Launching a Peer Supplemental Instruction (PSI) Program for STEM majors

By

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University System of Georgia STEM Summit
Middle Georgia State University
May, 2017
Presentation Agenda

• Introduction:
  - Inspiration and need for PSI
  - PSI Program objectives
  - Evolution of PSI at Georgia Gwinnett College

• Methods:
  - Unique adaptations for Georgia Gwinnett College
  - Leaders, training, sessions (2015-2017)

• Outcomes:
  - Impact of PSI on students and leaders
  - Incentive study

• Future directions:
  - Research questions
  - Enhancing the model
GGC’s Systems Approach Framework For Achieving Student Retention and Graduation

Institution

Curriculum

Faculty

Students

PSI
Grade distribution for BIOL, CHEM, MATH gateway courses

- Historically difficult for students
- >25% D, F, or Withdrawal rate
- “Gateway” or prerequisite course for STEM majors

Grade distribution for fall 2015 (Mean ± SEM).
PSI Intervention: 3 Key Objectives

1. To provide learning support for STEM students in traditionally challenging gateway courses → reduce DFW rates.

2. To equip students with active learning strategies tailored to STEM education.

3. To foster an academic culture of collaborative learning among STEM students.
Evolution of PSI Program

2014-2015 pilot
- Open to BIOL 1107K only
- Two new leaders
- 60-min sessions, twice per week
- Addressed specific course concepts
- Conducted in free student spaces

2015-2016
- Open to BIOL 1107K and CHEM 1211K
- Eleven PSI leaders
- 75-min sessions, three times per week
- Lesson plans covered all course content

2016-2017
- 7 gateway courses:
  - MATH 1111, 1113
  - BIOL 1108K, 1107K
  - CHEM 1212K, 1211K
  - ITEC 2140
- 25 leaders - senior leaders mentor and train new leaders
- Leaders can register for STEC 4800 (STEM Leadership)

PSI Schedule: Spring 2017

Peer Supplemental Instruction (PSI)
LEARN and GROW with your neighborhood STEM Grizzlies

Come to our free PSI sessions!

Questions? Ask your SST Professor about PSI.
Elements of our PSI program

Peer leaders
Model students
Trained in PSI strategies

Collaborative learning
Small group work
Not tutoring

PSI sessions

Course content
Weekly sessions cover chapter concepts

Academic skills
Time management
Note taking
Exam questions

Active learning
Concept maps
Drawing to learn
Multi-step problem solving
3D modeling
GGC SI Adaptations:
STEM classes capped @24 students

Traditional SI model

- One SI Leader per course/instructor and 100-300 students/course
- SI Session topics align 100% with course content
- SI is organized through student learning support services
- Leaders embedded in class only

GGC’s PSI model

- Two-three Leaders facilitate a session for students from multiple (15-35) sections
- Multiple topics in a session; different sections may be at different pacing
- Program designed and run by STEM faculty
- Leaders embedded in class & lab

GGC SI Adaptations:
STEM classes capped @24 students
PSI Leaders

1. Strong STEM grades, works well with students, reliable; faculty recommendations

2. Training
   ✓ Pre-semester training day
   ✓ Lesson plans
   ✓ Faculty-Leader interactions
     ◆ Weekly discipline meetings
     ◆ Monthly interdisciplinary meetings; professional development
     ◆ Faculty observations
PSI Leader Training

1. Pre-semester training
   ✓ Facilitation techniques
   ✓ Active learning strategies
PSI Session Planning

- Leaders prepare lesson plans
- Reviewed by faculty
- Three components:
  - Opening
  - Working
  - Closing

**PSI LESSON PLAN**

Complete and submit at least 10 hours before the session. It’s OK to write in the information and scan or use this electronic copy. Take this with you to the PSI session

| PSI Leader: |
| Week/date: |
| Chapter: |
| **Main lesson concept:** |

<table>
<thead>
<tr>
<th>7-10 minutes</th>
<th><strong>Session opening</strong></th>
<th>Review of foundation concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Using this strategy:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>45-60 minutes</th>
<th><strong>Concept work</strong></th>
<th>Sub-concept 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strategy:</td>
<td>Sub-concept 2:</td>
</tr>
<tr>
<td></td>
<td>Strategy:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10-15 minutes</th>
<th><strong>Session closing</strong></th>
<th>Check for understanding:</th>
</tr>
</thead>
</table>

Sessions are 75 minutes. Include worksheets, sketch of your plan e.g. matrix, questions on an informal quiz, vocabulary builder etc. and a key of what you expect students to do.

