Students' experiences with online tutorials in undergraduate mathematics.

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Introduction

* This talk concerns a blended learning environment in introductory undergraduate mathematics, where web-based training is integrated with classroom instruction.



The Department of Mathematics and Statistics at Memorial University is currently investigating the possibility of adopting a computerized assessment/tutoring system for introductory undergraduate courses.



*improve students' learning by giving them access to practicing the skills at their own pace, and

* free up the instructor's time from marking which allows more time to be devoted to actual teaching.

. On-line tutorial system can

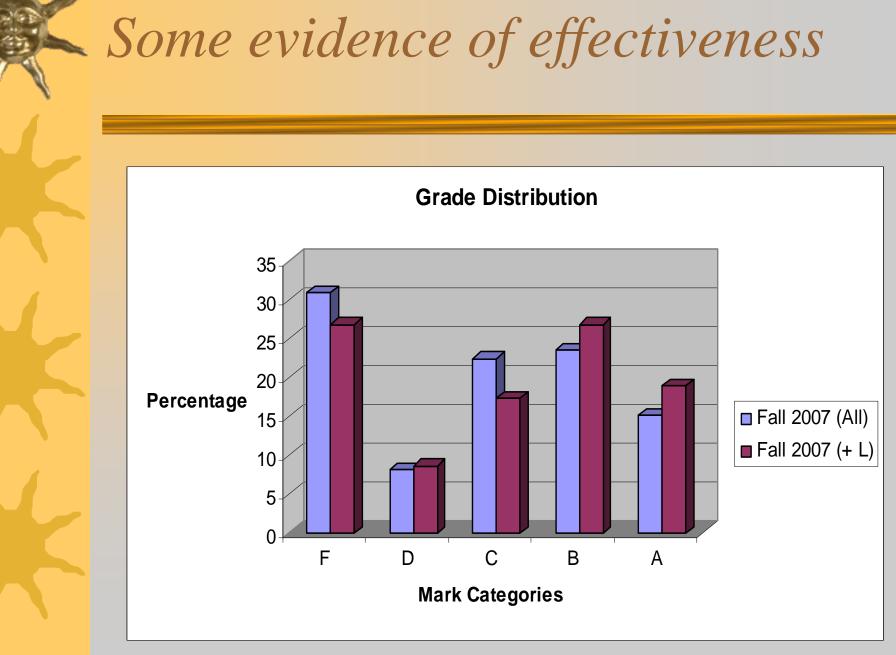
- * randomize numbers in problems similar to those discussed in the textbooks, thus provide the learner with virtually an unlimited set of problems related to a mathematical topic.
- * generates an instant feedback to a student's input which presumably forces the student to review the incorrect answer until it is accepted by the system.
- * provide access to similar examples with detailed explicit or guided solutions, videos of related lectures and textbook and other resources.

students at university need

Flexibility and efficiency in using procedures

Develop meaning from applying those procedures

Connect and structure the information they receive/obtain



Different effect on different learners

***** a study of mathematical intimacy, flow experiences and confidence of students, conducted by O. Radu & T. Seifert (2010), indicate that incorporation of on-line tutorial system in pre-calculus teaching "may have a positive effect for some students and a negative effect for others."

"Ideal user" of the on-line system?

*****Educational software can be considered from different perspectives such as domain and pedagogical expertise or the quality of the interface. The model of the student is one important characteristic yet to be taken into account (Wenger 1987). When tutoring software is designed, there is a certain assumption about the student who ideally will benefit from it.

Theoretical framework.

* "Pupils accomplish educational activities by using what they know to make sense of what they are asked to do."

(N. Mercer, "Culture, Context and the Construction of Knowledge in the Classroom". 1993 p. 31).

Thus, the **meaning** which students assign to an activity can be understood **as a condition** for them **to engage in learning** and to act accordingly (Lange, 2007; Skovsmose, 2005).

Meaning and culture

* "the construction of personal meaning is context bound" (Vollstedt, 2010), and that the surrounding learning culture is one of the important aspects of the personal context (Leung et al, 2006).

Hong-Kong student Emma

- Vollstedt (2010) describes a 16 years old Hong Kong student Emma, who studies mathematics. While the student possesses "a low mathematics self-concept", she admits that "practicing mathematics soothes and prepares for important exam".
- * "Emma's behavior is somewhat typical to Hong Kong students". The development of this personal meaning of doing mathematical problems and actions she carries out (practicing as much as possible) is attributed to the Confucian Heritage Culture

Emma is an "ideal user"!

*****One can see how Emma could clearly benefit from on-line tutoring software in learning mathematics. A learner who welcomes extra practice, handy resources, and a little 'push' in their study is the model of the ideal student that software developers apparently had in mind when they made the on-line tutoring software.

Best students (top 10%) have:

Solid background knowledge in high school mathematics;

- *****Ability to learn independently;
- Commitment to attend classes and do their homework;

*Goal to do well in their courses.

Top 50% students

*Are reasonably well prepared in high school, but often underestimate their mathematical deficiencies;

Know how to reproduce work shown by the teacher;

*Generally wish to grasp material and to do well, but are not always willing to give the extra effort needed.

Border-line student

- * Have underdeveloped basic skills in mathematics;
- * Possess misunderstanding of mathematical concepts;
- * Don't readily make connections; between topics;
- ***** Are unable to communicate mathematical ideas;
- * Possess low self-confidence;
- * Exhibit math anxiety on tests;
- * Want just to pass and move on.

