



Retaining Freshmen Interest in CS Using Collaborative Courses and Experiential Learning

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Poster layout

Title slide

Problem and needs

MATH & CS courses

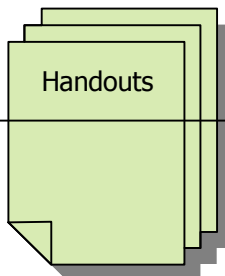
CSIE 177

Concepts

YMOW
projects

Results

Contact slide





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1. Problem
2. COSC 111 & MATH 105
3. Concepts
4. CSIE 177 – class details
5. YMOW – 3 projects
6. Results



Problem

- Table 1 from the paper



Why students are not interested in CS

Research studies indicate that students don't pursue careers in computing because of the following reasons:

- Students either have no information or incorrect information about CS [4].
- There still exists a strong disconnect between what knowledgeable students want to learn and what CS faculty want to teach [8].
- Students look for experiential, investigative, and hands-on type of learning [5, 7].
- Students are interested in applying what they learn in CS to other disciplines [3].
- Women feel that CS is not a people-oriented discipline [4].



Lack of immediate application

It has been found that freshmen do not appreciate a certain field of study due to the lack of immediate application of concepts they have learned in-class [5, 7].

Such application is essential for their critical thinking and assessment of results to make appropriate connections between fundamental and applied concepts.

Even though the CS curriculum recommends a senior, capstone project [2], it is too late for students, in their duration of study, to realize the practical applications of concepts they have learned.



COSC 111

Introduction to Programming

- First course in Computer Science
- Java programming
- Majors, Minors, and other students
- 2 hours lecture + 2 hours lab
- Topics
 - primitive data types, arithmetic expressions, strings, flow of control, console input and output, objects and classes, methods, static members, and arrays.



MATH 105

College Algebra

- A preparatory course for Calculus
- Major focus is on *functions*
- 3 hours
- Topics
 - Functions, a catalog of functions (linear, quadratic, polynomial, rational, exponential, logarithmic), solving systems of equations and inequalities, applications, graphs, sequences, and series.

Experiential education

“Tell me, and I will forget.
Show me, and I may remember.
Involve me, and I will understand.”
– Confucius, 450 B.C.



