

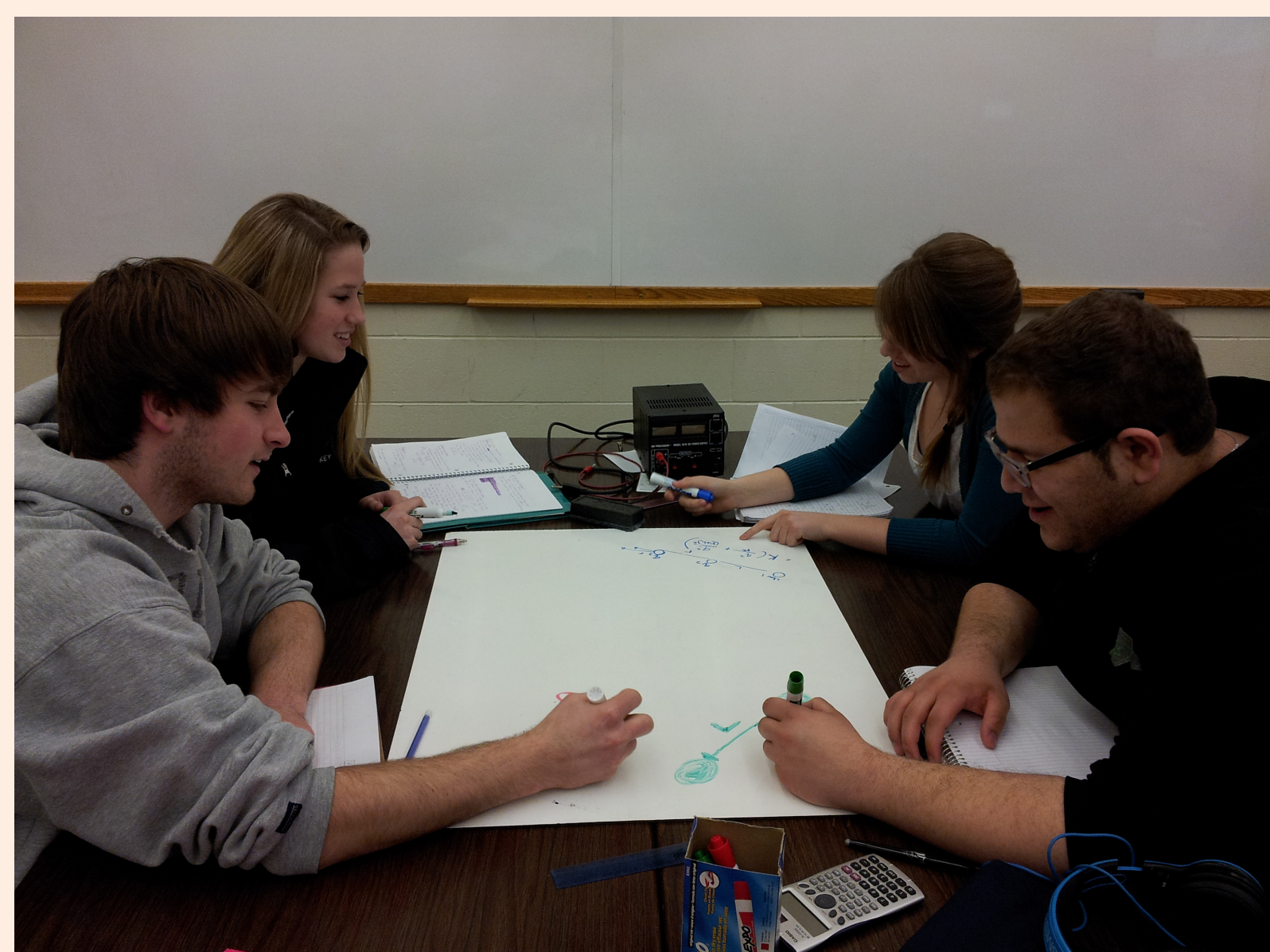
**OVERVIEW OF STUDIO PHYSICS PROJECT**

The physics department at Concordia College in Moorhead Minnesota has completed a three-year transition to implement Studio Physics pedagogy in both semesters of its calculus-based and algebra-based introductory physics courses. The goal of the Studio Physics project was to increase both student learning and the retention of STEM majors. The transition required modifications to our course schedule, teaching schedules and the classroom environment. The effectiveness of the new pedagogy was evaluated using the FMCE and the CLASS.