Students "at risk"

*Have poor understanding of math;
*Low interest in the subject;
*Come with negative mindset;
*Show lack of effort and low commitment to attend classes;

*Have hardly any educational goals.

Interviews with students

Three groups of questions regarding:
* General school experience
* Undergraduate mathematics
* On-line tutoring system

General experience

Amanda (28): returning student; had good high school preparation, worked 10 years.
Brenda (18): had problems with math in high school. Did not like her teacher and French emergence program.

Cindy (18): she had a good teacher but was never excited about math

All three agreed on

***** Math is about ability to solve problems *****Learning math from looking at similar examples and solving equations ***** Math lacks interaction with people and application to real world *****Math is not for their future career Their choices: linguistics, pharmacy, business.

Undergraduate math

All three students:

- *****Took pre-calculus before calculus.
- * think that Calculus is somewhat interesting, but they hardly connect it to their interests and programs of study:

*'it may be helpful''- Amanda,

- *"I need to pass and get out" Brenda,
- *"I will clear my mind after final"- Cindy.

On-line tutoring system-first use

Amanda felt satisfied and optimistic
Brenda and Cindy described their first reaction to the use of the on-line software as irritation, boredom, and helplessness.
All liked immediate feedback
All were challenged by the equation editor **Online tutorial system**—work habit

*****Amanda looks for mistakes on her own

*Brenda likes to use the resources (examples, ebook)

Cindy works with a tutor and then submits the answers

Online tutorial system - progress

- With time Both Brenda and Cindy felt more satisfaction with their on-line practice.
- * When Brenda discovered that she had access to on-line resources, she started to practice more often, whenever she had time between lectures.
- * The description of her experience now resembles many similarities with Emma such as "being diligent", "remember all steps" and "practicing as much as possible to prepare for important exam".

Online tutorial system - progress

- Cindy felt more optimistic as well and saw the value of the tool for her review before tests, but she still was overwhelmed by the length of the assignments and would have preferred to complete the work in smaller chunks.
- * Amanda continued to enjoy using the on-line system and she admitted that the extra practice helped her to build a confidence in her performance.

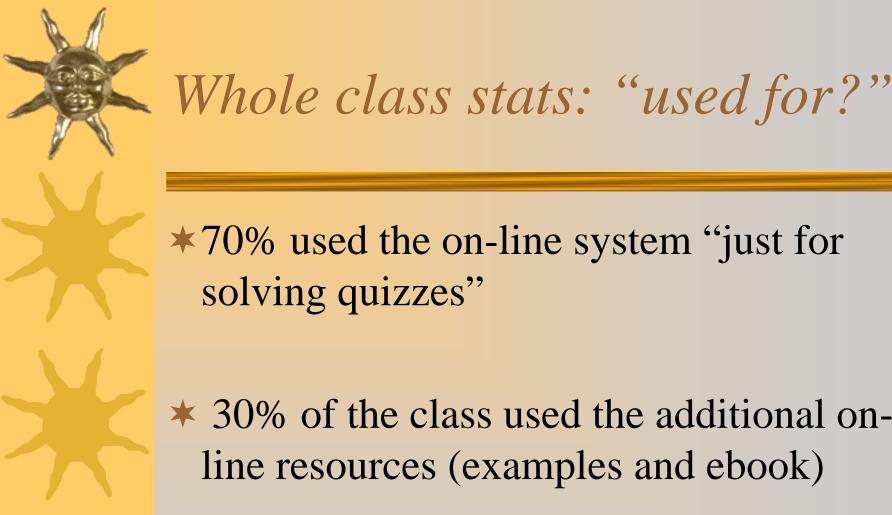
Whole class stats: "used when?"

 13% of the students used the on-line practice regularly,

★26% used it for review before the tests,

★ 55% postponed solving the on-line problems till the end of the course,

* 8% did not use the on-line system at all



 \star 30% of the class used the additional online resources (examples and ebook)

Whole class stats: happy or not?

- 53% of the class felt either satisfied or optimistic when using the on-line system,
- 46% reported being irritated.
- 30% of students were amused, surprised or exited about working with on-line system.
- 30% felt suffering, boredom, or helplessness. (Some students indicated that they experienced both positive and negative feeling regarding the on-line system at the same time.)

Students' recommendations:

- 64% were in favor of continuing the use of the on-line system in Calculus.
- 30% recommended increasing the weight of on-line assignment in total mark,
- 28% would introduce more intermediate deadlines,
- 25% would reduce the number of compulsory problems.



Students say that initial level of anxiety decreases with more practice and successful performance helps to build optimism and confidence.

*Thus it is critical for students to start doing the on-line practice regularly and develop the habit of "working hard" and "practicing as much as possible".



Regular on-line practice changes the local culture of learning and helps the students to assign personal meaning to this activity.
This is where the instructor's decision about the specific way of using the software can make a difference.

Instructors need to

 Carefully decide on the assignment weight: many students need an extrinsic motivation
 Remind students about on-line resources and learning materials

- Use combination of written and on-line assignments
- *Help students to decide on the amount of extra practice

Instructors need to think how to

*help students to use the online tutoring system as a partner for learning certain methods along with their conceptual layout.

produce a motivation for learning
 calculus based on students' own interest.

What skills can be learned?

***** I propose that with an adequate control from the instructor the use of the software may change students' learning habits through changing the meaning assigned by the students to the purpose of the activity. Even if the software fails to improve students' motivation to learn the subject, it still may contribute in teaching them how to organize and maintain their work on a regular basis.