The Use of Reflective Journals in the Implementation of Patterns for Active Learning

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1 Abstract

Actively engaging students in the learning process is key to the contemporary pedagogy called constructivism. Constructivism depends upon a cognitive apprenticeship between students and teacher, the use of realistic problems and conditions, and an emphasis on multiple perspectives. The constructivist theory has resulted in a series of pedagogical patterns, each describing a unique classroom situation and proposing a solution. In this paper, on-line journals are examined as one part of an implementation of several pedagogical patterns from the pattern language "Active Student".

2 Introduction

A contemporary view of learning, called *constructivism*, combines the discovery approach of Ausubel with the cognitive development ideas of Paiget.[1] Constructivism asserts that students actively construct new knowledge as they interact with their environment. Additions to, deletions from, or modifications to an individual's constructed knowledge base come mainly from sharing multiple perspectives. Constructivism depends on providing students with the conditions that will allow them to construct their own interpretation of key information and experiences and a mechanism for sharing their view.

Constructivism depends upon a cognitive apprenticeship between the student and the teacher, the use of realistic problems and conditions, and an emphasis on multiple perspectives.[1] Successful implementation of constructivism results in actively engaging the students in the learning process. Patterns for implementing constructivism, described in a collection of pedagogical pattern languages, provide a basis for creating an environment where students can actively construct new knowledge. Student journals are one of the techniques used to implement several of the patterns within the language. In this paper, on-line journals are examined as a vehicle for implementing patterns within the pattern language entitled "Patterns for Active Learning".[3]

Section 3 presents an introduction to the Pedagogical Patterns Project and the Active Learning pattern language. Section 4 examines the use of on-line journals for implementing several patterns within the pattern language. Section 4.1 describes the MOODLE (Modular Object-Oriented Distance Learning Environment) software system. Used to host the on-line journals and provide feedback, MOODLE is a complete on-line course delivery and content management system.

Section 4.2 discusses the use of on-line journals to encourage critical thinking among Advanced Placement Calculus and Computer Science students. Section 4.2.1 discusses the implementation of the "Prefer Writing" pedagogical pattern using on-line journals as a vehicle for forcing students to write summaries of what they accomplished during each week. Section 4.2.2 describes a method for measuring changes in students' understanding and cognitive models by using on-line journals to measure the effect of spiraling in the curriculum.

Critical thinking and ethical decision-making is key to any technical discipline, especially mathematics and computer science. Implementing the patterns "Reflection" and "Expand the Known World", section 4.2.3 describes the use of on-line journals as a mechanism for encouraging critical thinking about ethical problems. [3]

Making course material available to students at any time, day or night, is an overall goal of this project. MOODLE provides a vehicle for realizing the pedagogical pattern "24/7". A discussion of on-line journals and other tools for implementing the "24/7" pedagogical pattern is given in section 4.2.5.

Using journals to assess student learning and as a means of verifying the completion of assignments frees up considerable class time. Section 4.2.6 discusses using on-line journals as an assessment vehicle, and section 4.2.7 discusses using on-line journals to verify completion of assignments. These sections describe an implementation of the pattern "Explain it Yourself." [3]

Section 5 presents conclusions drawn from this project.

3 Background

3.1 The Pedagogical Patterns Project

Pedagogy is defined as "systemized learning or instruction concerning principles and methods of teaching."[2] Patterns provide a method for capturing and communicating pedagogy. The goal of the Pedagogical Patterns Project (PPP) is to facilitate the sharing of teaching techniques between "expert" and "novice" teachers.

The Pedagogical Patterns Project began in response to a paradigm shift in Computer Science. Moving from teaching a procedural methodology to an object-oriented one meant a complete re-thinking of the pedagogy used in Computer Science education. Born during a Pattern Language of Programming (PLoP) conference, the Pedagogical Patterns Project captures and disseminates the best teaching techniques. The project has grown beyond the original core group of Computer Science educators to encompass educators from other disciplines at the University and K-12 level as well as educators involved in industrial training. [4]

Pattern languages maintained by the project are regularly modified, revised and enhanced by participants to reflect the best current practice. Each pattern language consists of a collection of interrelated patterns. A pattern describes a single problem typically faced by a classroom teacher and presents a suggested solution. Although implementations of the solution may be described, the project's goal is to suggest solutions not to dictate or endorse specific implementations.

3.2 Patterns for Active Learning

A pattern describes a problem typically faced by a classroom teacher in a generic format. The pattern provides the basis for a solution, but does not provide specific implementation details. A collection of related patterns is called a pattern language.

Originally presented at the 2002 PLoP conference, “Patterns for Active Learning” is a pattern language that focuses on classroom situations at the beginning to advanced level. It consists of 28 interrelated patterns, but focuses primarily on the pattern “Active Student”. [3]

While the solutions given within each individual pattern suggest what to do to solve a specific problem, how to do it is left to the individual teacher. Appendix I presents the complete text of the pattern “Active Student” from the Pattern Language “Patterns for Active Learning”. The remainder of this report focuses on using on-line journals to implement this pattern and other patterns described in the pattern language.

4 Active Learning and Reflective Journals

4.1 Using MOODLE to Implement On-Line Journals

Implementation of Reflective Journals was accomplished using a computer based Content Management System (CMS). The CMS chosen for this project is the Modular Object-Oriented Distance Learning Environment (MOODLE). Licensed under the GNU public license, this computer based system supports student journal entries 24 hours per day, 7 days per week limited only by network downtime. Reasons for choosing MOODLE include:

1. Its design supports the Social Constructivist pedagogy.
2. It is open-source and licensed under the GNU/FSF public license. [See appendix III]
3. It has a large number of current users; over 660 organizations and over 3000 installations, including many K-12 schools.
4. It is scalable. The largest Moodle to date hosts 3,700 courses serving 18,000 students.
5. It has a large number of active developers.
6. It has readily available support via on-line forums and discussions.
7. It is modular, thus easy to customize.
8. Ranked as the easiest to use CMS (compared to other full-featured products, such as WebCT© and Blackboard©), its design and user interface is teacher friendly.

Using MOODLE, students are able to make new journal entries, review feedback on previous journals, as well as update and reflect upon all of their journal entries. The student view of the journals shows all of the journal questions, responses and feedback on a single web page. Each journal entry has an edit link allowing a student to easily and quickly add updates to their journal entries.

Creating a journal using Moodle is easy. The teacher adds a Journal Assignment to the course by selecting “add resource” from the course main menu. Once selected, the teacher is presented with the journal setup screen as shown in Figure 1. Clicking on the question mark icon next to each control provides on-line help. The journal prompt is added directly into the text-edit window provided; the grading rubric is selected using the provided pull-down text box; and the allowed editing window is selected using a pull-down menu. Students will be able to directly input or edit their journal entries from the main course page during the editing window. After the editing window has expired, students can still update their journal entries, but the MOODLE software will indicate to the student that the editing window for grading has expired.

Assessment of journal entries is possible at any time, and the teacher can update the assessment as many times as desired. Since journals, and in particular, on-line journals are new to most students, this gives the student the opportunity to submit a journal entry for feedback, then update the journal based on the feedback before the editing window ends [See the pattern "Reduce Risk" in Appendix II].