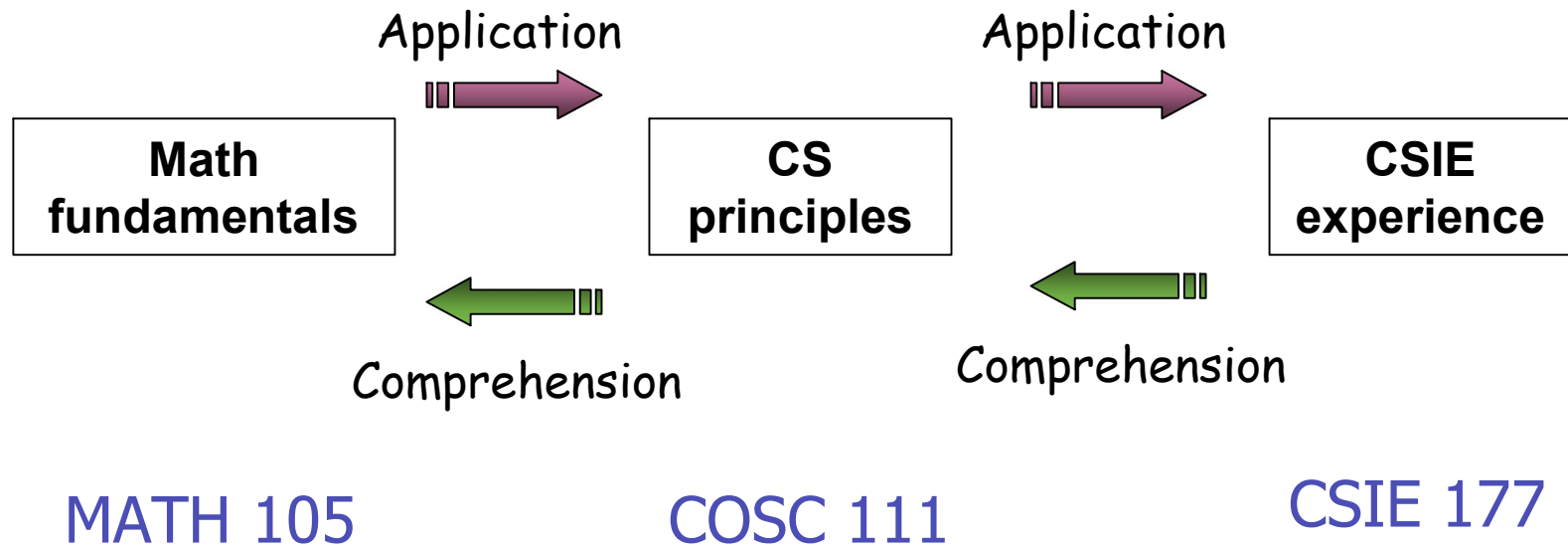


Learning-by-doing

- *Experiential learning*, by learning from experience using hands-on activities,
- *Active learning*, by engaging students in different types of learning activities in the classroom,
- *Cooperative learning*, by helping students learn as a team, and
- *Service learning*, by helping students learn as they serve their community and reflect on that service.

Collaborative courses

Reinforcement through continuous application and comprehension of concepts learned.





Collaboration between Math & CS

The handshake between the courses has been achieved in the following ways:

- Sequencing the introduction of topics in individual courses in such a way that one course' instruction will complement the other.
- Providing assignments in one course that will reinforce the concepts learned in the other.
- Helping students connect the materials by discussing and referencing related materials in the lectures.
- Constant communication between the instructors and incorporation of constructive feedback in the organization of the courses.



Sequencing of topics and sample assignments

- Example 1: A refresher on real numbers and binary numbers will be provided before computer processing of data is introduced.
- Example 2: Modulo operator (remainder) and precedence rules will be introduced prior to introduction of Java arithmetic operators and expressions.
- Example 3: Mathematical functions will be introduced prior to the introduction of class methods.

- Example 4: Write a program that tallies the results of an election after introducing mathematical functions and their graphs.
- Example 5: Write a method that computes and returns BMI (Body Mass Index) of a person, based on the gender, weight and height, after introducing mathematical functions.
- Example 6: Write a program to find the sum of a series of numbers using arrays after the introduction of sequences and series.



Theme-linked CSIE course*

- First implementation in Fall 06.
- A customized, inter-disciplinary, seminar.
- Co-requisites: MATH 105 and COSC 111.
- Purpose is to bridge the gap between the Math and CS courses.
- Class time used for reinforcing concepts from both classes and discussing applications of concepts as a team.
- Highlight of the course was a service-learning project.
- Students worked in small groups to create software solutions for a local non-profit.

* NSF-funded, Creative Scientific Inquiry Experience (CSIE) program. www.emich.edu/csie/



CSIE 177*

Meals on Wheels: Routing and Cost Analysis

- 1-credit hour seminar
- Provided hands-on experience for the students
- Served the software needs of a local non-profit agency
- Service-learning
 - Talks by the non-profit agency
 - Field trip and community service
 - Presentations of solutions by student groups

* NSF-funded, Creative Scientific Inquiry Experience (CSIE) program. www.emich.edu/csie/



