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Differences in Student Perception of Learning Environment Between Reformed and Non-Reformed Undergraduate Science Classes

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Previous studies determined that there was a significant difference in student perception that their preferences for the classroom environment occurred at higher levels for students enrolled in science classes that had been reformed under the NOVA program in comparison to non-reformed classes in the *National Study of Education in Undergraduate Science* (NSEUS), funded by the National Science Foundation. Differences in mean score on CLES were found between the 11 institutions involved in the study, no pattern in was found indicating that institution type was not influencing the differences in student perception of the classroom environment but other factors such as the level of reform and differences in the student population were more influential than institution type. In this report, we investigate differences in mean score on the five scales of CLES: (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, and (5) the *Uncertainty Scale* the students' perception of the level of inquiry based science knowledge in the classroom.

To measure differences in classroom preference and perceptions of students enrolled in reformed courses in comparison to students enrolled in comparison non-reformed courses, the scores on each of the scales of CLES from the students in the reformed courses at all institutions were averaged and compared to the average scores of students enrolled in the comparison non-reformed courses. On the preferred version of CLES, the students in the reformed classes (n=189) had a mean score of 3.22 (s=0.942) on the personal relevance scale, 3.11 (s=0.972) on the uncertainty scale, 3.07 (s=1.201) on the critical voice scale, 2.99 (s=1.100) on the shared control scale, and 3.26 (s=1.206)

on the student negotiations scale. The students in the non-reformed comparison classes (n=148) had a mean score of 3.25 (s=0.954) on the personal relevance scale, 3.00(s=0.961) on the uncertainty scale, 3.14 (s=1.171) on the critical voice scale, 2.83 (s=1.039) on the shared control scale, and 2.90 (s=1.152) on the student negotiations scale. There was statistical evidence ($F=7.795$; $p=0.006$) to suggest a difference in mean between the two courses on the student negotiation scale on the preferred version of CLES. There was no significant difference on the other scales indicating that students in the reformed courses prefer a higher level of interaction with other students than students in the non-reformed comparative course. On the perceived version of CLES, the students in the reformed classes (n=127) had a mean score of 3.93 (s=0.900) on the personal relevance scale, 3.63 (s=0.934) on the uncertainty scale, 3.98 (s=1.036) on the critical voice scale, 2.84 (s=1.122) on the shared control scale, and 4.58 (s=0.654) on the student negotiations scale. The students in the non-reformed comparison classes (n=128) had a mean score of 3.70 (s=0.932) on the personal relevance scale, 3.53 (s=0.954) on the uncertainty scale, 3.58 (s=1.125) on the critical voice scale, 2.57 (s=1.111) on the shared control scale, and 3.64 (s=1.138) on the student negotiations scale. There was statistical evidence ($F=7.795$; $p=0.006$) to suggest a difference in mean between the two courses on the personal relevance scale ($F=3.791$; $p=0.053$), the Critical Voice Scale ($F=8.436$; $p=0.004$), the Shared Control Scale ($F=3.750$; $p=0.054$), and the Student Negotiation scale ($F=65.736$; $p<0.001$) on the preferred version of CLES. There was no statistical difference in mean on the Uncertainty Scale ($F=0.725$; $p=0.395$) on the perceived version of CLES. The students in the reformed classes perceived that their preferred methods of instruction occurred during the course at a higher level than the students in the non-reformed on all scales except the Uncertainty scale.

A paired t-test was performed to see if there was a statistical difference between the preferred test taken at the beginning of the semester and the perceived test taken at the end of the semester. A statistically higher score on the perceived version of the test would indicate that (Taylor and Fraser, 1997; Cannon, 1997) the students preferred method of instruction during the course. The results are shown in Table 1. As shown in table 1, there was statistical evidence that the mean was different between the preferred version of CLES given at the beginning of the semester and the perceived version of CLES given at the end of the semester. The mean increased on all the scales excepted for the shared control scale where the mean decreased.

Table 1: Paired T-test comparing students' pre and post test scores.

	Mean	Std. Deviation	t	sig
Personal Relevance Scale Preferred	3.34	.947	-5.573	<0.001
Personal Relevance Scale Perceived	3.86	.921		
Uncertainty Scale Preferred	3.08	.935	-5.048	<0.001
Uncertainty Scale Perceived	3.54	.994		

Critical Voice Scale Preferred	3.13	1.160	-6.327	<0.001
Critical Voice Scale Perceived	3.81	1.077		
Shared Control Scale Preferred	2.98	1.068	2.678	0.008
Shared Control Scale Perceived	2.68	1.137		
Student Negotiation Scale Preferred	3.23	1.267	-8.430	<0.001
Student Negotiation Scale Perceived	4.19	1.039		

To determine if students enrolled in the reformed science courses showed a greater increase on CLES than students enrolled in the comparison or traditional courses, the split file was used to divide the data into reformed or comparison, and a second paired t-test was ran. The results are shown in Tables 2 and 3.