Assessing journals using MOODLE is particularly easy since all of the journals for a given course are presented to the teacher on a single web page. The teacher enters comments to the student directly into the web page as each journal entry is assessed. Finally, the teacher may optionally enter a score, given according to a predefined rubric or points, using a drop-down text box. Once assessed, notification via e-mail that the assessment has been made and is available for review is sent automatically to the student. Reading and assessing journal entries at the rate of approximately 100 journal entries per hour is possible. Figure 2 illustrates the journal-grading screen.

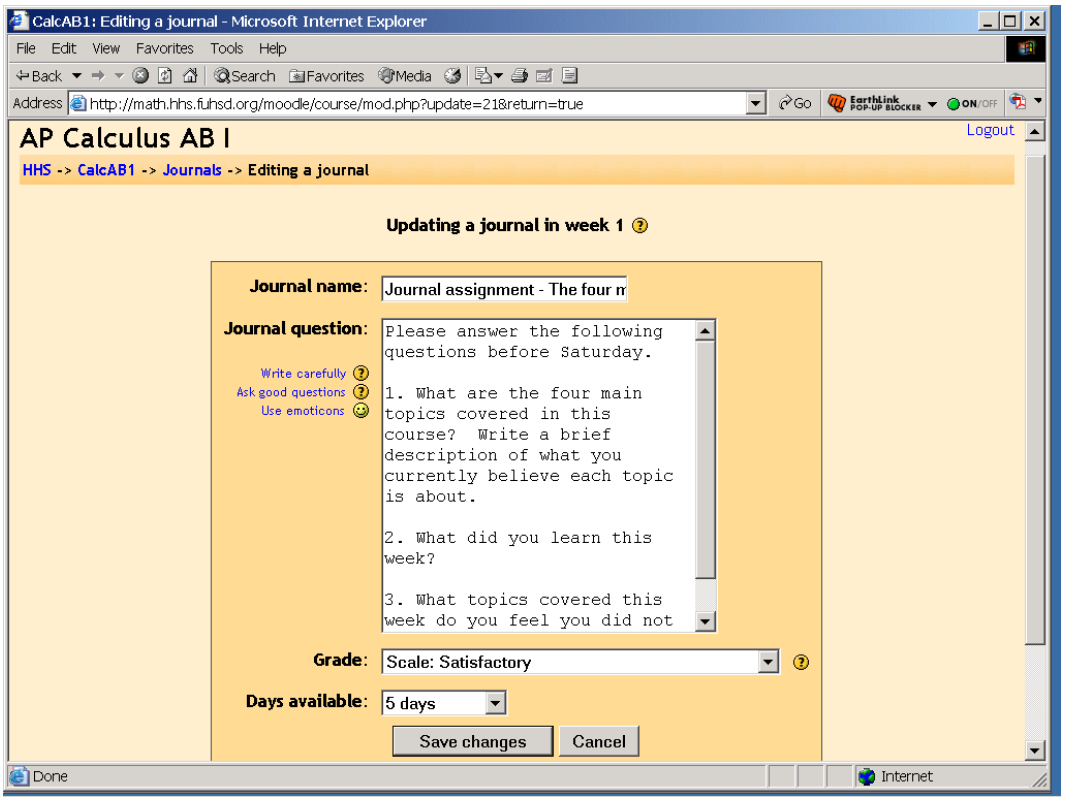


Figure 1 – Journal Setup Screen

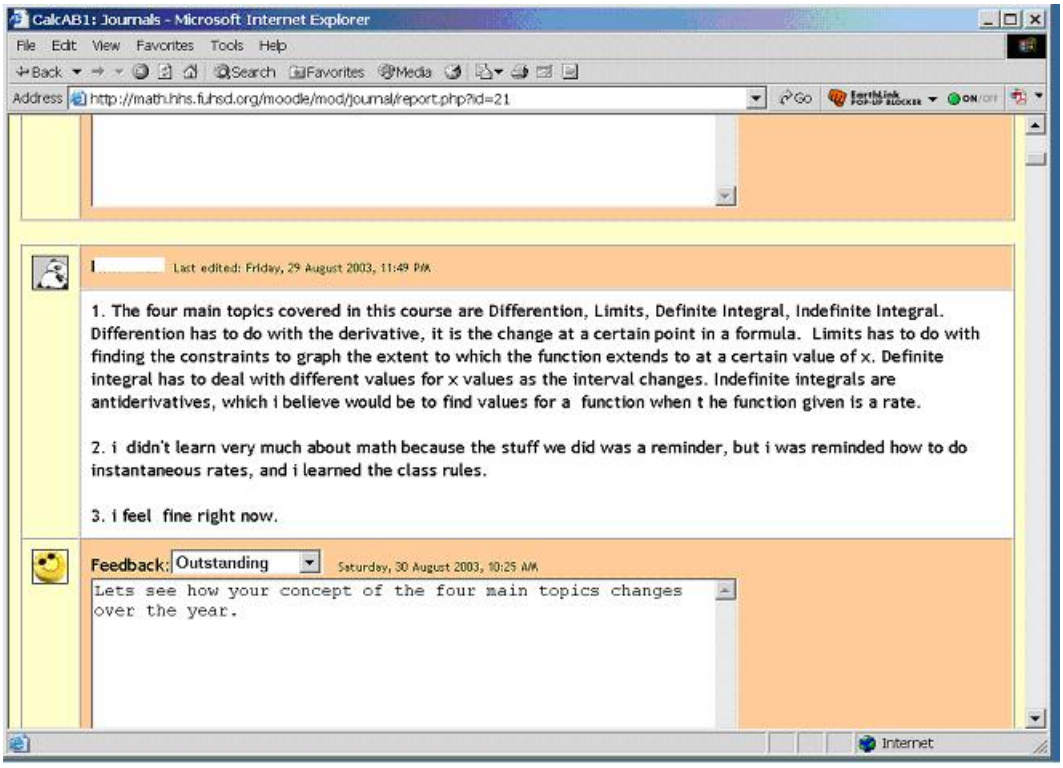


Figure 2 – Journal Grading Screen

4.2 Using Journals to Encourage Critical Thinking

4.2.1 Implementing the "Prefer Writing" Pedagogical Pattern

"Prefer Writing" asserts that students need to practice writing both because it is useful and because it forces them to be engaged with the ideas.[5] Engaging students with ideas is the purpose of on-line journals in the Computer Science and AP Calculus curriculum. Mathematicians and computer scientists create things. They write. They write and re-write proposals, programs, and documentation.

Students, especially high school students, seldom like to write. Journals force students to write. Requiring summaries of important material requires students to write and to engage the material.

Presenting a weekly journal assignment on the MOODLE with a topic prompt each week and asking students to respond to the prompt with a definition; with their opinion; or with an explanation and examples ensures that students actively engage the material. Grading journals not only provides feedback but it also ensures that students invest time in this activity and legitimately respond. Graded using a 3-tier scale of 'outstanding', 'satisfactory', and 'not satisfactory', or a point system provides validation of the student's thinking. Commenting on journal entries helps establish a cognitive apprenticeship between student and teacher.

As an example, Calculus students were asked to explain the Fundamental Theorem of Calculus in their own words. Two examples are shown as Figure 3 and Figure 4. It is evident from the responses that students are willing to write and express their ideas given an environment where they feel safe and where they feel that their comments will receive a response. In addition to the benefits for the student, reading the journals gives the teacher excellent insight into students' understanding of the material.