CSIE 177

Include

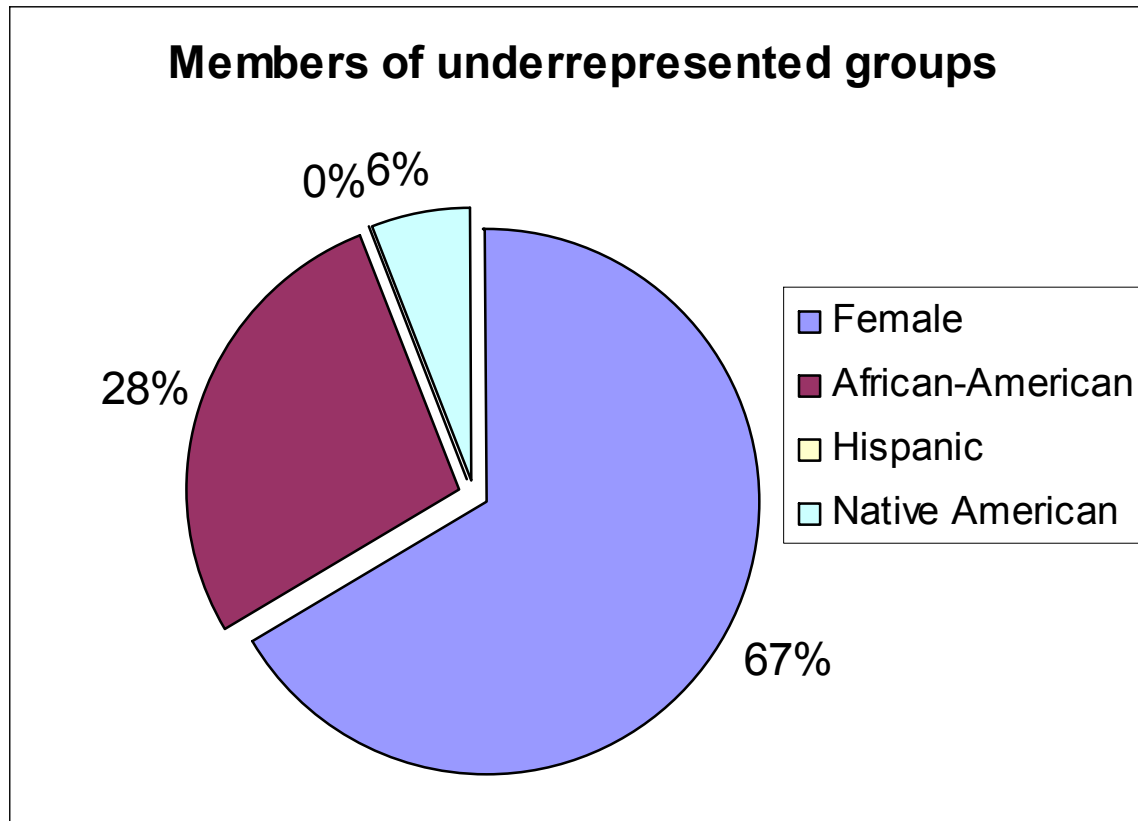
- Syllabus
- Class projects – spider on the wall, modeling the volume of a box
- Initial YMOW profile
- YMOW projects
 - Annual reporting
 - Cost analysis
 - Routing analysis



Evaluation - parameters

- Small dataset for evaluation because of first implementation in Fall 06
- The dataset included up to 21 students in two CSIE clusters – Math/CS and Biology/Chemistry
- Four faculty teaching two CSIE clusters for the very first time

Student Demographics



Number of student responses **n = 19**



Student Evaluations

The following average ratings were given based on a 5-point scale where 5 means "Very Effective" and 1 means "Very Ineffective".

- What is your overall general rating of your two current CSIE courses (not counting the one-credit hour seminar)?
Mean = 3.9 n = 21
- What is the overall, general rating of your two current CSIE instructors? **Mean = 3.8 n = 20**
- What is the overall rating of your current one-credit hour CSIE seminar? **Mean = 2.6 n = 19**
- To what extent do you feel that your CSIE experience has encouraged you – as a member of an underrepresented group to succeed? **Mean = 3.5 n = 13**
- To what extent do you feel that your current CSIE instructors have encouraged you – as a member of the underrepresented group – to succeed? **Mean = 4.0 n = 13**



Student' Comments

- "I was able to see practical real world applications and use technology that I normally would not use."
- "I like the small hands on learning with the laboratory and lecture classes."
- "There was a lot of interaction with the Professors."
- "It was interesting to be a part of more advanced experiments and field work that most entry-level science students do not get to be a part of."
- "There was more exposure to see what I am capable of doing in a real-world situation."



Faculty Evaluations

- Students at the freshmen level will benefit more from supplemental kind of instruction than additional work that was involved in the seminars.
- It was extremely difficult to set up service learning projects with meaningful CS applications for freshmen with very little programming knowledge.
- Career explorations might be more beneficial at the freshmen level.



Informal student feedback

- 3 out of 5 students said that they are planning to major in CS.
- 1 student was not sure.
- 1 student decided not to major in CS.



Conclusions

This program fosters the following qualities within its students:

- Team player.
- Critical thinker.
- Effective communicator.
- Knowledgeable and curiosity in the discipline.
- Competent professional.
- Enthusiastic contributor to the community.



Conclusions

The following highlights of the program are attractive to women:

- People-oriented project.
- Application in a different field.
- Not having to sit at a computer all the time.
- Not just about programming.
- Team-work.
- Students as better citizens.



Conclusions

The program is still in its formative stages. The following are some observations:

- It attracts under-represented groups to the Sciences.
- The CSIE cohort of students form a community of their own and students support each other in academic activities.
- The 1-credit seminar course has to be structured better to serve students' needs.



References

- References from the paper



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