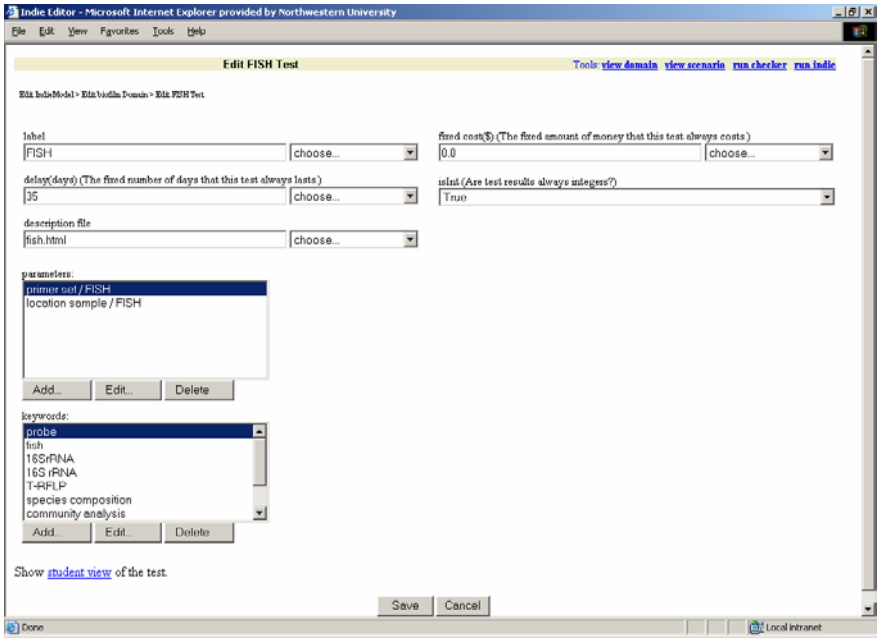
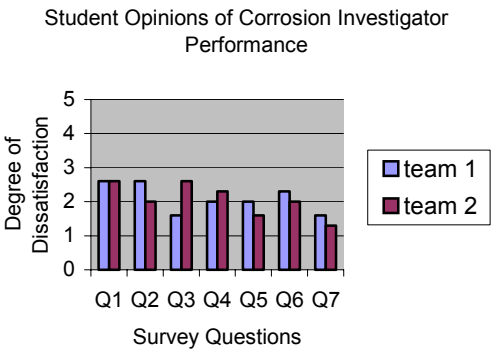


Figure 5: The Indie authoring tool.

Results of Previous Usage

In May of 2002, Corrosion Investigator was used in an Environmental Microbiology class by six first-year graduate students in the Civil Engineering Department. They were asked to form into two groups of three each. Students completed a survey on their experience at the end.



Q1: I would like to use the system to construct a report rather than write it all by myself.
Q2: Overall, the interface makes me feel comfortable.
Q3: The system has provided enough support for doing the project.
Q4: Overall, this is an excellent system for doing the project.
Q5: Overall, the project has been completed successfully.
Q6: I prefer to use this system to run the tests and get the results back, instead of doing that via email with a person.
Q7: I would recommend this system to be used in next year's class.

1 = strongly agree 5 = strongly disagree

Figure 6: Student opinions of Corrosion Investigator performance

According to the students' responses shown in Figure 6, overall the system was satisfying for doing the project. According to the professor, the use of the Corrosion Investigator significantly reduced his workload from 24 man-hours to 4 man-hours. By using the software, the project time was reduced from 8 weeks (the time it took when the same scenario was delivered without the software) to 3 weeks. According to the professor, the quality of the students' final reports using the Corrosion Investigator was identical in quality to those of the students when he taught the course without the software. Though the data was based on only six participants, it is still encouraging.

The professor used the tool to enter the following fairly complex test (see Fig. 7) into the learning environment, including keywords that the system uses to match student test inquiry, parameters for the test, parameter values that students can pick, result ranges associated with parameter value combination, etc. This process took about two hours.

FISH Test

- description file: fish.html
- keywords: phylogeny; community structure; community analysis; species composition; T- RFLP; 16sRNA; 16s rRNA; probe; FISH;
- cost: $10,000 per primer set.
- time: 5 weeks

primer set / location of sample	Checkpoint 1	Checkpoint 2, Checkpoint 3, Checkpoint 4, Checkpoint 5, Checkpoint 6, Checkpoint 7, Checkpoint 8	Checkpoint 9, Checkpoint 10	Checkpoint 11, Checkpoint 12
all bacteria	1500 - 4000	5000 – 10000	2500 - 6000	5 – 50
methanogens	50 – 500	250 – 1000		1 – 50

Figure 7: Description of the FISH test.

Deployment and Access

Students and faculty can run Indie learning environments using Internet Explorer 5.5 or above on either a Windows or a Mac computer. The authoring tool is similarly web-based. No special software needs to be installed on the users' computers to use Indie.

We are ready and eager to work with faculty members to create other Indie learning environments in different domains, and to help collect data to assess student learning outcomes. Indie is appropriate in any area where gathering data via tests or some kind, and using that data to construct arguments, is a valid activity. While Corrosion Investigator demonstrates a particular complicated example of Indie systems, your module does not need to have the same complexity. We will provide you with design and implementation support throughout developmental process.

Acknowledgements

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