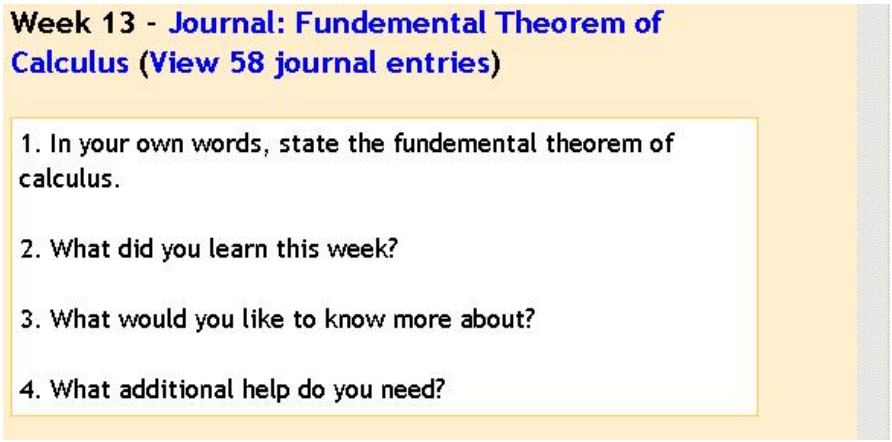


Figure 3 - Fundamental Theorem Prompt

The fundamental theorem is used to simplify the work of integrating different functions. (Extremely useful I might add). However, this works if the integral is properly defined with a definite beginning and end point.

The first fundamental theorem form is where the definite integral from the lower boundary, a, and the upper boundary, b, is given. The result of that function's integration can be defined as g(b) - g(a). However this is only true if and only if the derivative of the function's integral is equal to the function of itself. [g'(x) = f(x)]

The second form of the fundamental theorem is where the integral of a function is given in a variable, for example we shall use t. and the boundaries given for the lower is a constant, a, and the upper boundary is given as variable x as an example. If this is true and the integration works then the derivative of the function (g'(x) = f(x)). If the function g of u is equal to the integral from the constant for the lower limit given as an example, a. And the upper boundary would be given as the letter u of the function f(t) then the derivative of that function g(x) would be equal to the derivative of the function f'(u)du/dx with resepct to u in terms of x.

The natural log function is defined as:

ln x = the integral from lower boundary 1 to upper boundary x of the function 1/t dt. Where x is a positive number. This can also be said to be the area under the region of the graph known as y = 1/x from t = 1 to t = x. Problems that create natural log as an answer are the problems whose function is something similar to (1/u) for example. (?)

In any case, this week has been a bit confusing. At first with taking the derivative of functions involving the nautral log functions have been fairly easy. However as we moved onto the integration I found even the exploration to be challenging. Perhaps it will take practice, over the weekend most likely, to prepare and understand the proof and reasoning behind how the integration of the natural log function works.

*EEEK! I have the SAT 1s on Saturday morning.....Worried

Figure 3 - Student Response to Fundamental Theorem Prompt

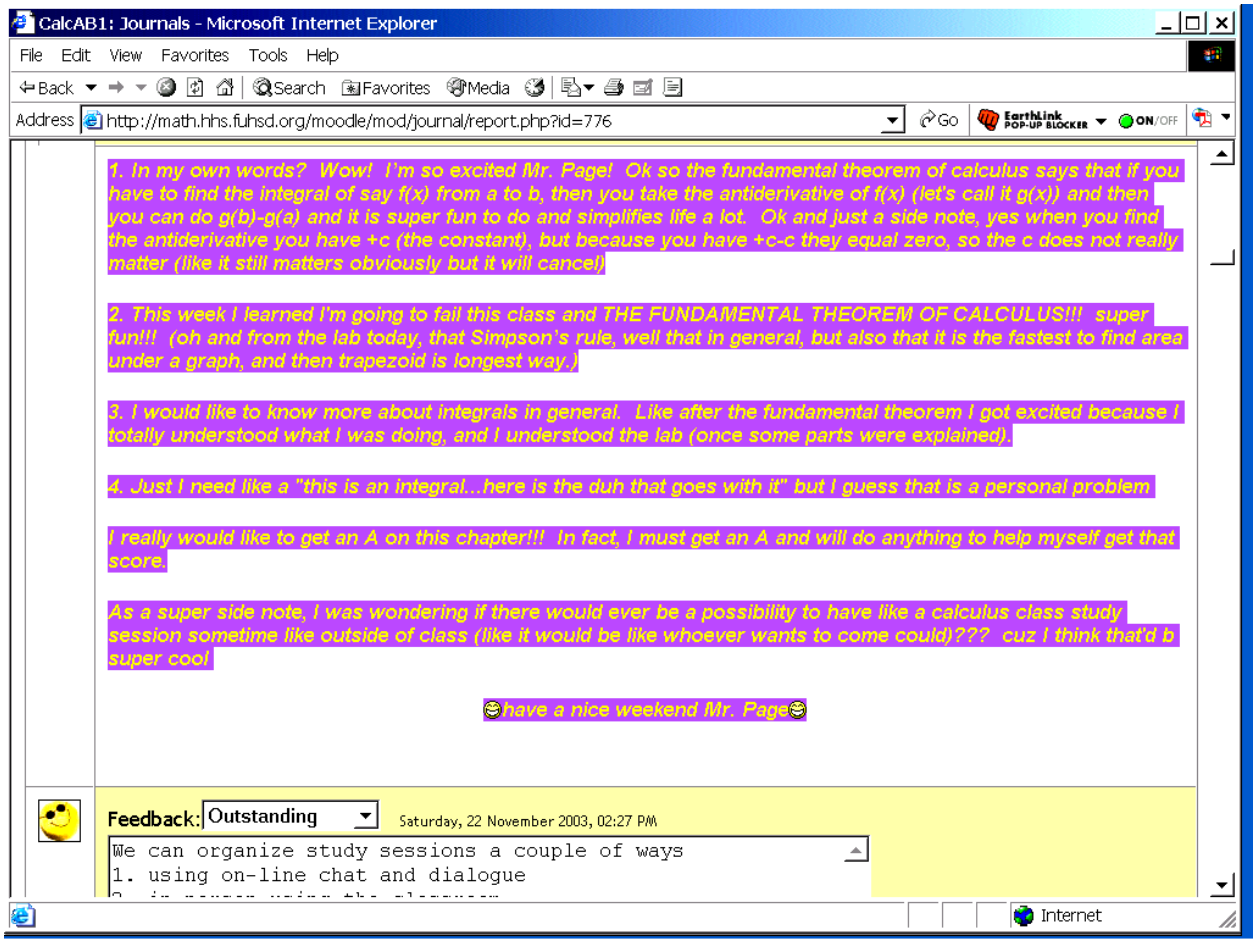


Figure 4 - Student Responses to Fundamental Theorem Prompt

4.2.2 Recording the Evolution of Student Thinking

Journals provide a vehicle for measuring meta-cognition among students. Carefully selected questions that record a student's understanding of a particular topic answered at multiple sample times provide the basis for the measurement. Using journals in this way implements the patterns "Spiral", "Explain it Yourself", and "Own Words".[3]

Journals provide several pedagogical advantages in the design of a course as evidenced by of the AP Calculus AB curriculum. In particular, the teacher introduces a topic or series of topics that are central to the curriculum. Asking students to interpret and comment on several concepts that are central to the course as they are introduced generates a baseline for measuring the evolution of student thinking. When students comment on the same topics later in the course, an objective measure of this evolution of thinking is produced. Examining and comparing responses over time and looking for increasing understanding of the topics as the students build the required knowledge guides the development and pacing of the course.