**Reflection on this session (Did it work? What would you do differently?):**
BIOL 1107K PSI LESSON PLAN

Week/date: Week 7 (2/27/2017)
Chapter: 5
Main lesson concept: Passive and Active transport

7-10 minutes Session opening

**Background related to passive and active transport**

**Strategy: Snow ball**
1. Students write terms related to the cell membrane on a piece of paper, crumple the paper and throw to the center of the room.
2. Each student will pick a snow ball, read the term to the group and then describe as much as they can about the term. Brief discussion for clarification if needed.

This opening lays the foundation for understanding transport across the cell membrane.

Key terms students should cover: hydrophilic, hydrophobic, ions, fluid mosaic model, channels, concentration gradient, electrochemical gradient, active, passive, ATP.

45-60 minutes Concept work

**Sub-concept 1: (30 mins) Na+/K+ pump**

**Strategy: Group work/Board model**
1. Students will be grouped and instructed to draw the sodium potassium pump and annotate steps to explain the movements of molecules. Students use textbooks and online resources.
2. Groups will then take turns to explain the process of the movement of particles across the cell membrane to the other groups.

**Sub-concept 2: Active Transport (20 min)**

**Strategy: Matrix**
1. Students will first watch a video on active transport: [https://www.youtube.com/watch?v=1MXG6508IIM](https://www.youtube.com/watch?v=1MXG6508IIM)
2. Pairs of students will be asked to complete the following matrix after watching the video.

<table>
<thead>
<tr>
<th>Direction of flow</th>
<th>Does or does not require ATP</th>
<th>With or against the Conc. gradient</th>
<th>Example:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive transport</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Students label a membrane diagram to indicate active or passive transport

10-15 minutes Session closing

**Check for understanding**

**Strategy: Quick Quiz**

Students will submit anonymous answers to the questions below which will be reviewed by the leader.

1. Which ion is in a higher concentration outside of the cell (in the cytosol)?
2. What is the ratio of sodium’s & potassium’s that is transferred into and out of the cell?
3. What is needed for active transport to occur?
Solution/Key:

Sub-concept 2:

<table>
<thead>
<tr>
<th>Does or does not require ATP</th>
<th>With or against the Conc. gradient</th>
<th>Example:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Require ATP</td>
<td>Against</td>
<td>exocytosis, endocytosis</td>
</tr>
<tr>
<td>Does not require ATP</td>
<td>With</td>
<td>Simple diffusion, facilitated diffusion, osmosis</td>
</tr>
</tbody>
</table>

Sub-Concept 3

Passive: Passive if blue and active if green
Active:

Closing: Answers

1. Sodium
2. \(3Na^+:2K^+\)
3. ATP and a Channel protein
4. A. Passive does not require energy while active transport does.
   B. The types of transport vary.
      - For active transport: Endocytosis, Exocytosis and cell membrane/sodium-potassium pump
      - For Passive transport: Diffusion, facilitated diffusion and osmosis
### Session Observations by faculty

**PSI Session Information**

<table>
<thead>
<tr>
<th>Date</th>
<th>Room No.</th>
<th>Course(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/30/2015</td>
<td>HS205</td>
<td>BSCL1107</td>
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</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00-3:00</td>
<td>Calvin cycle, glycolysis, mitosis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leader(s)</th>
<th>Auditor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jimmy and Jane</td>
<td>Jennifer Hirst-Kennedy</td>
</tr>
</tbody>
</table>

#### SI Leader(s) are Prepared

<table>
<thead>
<tr>
<th>#</th>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leader(s) knowledgeable of course content</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Participation log available/filled in</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Leader addresses students' needs/questions</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Lesson plan available during session</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Atmosphere of Session

<table>
<thead>
<tr>
<th>#</th>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Session beginning on time</td>
<td>X</td>
<td></td>
<td></td>
<td>auditor arrived late</td>
</tr>
<tr>
<td>6</td>
<td>Agenda set at beginning of session</td>
<td></td>
<td>X</td>
<td></td>
<td>- posed difficult questions or figures/diagrams presented to others for discussion</td>
</tr>
<tr>
<td>7</td>
<td>Room arranged for group work/students working in groups</td>
<td></td>
<td>X</td>
<td></td>
<td>students worked at boards</td>
</tr>
<tr>
<td>8</td>
<td>Students doing most of the talking (solving together)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Students explaining material back to leader</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Students referring to textbooks and notes for info, rather than leader</td>
<td></td>
<td>X</td>
<td></td>
<td>students also encouraged to use Google, YouTube</td>
</tr>
<tr>
<td>11</td>
<td>All students participating in session</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Leaders managing time; using a timer for activities</td>
<td></td>
<td>X</td>
<td></td>
<td>reminded students of time frequently to keep them on track</td>
</tr>
</tbody>
</table>