**STUDIO PHYSICS**

**Classroom:**

- Flexible classroom designed to g a combined lecture and lab.
- Students learn the physics concepts by guided hands-on activities interspersed with mini-lectures and group problem solving.
- Class size of 24 (6 groups of 4 students)



**Daily Schedule:**

- Meets three times per week for 70 minutes
- Meets one two-hour period once a week.
- Schedule meshes with campus's traditional daily schedule
- Like our traditional course schedule (Lecture and Lab Time offerings)
- Students co-enrolled in a lecture linked to a specific laboratory period

**COURSES TRANSITIONED TO STUDIO PHYSICS**

Concordia College physics department offers two levels of introductory physics that are each two semester-long sequences. The four introductory physics courses offered at Concordia College. These courses and their content are:

Calculus—Based Physics Courses

PHY 128—Kinematics, Newtonian Mechanics, Rotational Motion  
 PHY 211—Waves, Sound, Light, Optics, Electricity and Magnetism

Algebra—Based Physics Courses

PHY 111--Kinematics, Newtonian Mechanics, Rotational Motion, Waves and Sound.  
 PHY 112– Light, Optics, Electricity, Magnetism, and Nuclear Physics

**PROCESS FOR TRANSITIONING TO STUDIO PHYSICS**

- Implementing the new pedagogy is very time consuming.
- Planned a 3 year transition to the Studio Physics pedagogy
- Transition occurred in the following manner:
  - Year 1—PHY 128 and PHY 211
  - Year 2—refinement to PHY 128 and PHY 211
  - Year 3—PHY 111 and PHY 112

**ASSESSMENT OF THE STUDIO PHYSICS PEDAGOGY**

Two primary methods of assessment.

**1. Forces, Mechanics Concept Evaluation (FMCE)**

Administered in the PHY 128 and PHY 111 courses

**2. Colorado Learning Attitudes in Science Survey (CLASS)**

Administered in the PHY 128, PHY 211 and PHY 111 courses

\*no standardized content survey was use to asses the PHY 211 or 112 courses.



Photo of Studio Physics Classroom layout.

**RESULTS OF THE ASSESSMENT DATA**

**FMCE:** Gains in content knowledge in PHY 128 and PHY 111 were assessed using the Force and Motion Conceptual Evaluation (FMCE). Our students demonstrated an average gain of 48% in PHY 128 (Table 1) and an avearge gain of 31% PHY 111 (Table 2) in the course taught with Studio Physics pedagogy. This can be compared to the 7-10% gain typically resulting from traditional instruction (Thornton and Sokoloff, 1998).

N=95	Pre-%	Post-%	Normalized Gain	Standard Error
Total (37)	24.9	61.2	48%	4%
Total (33)	24.6	59.9	47%	4%

Table 1. FMCE data from PHY 128 from 2012, 2013 and 2014

N=67	Pre-%	Post-%	Normalized Gain	Standard Error
Total (37)	15.0	41.6	31%	3%
Total (33)	14.3	38.5	28%	3%

Table 2. FMCE data from PHY 111 from 2014

**RESULTS OF THE ASSESSMENT DATA**

**CLASS:** The Colorado Learning Attitudes about Science Survey (CLASS) was used to assess student attitudes towards science. The national trend obtained with this instrument observe a significant deterioration in attitudes towards science in all categories of beliefs in first-semester courses, regardless of type of instruction<sup>1</sup>. The results for PHY 128 and 211 are presented in the Table 3. These data are similar to the national trend showing a decrease in student attitudes after the first semester physics course, but this decrease only happens in 4 of the 8 categories. The data from the second semester course (PHY 211) show no change in 6 of the 8 categories and 2 categories show a significant increase to more expert-like thinking.

	PHY 128		PHY 211	
Categories	shift in expert-like thinking	shift in novice-like thinking	shift in expert-like thinking	shift in novice-like thinking
Overall		↑		
All categories		↑		
Personal Interest				
Real World Connection				
PS General	↓	↑		
PS Confidence	↓	↑		
PS Sophistication	↓	↑		
SensesMaking/Effort	↓	↑		
Conceptual understanding Applied		↑	↑	
Conceptual understanding			↑	

Table 3. CLASS data from PHY 128 and PHY 211. Arrows indicate the direction of a statistically significant shift in the student thinking.

**SUMMARY**

Assessment data from the physics course indicate:

- Student learning on the FMCE increased more in classes with the Studio Physics pedagogy as compared to national averages in courses taught with traditional lecture methods.
- Students attitudes toward learning science are better than the national trend measured by the CLASS

**ACKNOWLEDGEMENTS and REFERENCES**

- <sup>1</sup> Adams, Perkins, Podolefsky, Duson, Finkelstein, and Wieman, 2004.
- We are grateful to Dr. Mona Ibrahim, the assessment coordinator for the STEP grant at Concordia College. Her careful analysis of the assessment data has been very valuable and greatly appreciated.
- The project was funded by the National Science Foundation STEP grant award #0969568.