Calculus AB addresses four distinct topics in a spiral fashion. Tasking students to comment on the four topics immediately after introduction provided the baseline for measuring the evolution of thinking and provided insight into students' initial attempts at building a correct model for the topics covered during the course. After exploring each topic in detail, students review their initial response and comment on their current understanding of the topic. Using journals in this way provides clear documentation of the student's changing cognitive model and gives the teacher an opportunity to quickly correct misconceptions or model errors.

As an example of using journals for the measurement of the evolution of student thinking, AP Calculus students responded to the question: "What are the four main topics covered in this course?" They responded following the first week introduction to the course when the four main topics, limits, differentiation, integration, and indefinite integration, were first introduced. Several weeks later, after completing the study of differentiation, students again responded with their current thinking on the topic of differentiation. Figure 5 is an example of one student's response, and figure 6 is a second student's response.

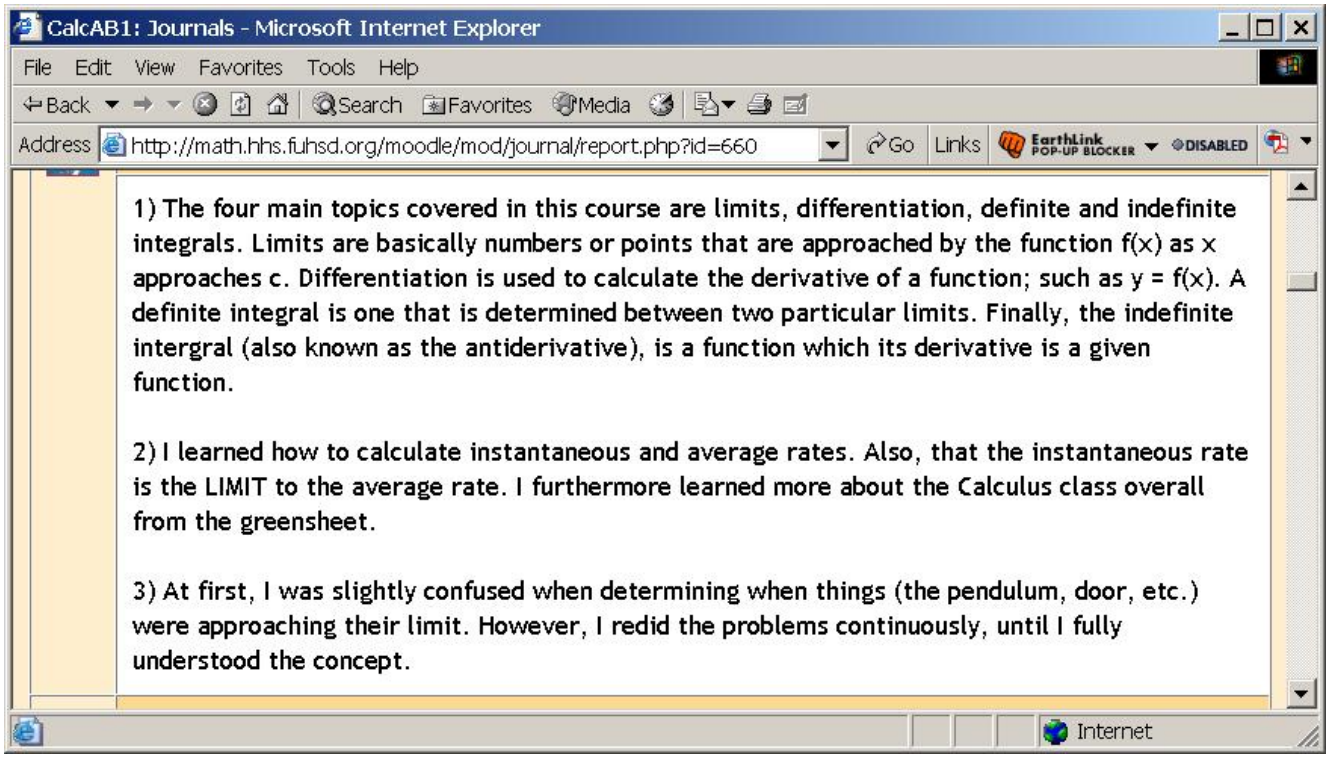
Connecting new information with previous knowledge allows the learner's mind to reorganize knowledge structures. Sometimes referred to as the "Advance Organizer", this connection activates prior learning for the acquisition of new knowledge. Journals used to document a student's thinking as the course evolves give the students a way to connect and organize knowledge structures. Beneficial as a guide to the teacher for instructional pacing and delivery as well as a guide for the student to organize knowledge and construct knowledge models, on-line journals serve a dual purpose when used to record the evolution of student thinking.

4.2.3 Encouraging Reflection and Questioning

Encouraging reflection and questioning of ideas and values often requires removing the student from distractions and peer pressure. On-line journals, viewed only by the teacher, are ideal for this purpose because of the cognitive apprenticeship relationship between student and teacher. Nurturing this relationship yields remarkable results. If there is an atmosphere of mutual respect between the teacher and the student, the student will share his most private thoughts. Eliminating peer pressure from the activity and demonstrating to students that their thoughts and ideas are important allows students to open up and express their thoughts. The teacher must read and respond to the students if this is to be effective. It is not necessary to respond to every student every week; therefore, the additional work for the teacher is minimal and a good investment when compared to the gain in student understanding.

When the journals are on-line and students are allowed to respond anytime within a specified window, the pressure to produce "on the spot" in the classroom is eliminated. Students have the opportunity to write their thoughts, and reflect on their writing. Further, when the on-line journal entry can be submitted for feedback before the due date, then revised for final assessment, risk is reduced since the student will not be penalized for a less than satisfactory first response, rather she will receive further direction and a chance to succeed. [See "Reduce Risk"] An additional benefit is the cementing of the relationship between the student and the teacher – a necessary step if students are to actively engage the material. Of course, reading journals multiple times

and responding multiple times does create an additional workload for the teacher; however, the results justify this additional effort.



1) I used to think that the derivative was simply the instantaneous rate of change; however, now I know that the derivative is also the slope of the tangent line. I found it quite interesting how we learn so many different things about one topic as the months progressed.

2) This week I learned a lot about differentiation. And today I learned from the exploration that if a function can be differentiated, it is also continuous.

3) Graphing some functions was a little difficult to complete at times; however, I hope to get a lot of practice with it over the weekend.

4) I believe I need more time to study all the material covered in Chapter 4, because although I understand the topics, I am not completely comfortable with all of them yet.

Figure 5 – Comparison of Thoughts about Differentiation Student 1

1. The four main topics covered in this course are limits, derivatives, integrals (one kind) and integrals(another kind.) I believe that limits deal with the fixed points of graphs and discovering whether or not a point is increasing or decreasing. Derivatives relate to being able to find the average rate of change for any situation. Lastly, integrals are used to find the original equation. For example, the integral of 4 is 4x. We will be learning about two types of integrals.

2. This week I learned the concept of instantaneous rates (finding instantaneous rates of change.) And, on Friday I learned about the rate of change by equations, graphs, or tables. Today in class, the teacher expanded the definition of what limits are and determining whether or not the slope is increasing or decreasing at a given point.

