

The Impact of Science Education Reform on Students' Perceptions of the Learning Environment



Erika, Steele, Cynthia Sunal, Dennis Sunal, Donna Turner
The University of Alabama
Cheryl Mason
San Diego State University
Dean Zollman
Kansas State University

Problem Investigated

Reform is needed at the undergraduate level to make undergraduate science courses more relevant, interesting, and motivating in order to increase student learning and the STEM pipeline .



Research Questions

Do undergraduates enrolled in science courses with various levels of reform perceive differences in their learning environments?



Data Collection Instruments

- Constructivist Learning Environment Survey (CLES)
(Taylor & Fraser, 1991, 1997)
- Reformed Teaching Observation Protocol (RTOP) (
Sawada, D & Pilburn, 2000)



The Reformed Teaching Observation Protocol (*RTOP*)

- Developed by Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT)
- Observer has a list of items that he/she rates: (0 point) *never occurred* (4 points) *very descriptive*.
- Categories include
 - Lesson Design and Implementation
 - Content: Propositional Knowledge
 - Content: Procedural Knowledge
 - Classroom Culture: Communicative Interactions
 - Classroom Culture: Student/Teacher Relationships
- The items in each category were summed to give a score between 0 and 20

The Constructivist Learning Environment Instrument

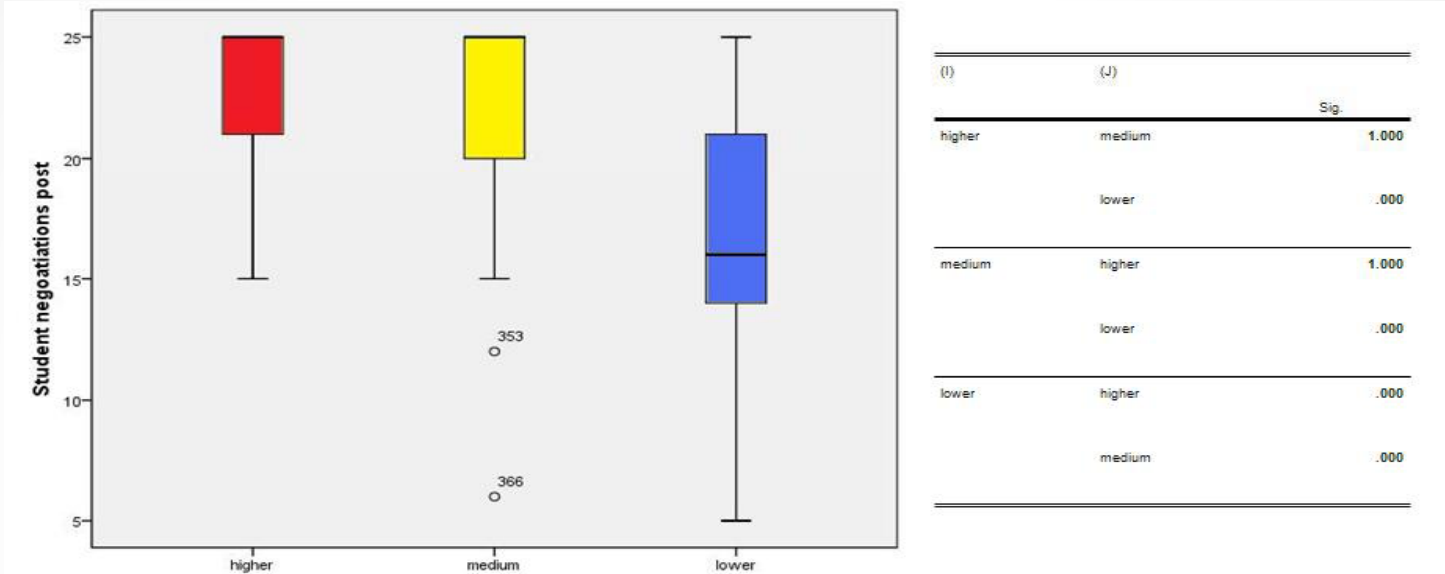
(CLES)

- The *Constructivist Learning Environment Survey* instrument (CLES) was developed by Peter C. Taylor and Barry J. Fraser in 1997 to enable teachers of science to monitor their constructivist approaches to teaching.
- The instrument contains five scales
 - (1) the *Personal Relevance Scale* measures how relevant students feel the course content is to their lives outside of the classroom,
 - (2) the *Shared Control Scale* measures students' perceptions of their control over classroom learning
 - (3) the *Critical Voice Scale* measures students' perceptions of their ability to question the teacher's pedagogy
 - (4) the *Student Negotiation Scale* measures students' perceptions of their ability to share their ideas with other students in the classroom
 - (5) the *Uncertainty Scale* measures students' perceptions of the level of inquiry based science
- The CLES instrument uses a five point Likert-type scale with the categories of *almost always* (5 points), *often* (4 points), *sometimes* (3 points) *seldom* (2 points), and *almost never* (1 point).

Do Students Perceive Differences in Their Classroom Environment?