#### Effective Use of Facilitation & Learning Strategies

<table>
<thead>
<tr>
<th>#</th>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Facilitation by redirection, wait-time and/or check for understanding</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Learning strategies employed for opening, working through and closing session</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Leaders explain purpose and benefit of employed learning strategy(ies)</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**16. Learning Strategies Employed During Session:**

- Drawing on the board, writing own exam questions, making question lists, drawing graphs, asking questions

**17. At the back of this sheet, diagram the communication/interaction between leaders and students**
PSI video by
Super leader Brittany X
PSI in action!
PSI Attendance

Attendance x Course

<table>
<thead>
<tr>
<th>Course</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1107K</td>
<td>347</td>
</tr>
<tr>
<td>BIOL 1108K</td>
<td>102</td>
</tr>
<tr>
<td>CHEM 1211K</td>
<td>370</td>
</tr>
<tr>
<td>CHEM 1212K</td>
<td>150</td>
</tr>
<tr>
<td>MATH 1113</td>
<td>106</td>
</tr>
</tbody>
</table>
PSI Attendance: Biology

Frequency of attendance

- 50% students attended 3+ sessions
- One student attended 38 sessions!

N = 448 Students
PSI Incentive study

• How can we improve attendance at PSI sessions?
• Can students be incentivized to attend more sessions?

Instructors offer PSI under varying conditions:

A. Voluntary
B. Participation credit (5 PSI/tutoring sessions by mid-term)
C. Extra credit (5 PSI/tutoring sessions by mid-term)
PSI Attendance

Students go to more sessions on average with incentives.
Spring 2017: Course Performance in Biology

Course GPA x Attendance x Incentive

- Mandatory - Only 50% of students met requirement
- Correlation of increased attendance and course grade
Fall 2015: Exam Performance in BIOL 1107K

Grade x PSI participation

Grade x Frequency of attendance

* p<0.05, Student’s t-test

- Significant effect of participation
- Higher grades 4+ sessions
PSI participants show higher exam scores than non-participants. t-test p<0.05

PSI participants who attend 4+ sessions score approximately a letter grade higher
Spring 2017: Course Performance in Biology

Mean Course GPA vs. Number of Sessions Attended

- BIOL 1108K
  - $R^2 = 0.9847$

- BIOL 1107K
  - $R^2 = 0.8956$
PSI participants in CHEM 1211K have fewer DFWs

Aggregate grade distribution. Comparison of course grades for students in the non-participating sections (n = 583, blue), participating sections (n = 231, red), and students who attended PSI sessions (n = 23, green).
Benefits to PSI Leaders

• Professional development opportunities

Victoria and Janyne presented on PSI activities at the American Society for Cell Biology conference, Dec 2015

Paul and Jonathon presented on PSI learning strategies at GGC’s annual STEM symposium, May 2017
Benefits to PSI Leaders

- Pre- and Post-semester concept tests
Benefits to PSI Leaders

- End-of-semester Reflections Survey

Skills learnt:

- Scientific communication
- Time management
- Leadership
- Public speaking
- Learning strategies
- Teamwork
- Patience

Other benefits:

- Increased confidence in STEM
- Relearning biology is helpful for the MCAT and PCAT
- Experience to acquire a TA position in graduate schools
- Gratification in seeing students improve in grades and confidence
- STEC 4800 course credit opportunity
Overall Assessment

Student impact

- Students participating in PSI sessions
  - Participate more when incentivized but no incentive increased FREQUENCY of attendance
  - Correlation between exam/course performance and frequency
  - requested PSI support in other courses; for longer periods and more sessions; began their own PSI sessions → culture of collaborative learning!!

- PSI Leaders
  - showed significantly improved mastery of basic course principles
  - reported increased confidence in current STEM courses
  - developed new skills and clearer about career aspirations

Challenges

- Student participation (max of 25%)
- Meeting the needs of multiple course sections in one session
Fall 2015: leaders embedded in biology labs to assist and assess graphing and micropipetting skills. Student’s t-test, *p<0.01, n=113.
Future directions: Blended LA+PSI model

Goal: To enhance learning in the classroom and establish rapport between leaders and students.
Acknowledgements

Biology
• Christopher Brown
• Jennifer Hurst-Kennedy
• Judy Awong-Taylor
• Cindy Achat-Mendes

Chemistry
• Benjamin Shepler
• Chantelle Anfuso
• Rashad Simmons

Mathematics
• Katherine Pinzon
• Jamye Curry

Information Technology
• Cynthia Johnson
• Sonal Dekhane

The PSI program is a component of Georgia Gwinnet College’s grant “Improving P-16 STEM Performance with High Student Engagement Strategies” which is supported by the University System of Georgia’s Board of Reagents STEM Initiative Education Improvement Plan
Questions?