3. I believe that I have completely understood the material that has been discussed in class. However, whether or not I *truly* understand the material will be reflected on my performance in the class. I am aware that if I do not completely understand a concept to either ask Mr. Page or receive help from my peers.

1. The derivative has many different aspects to it. There is the derivative in x=c form, which states that the derivative of a function is equal to the limit of the function as x approaches c. It also has a geometrical interpretation, which is the slope of the tangent line. Both these definitions are equal to the instantaneous rate of change. The derivative can be defined using the change in x or h form as well. There are also different properties of differentiation: power function, sum of two functions, constant times a function, a constant function, derivative of a quotient of two functions, derivative of a product of two functions, differentiability implies continuity, and the chain rule. There are many different ways of writing the derivative. The derivative of displacement of a moving object from a fixed plane is equal to the velocity. The derivative of velocity (double derivative of displacement) is equal to acceleration. We also learned the derivative of all the sinusoidal functions, which can be derived through the properties of derivatives and the technique of implicit differentiation.

2. This week, I learned the derivatives of the sinusoidal functions (besides sine and cosine) and implicit differentiation.

3. I understand all the topics we covered this week.

4. I do not need any additional help this week.

Figure 6 – Comparison of Thoughts about Differentiation Student 2

One project implemented in both JAVA programming and AP Computer Science focused on a discussion of the ethical use of computers. Beginning with a presentation of a case of plagiarism

that occurred in the IEEE Communications Magazine, students were shown the implications of committing plagiarism as a professional. In this particular case, an assistant professor plagiarized a recent PhD thesis. The original author demanded a public apology. The results of this were shown to the students, along with commentary about the assistant professor's career potential following this incident. In particular, it was pointed out that this person's academic career most likely ended. The discussion then turned to a discussion of intellectual property rights and copyright infringement. Finally, we discussed the Record Industry's recent attempts at preserving its copyrights.

Ethics and in particular respect for intellectual property is an important concept in computer science. Computer scientists are involved in nearly every aspect of our lives, from purchasing groceries at the corner market using a self-serve kiosk to figuring out the optimal coding strategy for communicating with a Mars rover. The very essence of our society as the "information age" reaches maturity is the concept of the protection of intellectual property. This assignment allows students to reflect on the concept of intellectual property rights in a computer driven society.

Students were reluctant to express their views in class. Seemingly afraid of looking foolish in front of their peers or possibly exposing a fellow student who may be illegally downloading music, they preferred to avoid any serious discussion. Determining what individual students thought about this topic using whole group or small group discussion therefore requires more than a reasonable amount of time. Yet, with the assurance of privacy students were willing to reflect on the issues and write their opinions in an on-line journal outside of class.

Students found the case of the plagiarized PhD thesis to be straight forward, although there were divided opinions on the severity of the punishment. Recent enforcement of copyright by the RIAA brought out a large number of diverse opinions. In all cases, students thought actively about the problem and expressed opinions indicating an appreciation for the moral and ethical issues. Even those that disagreed with the RIAA position still felt that recording artists were entitled to fair compensation.

Figure 7 shows the journal prompt and one student response. Figure 8 shows additional student responses.

4.2.4 Supporting Pedagogy

Weekly journals offer students the opportunity to provide feedback on the course direction and pacing. Each journal requires students to respond to four questions:

1. What did you learn this week?
2. What would you like to know more about?
3. What topics covered this week do you feel you did not completely understand?
4. What additional help do you need?

Students who are reluctant to speak out in class feel comfortable answering these questions in an on-line journal. Action on the students' comments is required. If there is no apparent action on the part of the teacher, then there is no incentive for the students to continue to provide feedback.

Any action increases the students feeling of ownership in the course. Feedback can be as simple as supplying the rationale behind course content and direction. In some cases, where appropriate, acknowledging the need for a change in direction of pacing of the course is necessary. Usually it is possible to provide students with specific choices when making changes to the course. This can be as simple as allowing students a choice of two or more possible dates for a quiz or test.