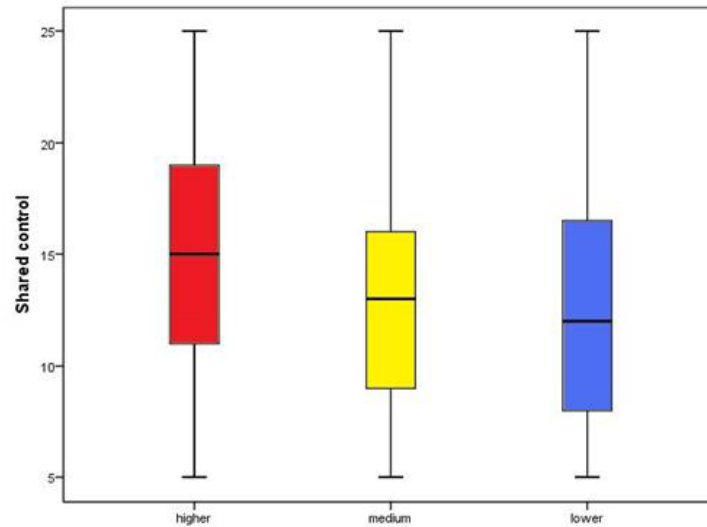
- A score of 71 or above has to be achieved in order to make a difference in post-test scores of the *CLES*
- A score of 45 or below has to be made to make difference on the *CLES*

Do Students Perceive Differences in Their Classroom Environment?



- Significant differences between the three groups were found on the Student Negotiation scale ($F = 5.41, p > .001$).
- Students in the high and medium group perceived that they were able to interact with their peers more than students in the low group.
- A high correlation level was found between level of reform and the Student Negotiations Scale ($R = .5, p > .001$)

Do Students Perceive Differences in Their Classroom Environment?



| (I) | (J) | Sig. |
|--------|--------|-------|
| higher | medium | .302 |
| | lower | .024 |
| medium | higher | .302 |
| | lower | 1.000 |
| lower | higher | .024 |
| | medium | 1.000 |

- Significant differences between the three groups were found on the Shared Control scale ($F = 5.41, p > .001$).
- Students in the high perceived that they were able to have more control over how they learned in the classroom.
- A weak correlation was found between score on the Shared Control of the post *CLES* and the level of reform implemented in the classroom $R = .169, p = .009$.

| RTOP Rating | Description of Instruction | Students Response to Learning Environment |
|--|---|--|
| <p style="text-align: center; font-size: 2em; font-weight: bold;">83</p> | <p>The instructor said you have to know the science content to be at ease in changing or modifying the curriculum to suit the needs of students</p> | <p>Students in the focus group believed that their experience of having to teach the content to others helped them develop their own understanding.</p> |
| | <p>Believed that science should be interdisciplinary</p> <p>Used models to represent phenomenon that are relevant to student lives</p> <p>took into account prior knowledge and learning style</p> <p>Use models to represent abstract concepts</p> <p><i>“They need to know how to explain circuits, and to trouble shoot why things “go wrong.”</i></p> | <p>In addition to being given hands-on experiences, the students were given closure to what they had learned and how the science content is connected to the activities.</p> |

| RTOP Rating | Description of Instruction | Students Response to Learning Environment |
|------------------|--|--|
| | <p>Faculty stated that scientific investigation was the best approach to science teaching and learning; he used experimental designs to teach Newton's Laws and how these laws govern "flight"</p> | <p>While the students enjoyed the hands-on activity in the class, they could not make a connection between the activities and the lectures.</p> |
| <p>52</p> | <p>The instructor was attempting to get students make a connection between what they have presumably read about the mechanism of flight and what they actually observe in the classroom</p> | <p>The students did not feel confident that they had learned the course material and wished that the instructor provided them with more closure.</p> |

| RTOP Rating | Description of Instruction | Students Response to Learning Environment |
|------------------|---|---|
| | <p>The instructor attempted to engage students by asking them questions, but did not give students enough time to answer them or he would answer the question for them if he sensed they were confused.</p> | <p>The students in this class were dissatisfied with both the lecture and lab portions of the course.</p> <p>They did not like how the</p> |
| <p>22</p> | <p>The instructor seemed to believe that by telling the students the material, they will learn it.</p> | <p>instructor only demonstrated one method of solving the problems in class.</p> <p>They also felt penalized for not solving the problem the way the instructor desired.</p> <p>The students felt the course was the same as their high school science course</p> |

Conclusion

- **Students notice the level of reform present in courses**
 - Statistical differences are not seen on the *CLES* unless the *RTOP* score is above 71 or below 45.
- **The Shared Control and Student Negotiations Scales were significantly different between the groups**
 - The student Negotiation's scale was highly correlated with *RTOP* score.
 - Students in the high group perceived more interactions with their peers and instructor
 - Felt more in control of their learning
- **Students experiencing courses where elements of reform were implemented at higher levels**
 - Better attitudes toward science
 - Expressed feeling more confident that they can teach science content
 - Felt they had learned more
 - Demonstrate a better understanding concepts in the classroom