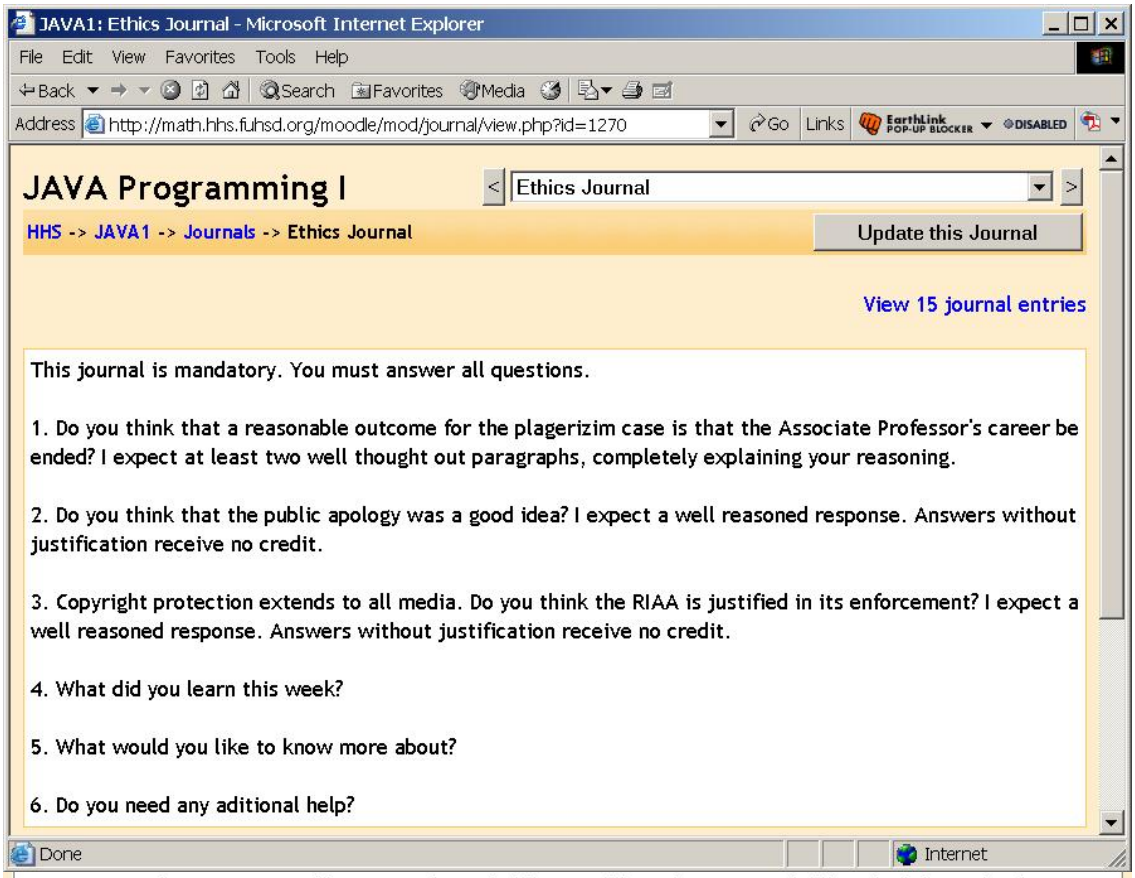


Figure 7 – Ethics Journal and Student Responses

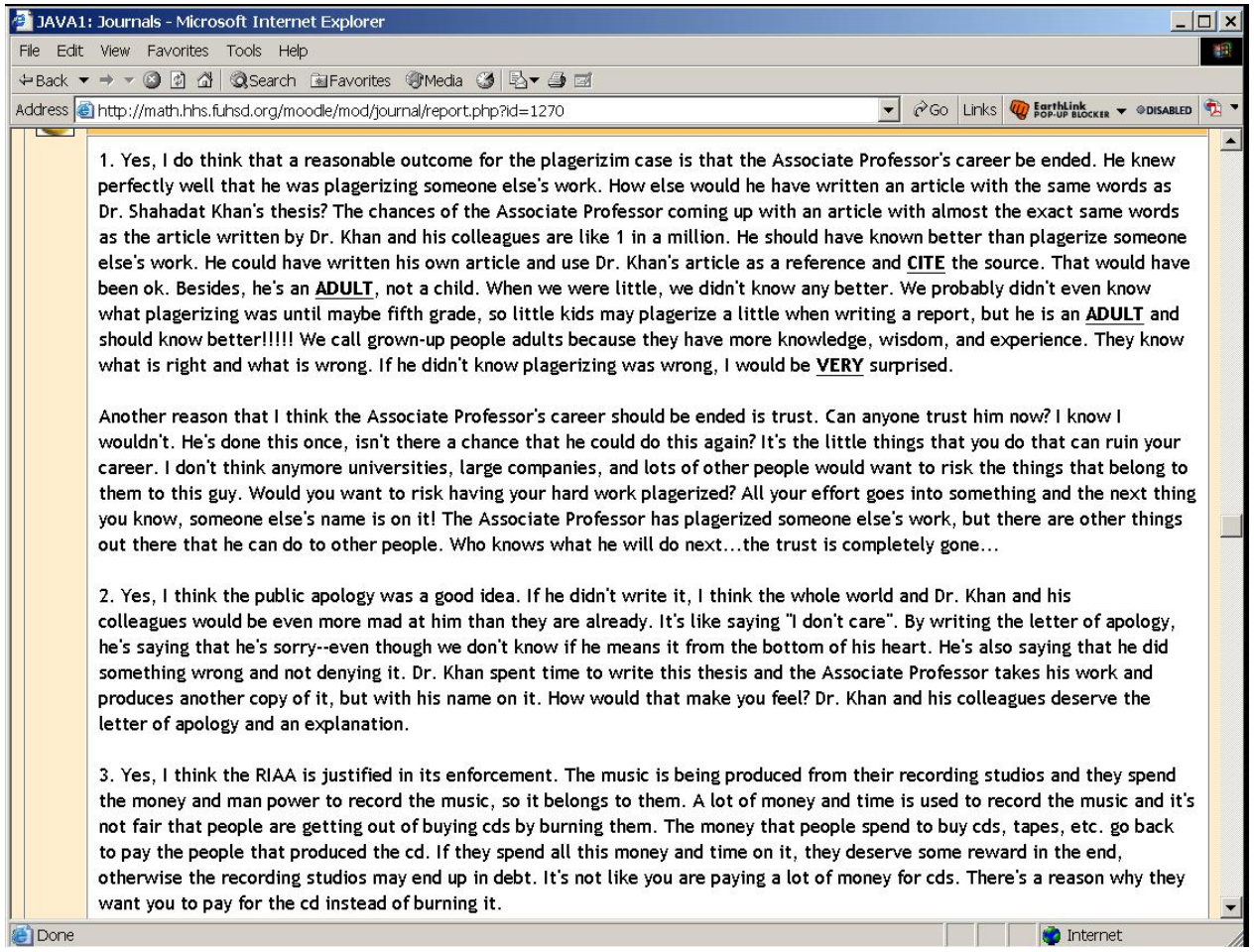


Figure 8 – Further Ethics Journal Responses

Benefits for the teacher are many. Usually each succeeding lesson in a mathematics course builds upon knowledge from previous lessons. If a student has not built a cognitive model incorporating previous material, they will quickly fall hopelessly behind in the course. Often students do not realize that the knowledge they have constructed is insufficient or incorrect, however when they answer the journal questions it becomes obvious to the instructor. Quick intervention can mean the difference between success and failure for even the most talented students.

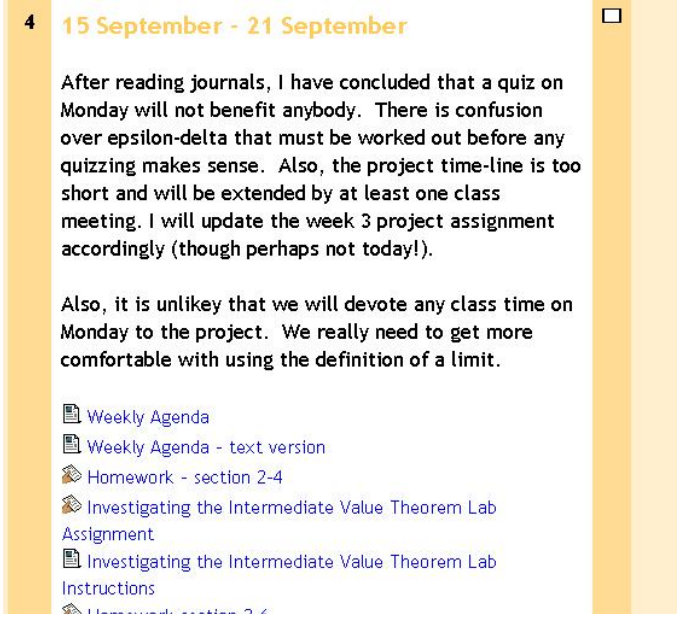


Figure 9 – Results of Reading Journals

Because of reading journals, a quiz was postponed and extra instruction added to accommodate a project that was not fully understood (See figure 9). Even though there were minimal questions and comments during class, journal responses showed that the course pacing at that particular time was too fast. Another journal suggested the need for a tutorial session devoted to the TI calculator. Adding a student choice to the MOODLE allowed the desired number of tutorial sessions to be scheduled and prompted further journal discussions about specific topics.

4.2.5 On-line Journals and the "24/7" Pedagogical Pattern

A principle objective of this project was to change students' ideas toward their courses and 'break down the classroom walls'. Instead of viewing each course as an event that re-occurs at a particular time several times per week, the goal is to have students view the class meetings as an opportunity to gain new information that allows them to continue their own personal study of the course topic. Self-learning and self-assessment are the true goals. Most of the actual course material is fleeting. Studies have shown that the typical high school student retains less than 30% of what they learn in high school. Teaching students how to learn must be the real goal behind instruction, with the course material serving as a vehicle for accomplishing this objective.

If students are going to become self-directed learners, it is important that instructional materials and assistance be available outside of the normal classroom hours. Students must have access to the course at times convenient to them as well as during regularly scheduled class meetings. This is summarized succinctly in the pedagogical pattern "24/7":

"Many of today's students work in addition to going to school. They do their outside-of-class exercises at odd times. They are otherwise very busy. It is frustrating to have a question and not be able to get it answered for several days. Use technology to keep in touch with your students. If used well, students will have the idea that they are in contact with their teacher twenty-four hours a day, seven days a week ". [3]

Figure 8 shows the activity log of a fictional student taken from the MOODLE web site. Looking at actual student data reveals that there are predicable patterns. For example, activity peaks between 7:00 and 9:00 most weeknights with upwards of 200 web site hits per minute. There is generally significant activity around midnight on Friday (when journals are due). Activity again peaks early Saturday morning (when journals are read and assessed). The next peak occurs on Saturday afternoon around 4:00 PM, and Sunday from 5:00 to 8:00 PM.. Using this information, and utilizing the facility built into MOODLE to provide e-mail notification whenever a forum is modified or an on-line dialog is entered, it is possible to monitor and respond to students quickly, giving the illusion of 24 hours per day, 7 days per week availability of their teacher. Additional instructor availability is also provided by the on-line chat facility built into the MOODLE.

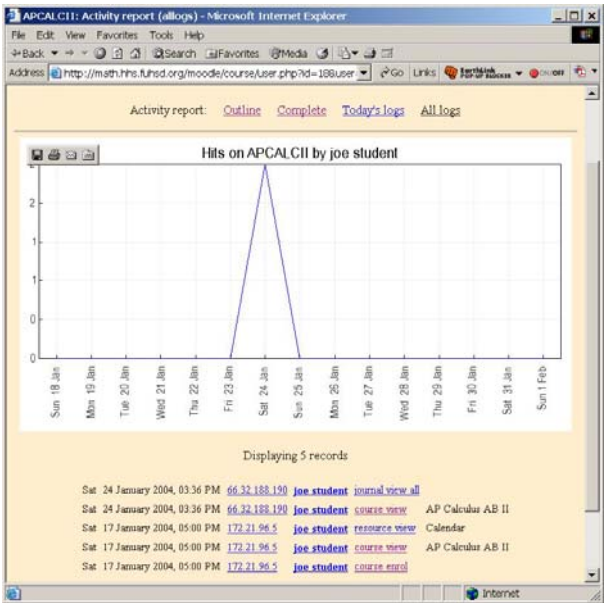


Figure 10 – Typical User Log from MOODLE

Weekly journals reflect the students' current model of the course material. Often questions are posed in journal entries by students who are reluctant to raise questions in class. There are cultural issues here as well. In Pacific Asia, students do not like to ask questions because it implies a double loss of face. The student loses face in not understanding the instructor properly. The student causes the instructor to lose face because a question implies that the instructor has failed to anticipate the question [see "Honor Questions" in 3]. If students are successful in getting a response to their questions using these tools, they will continue to use them. Often, a few words in response to a journal entry can avert a complete misunderstanding of a topic.

Please answer the following questions before Saturday.

1. What is the difference between a particular equation and a general equation? Give an example for a linear equation.

2. Write the meaning of Derivative.

3. What method(s) do you know for computing a definite integral?

4. What two values in the Trapezoidal rule are multiplied by 1/2 and why?

5. What is a removable discontinuity?

Figure 11 – Journal Prompt on Background Knowledge

4.2.6 Using Journals for Assessment

Assessment of student work is one of the primary jobs of the classroom teacher. Many confuse assessment with grading. Within the framework of constructivism, Blooms Taxonomy provides a proven means of assessing student progress. Yet, many of the artifacts students are asked to produce are designed to be 'easy to grade'. The result is that they measure progress relative to Blooms Taxonomy only at the knowledge level.

Measuring a student's ability to think critically about a topic and synthesize new information is difficult. It is difficult to construct assessments, and it is time consuming for the teacher to perform the assessment.

On-line journals can provide one measure of a student's progress. Carefully selected prompts allow the student to respond at their level within the taxonomy. Students who have mastered the material at the knowledge level will have the opportunity to demonstrate their knowledge of the subject matter, while students who have advanced to the analysis and synthesis levels will also be able to demonstrate their constructed knowledge and understanding. Using reflective journals as an assessment vehicle linked to Bloom's Taxonomy implements the patterns "Explain it Yourself", "Own Words", and "Expand the Known World".

Using journals in this way is not an easy skill; the prompts are hard to generate, and assessing student response is time consuming. Nevertheless, the rewards in terms of overall understanding of the course material by the students outweigh the difficulties posed. As in all endeavors, practice by the teacher ultimately results in a decrease in the required time commitment.

Figures 11, 12 and 13 are an illustrative example of using reflective journals as an assessment vehicle. Figure 11 shows a prompt that admits an answer at any level of Bloom's taxonomy. Figure 12 shows a student response corresponding to the knowledge level in Bloom's taxonomy. Here, the student understands the concept of a general equation and particular equation only in terms of the simplest case of a linear equation. This student has not extended that knowledge to an arbitrary polynomial, nor has the student generalized to include any function. Emerging analysis and synthesis levels are indicative of the response shown as figure 13. Here the student recognizes that a general equation can refer to any type of function, and understands that substituting specific values for arbitrary constants in a general equation results in a particular equation. Comparing the responses to the prompt on removable discontinuities provides another example.

1)A general equation is y=mx + b but a particular equation actually has given values such as y=2x + 15, which is an example of a linear equation.
2)The derivative of a function at a particular value of the independent variable is the instantaneous rate change of the dependent variable with repect to the independent variable.
3)One method is counting squares and multiplying that number by the value of the square. Another method is the trapezoidal rule.
4)The first and last values, or the outside y-values. This is because when you add up the trapezoid's, some of the sidelines overlap and get counted for twice. this is true for all but the outer lines. and part of the formula for a trapezoid is multiplying it by 1/2.
5)A removable discontinuity is when the function is discontinuous at x=c but continuousthere with a suitable definition of f(c).

Figure 12 – Student Response Indicative of the Knowledge Level

1. A general equation is a generic form of an equation that uses contains variables instead of actual numerical values. A particular equation has the same form as a general equation, but the constant variables are replaced by specific numerical values.
y = mx + b - General equation
y = 2x + 5 - Particular equation

2. A derivative is the instantaneous rate of change at a certain point.

3. I know how to compute the definite integral by counting squares and by using geometric shapes (trapezoids)to find the area.

4. The first value and the last value are the values that are multiplied by 1/2. This is because the first and last values are only used once. However, all values in between are used twice. Therefore 1/2 multiplied by 2 is 1 (for the other values).

5. Removable discontinuity is practically a point on a graph that can be removed. It is a point that can be undefined or even defined at a different part of the graph. The limit, however, can still be calculated for a graph (with a removable discontinuity) if the graph does not take a "step."

Figure 13- Student Response Approaching the Analysis/Synthesis Level

4.2.7 Using Journals to Verify Assignment Completion

A recurring problem faced by classroom teachers at the secondary level is verifying that students complete assignments, especially reading assignments. Even though textbook problems relating to the material are usually assigned as homework, there is a tendency for students to disassociate

the homework from the required reading and attempt to complete the homework without doing the reading. As a result, student understanding suffers. An in-class quiz is the typical solution.

Quizzing in class as a means of verifying assignment completion reduces the amount of instructional time available. Therefore, alternative solutions are appropriate. Using journals with prompts that can be answered at several levels within Bloom's Taxonomy not only serve as a valuable assessment tool, but also serves to verify whether or not a student has completed pre-requisite reading and study. Asking students to reflect and comment on a reading assignment, for example, allows each student to demonstrate their understanding. Using carefully selected journal prompts, the teacher can insist that students answer at least at the knowledge level. Failing to do so indicates that the assignment was either not read, or was completely misunderstood.

If the objective is to only verify that the student has studied the material, prompts can be designed that test understanding at only the knowledge level of the taxonomy. Figure 14 is an example of a journal prompt that measures understanding at only the knowledge level of Bloom's Taxonomy. Examining the response shown in Figure 15 reveals that the student not only read the material, but also paid particular attention to in-class discussions. The response shown as Figure 16 clearly indicates that the student either did not do the reading assignment, or did not understand the reading assignment. The student answered every prompt with an incorrect or incomplete response.

1. Are you allowed to use a return statement from a void method?

2. What happens if you try to assign an integer value to a double variable?

3. Consider the following method:

```
void aMethod(int a, int b)
{
a = a+b;
}
```

if the main program does the following, what will be printed out?

```
...
int a = 5;
int b = 6;
a = aMethod(a,b);
System.out.println(a);
...
```

4. What must be identified when a recursive method is designed?
5. What did you learn this week?

Figure 14 – Prompt Designed to Verify Completion of a Reading Assignment

Given a set of journal entries, the teacher can easily determine if the students are doing assigned outside-of-class activities. A general lack of understanding exhibited by many of the journal entries may indicate that the assignment was too difficult, or misunderstood by many in the class. Such a finding would necessitate re-teaching of the topic. When only a few students demonstrate a lack of understanding, the students who failed to master the material can be assigned to a tutorial session, or given other work to improve their understanding. Using journals instead of in-class quizzes makes more efficient use of class time and provides valuable information about student understanding.

1. It will allow the program to stop, but it is not allowed because it shows that your design/strategy was not complete.
2. It will be fine, but when you tell it to println, it will give out a a decimal number. Ex. you put in 5, it will give out 5.0. Basically, it turns the int into a double.
3. The method would print out "5." Even though in aMethod a=a+b, the a is deleted immediately when the aMethod terminates. So, it does not permanently change the value of a. To get it to redefine a, a return a must be assigned to the end of aMethod.
4. The base case must always be identified when a recursive method is designed. Without it, the recursion would never stop. The reduction step is something else that must be identified.
5. I learned about recursion and more about ELSE/IF. It works almost the same way as recursion in Karel except it is much more flexible. The communication between different methods through parameters and RETURN statements are also very interesting. Too bad that the method can only return one variable.

Figure 15 – Student Response Showing Understanding of Assigned Reading

1. No
2. An error.
3. It prints "11".
4. Base case.
5. Not really.

Figure 16 – Student Response Showing a Lack of Understanding of Assigned Reading

5 Conclusions

This report summarizes using on-line reflective journals to support a constructivist pedagogy and implement patterns within the pattern language “Active Student.” [3] The successful implementation of several patterns from this pattern language has resulted in a more successful

learning environment for students. In particular, it has been demonstrated that students often prefer to respond to on-line journal entries rather than participate in class discussions. Students will pose questions, and reveal their thought processes much more readily using journals as a vehicle as opposed to in class discussion. It has been shown that students are much more open with their responses when their privacy is assured and when their responses are acknowledged and encouraged.

On-line reflective journals have been demonstrated to be a meaningful assessment tool. Assessments of student work spanning all levels of Bloom's Taxonomy are possible. Additionally, by implementing the patterns "Own Words" and "Explain it Yourself", students are able to actively construct knowledge because of making these journal entries.

On-line journals were shown to contribute to a solution to the pattern "24/7", giving students the illusion that the instructor is available 24 hours per day, 7 days per week. Students are able to get answers to their questions nearly in real time, thus avoiding the usual frustration of having to wait several days for an answer.

On-line journals have been demonstrated to be effective in extending the classroom walls. Students are actively engaging the material both inside the classroom as well as outside the classroom.

6 Appendix I – Active Student Pedagogical Pattern

Active Student **

This pattern was originated by Joseph Bergin as Active Student and by Astrid Fricke and Markus Voelter as Work Forms [VF].
You want to maximize student learning.
***
Passive students don't learn much. If students listen to explanations, without themselves becoming engaged, what is learned is unlikely to go into long-term memory. **The deep consequences of a theory are unlikely to be obvious to one who reads about, or hears about the theory. The unexpected difficulties inherent in using the theory or applying the ideas are not likely to be apparent until you actually do use the theory.** However you might have grown up with the passive style of teaching only and really don't know anything else. But, readings, lectures, and multi-media demonstrations, unless interactive, leave students passive.
***
Therefore: keep the students active. They should be active in class, either with questions or with exercises. They should be active out of class. Reading alone is often insufficiently active. Short readings should be followed by activities that reinforce what has been learned in the reading. The same is true of information given verbally or even visually through multi-media visualizations. If the students don't actively engage the material, they won't retain it. They need to write and they need to "do."
Choose (or write) textbooks and other materials that have a lot of activities at different levels of scale and difficulty. Consider using Different Approaches [BEMW] for taking different sensory modalities into account when engaging students. Students can write as well as read (PREFER WRITING), they can answer questions in writing or orally. Make them work together, using GROUPS WORK, or STUDY GROUPS both in class and out of class. Make them answer their own questions, as in TEST TUBE [BEMW]. Allow them to learn a concept by exploring or trying it for themselves (EXPLORE FOR YOURSELF [BEMW], TRY IT YOURSELF, or Explain it Yourself. Both in: [EBS]). You should ideally try to alternate between the different teaching and learning styles.
The most important aspect of course planning is in knowing what the students will be doing throughout the course. Remember that your job is not to give the students information. It isn't really even showing them ways to find information. Your real job is to show them ways to build new information structures for the problems of their days. This is an inherently active process.
***
Law schools use moot court and Law Review and a number of other devices to keep the students active. Business schools use case studies requiring extensive write-ups for the same purpose.
Medical students have a "path pot[1]*" where they are given a set of organs from a deceased patient and must explain the reason for the patient's death.*
Joe Bergin often phrased the underlying idea of this pattern as: "It doesn't matter what I do. It only matters what my students do."
A corollary to this idea is that of the Active Lecture, in which the students are active during "lecture" time. See STUDENT DESIGN SPRINT [EMWM], for example.

A special case of this is Christoph Steindl's SELF TEST Pattern [EBS]. A self-test is a pseudo exam that the students may take informally to prepare themselves for an upcoming exam. Make these available, but don't require them. Provide answers and feedback for those who ask for it.
While taking this pattern into account is most often more efficient and fun for the students, it means much more effort for you in terms of preparation and attention during the session than a traditional lecture style session.
Lecture-style teaching should only be used, if you intend to pass a lot of information in a short time frame. The emphasis is on *passing* information and not on *understanding* information.

7 Appendix II – Reduce Risk

Reduce Risk **

You don't want to act as a *gate* blocking your students, but a *way* that enables them. While you must evaluate your students, the exam process often gets in the way of education. Exams are viewed negatively by students and some do poorly for psychological reasons unrelated to what they have learned. Others do relatively poorly based on language or cultural factors. You don't want your students to become primarily good exam takers as you have more to give them than that.
Also, you realize that students come to you to be educated, not examined. You realize that the purpose of a course is not to have the students prove to you that they don't need that course. You want to enable the students to take risks, but not to feel *at risk* for doing so.
Therefore take effective action to reduce your student's risk of course failure. Exams can count for a smaller part of their grade. If this is impossible, you can give Trial Exams. You can help them form Study Groups. You can Grade It Again Sam. You can have them write a research paper on a topic on which they did poorly on an exam. You can use Student Selected Activities.

8 Appendix III – GNU General Public License

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