Environmental Benefits Associated with Online Instruction

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Abstract:

Meta-analyses indicate that online learning and face-to-face instruction are similar in learning achievement and course satisfaction. In this study, we ask whether offering courses online results in behavior change such that fewer driving trips are made to campus. The environmental consequences are assessed by calculating the CO_2 emissions savings. The results indicate that offering a class of 100 students with an online format leads to reduced CO_2 savings of 5-7 tons, and knowledge of such an environmental benefit can lead to enhanced student satisfaction with distance learning.

Problem and Background

Distance education, a somewhat marginal instructional format just 10 years ago, has now become an accepted mode of instruction on college campuses across the nation. Most of those attending this teaching conference have witnessed the steady increase in number of courses offered via online sections. It appears that online education is quickly becoming established and is “here to stay” (Mayadas, Bourne, & Bacsich, 2009). By “distance education” we refer to instruction in which the students and teacher are separated by place and sometimes by time (Gunawardena & McIsaac, 2004). Such instruction is often administered by means of communication through the internet.

Early efforts at distance education were viewed somewhat suspiciously. The concern was that the quality of instruction was being degraded and that the students would receive an inferior education. A recent summary of four meta-analyses has provided the desired comparative data. Distance education and face-to-face instruction results in essentially the same learning outcomes (actually there is a small difference favoring distance education). The degree of student-teacher interaction has no effect on amount learned. Student satisfaction levels are similar for distance and face-to-face instruction (with a slight preference for the face-to-face format). Further analyses indicate that satisfaction with distance education is highest for students who like to work independently, who score high on internal locus of control, who are technologically oriented, and who are highly motivated (Allen, Bourhis, Mabry, Burrell, & Timmerman, 2006).

With the initial questions about learning performance and student satisfaction addressed, we can begin to address other differences between online and face-to-face instruction. It is possible

(but by no means certain) that offering an online section of a course results in behavior changes with ensuing environmental consequences. If taking a course via the internet results in fewer driving trips to campus, then the environmental savings can be identified in terms of carbon dioxide savings. Documentation of such a benefit would be an appropriate addition to the other known benefits associated with online instruction: accessibility (for nontraditional and disabled students), flexibility (no scheduling conflicts), and cost (no classroom space needed). Furthermore, knowledge of environmental benefits associated with distance education may encourage positive attitudes toward this instructional format.

2. Hypotheses

Hypothesis 1: Offering a course online will result in fewer student commute trips to campus and the reduction in driving will result in less carbon dioxide emitted into the environment.

Hypothesis 2: Knowledge of the environmental benefits of online instruction will elicit positive attitudes regarding this teaching format.

3. Method

The participants were students on three campuses enrolled in six online courses (Table 1). Several weeks before the end of the semester, the students responded to a brief survey (sent via email or provided on the course website) that asked about mode of transportation typically used in getting to campus, miles per gallon used (if drivers), distance from campus, and whether fewer trips were made on account of the online course format.

After the CO_2 calculation was completed, results were made available to the students by email or (in four classes) on an online discussion forum. Student reactions (by return email or posted to the forum) were reviewed using subjective appraisal.

4. Results

Of particular interest was the estimated reduction in trips to campus for students who commuted by personal car. Total miles *not* driven, total gallons of fuel saved, commute distance, and car efficiency (reported miles per gallon) were used to estimate the savings in gasoline consumption for the whole class. This fuel total was used to calculate the resulting savings in CO_2 emissions for the class and the mean CO_2 for each student enrolled. These results are summarized in Table 2.

Representative comments from students upon learning of the CO_2 savings are presented in Table 3.

5. Discussion

Hypothesis 1 was supported. Close to 30 percent of the students in the lower-division classes reduced their trips to campus by two per week. The proportion of drivers was higher in upper-division classes (50-80%). Calculation based on these data suggest that the online teaching format results in a total CO_2 emissions savings of 100-350 pounds per student enrolled. Over the semester this adds up to 5-7 tons in reduced emissions for a class of 100 students.

Hypothesis 2 was also supported. Students reacted with surprise and pleasure on learning of the environmental benefit associated with their enrollment in an online section. The feedback appeared to reinforce positive attitudes regarding distance learning and helped to mitigate dissatisfaction with the online format.

It is noted that the student driving data is based on personal estimates which may be inaccurate. One could include in the calculations data on energy consumption associated with doing class work from home. And the examination of effects of these data on student (and faculty) attitudes could be addressed more rigorously.

6. References

Allen, M., & Bourhis, J., Mabry, E., Burrell, N. A., & Timmerman, C. E. (2006). Comparing distance education to face-to-face methods of education. In B. M. Gayle, R. W. Preiss, N. Burrell, & M. Allen (Eds.), *Classroom communication and instructional processes* (pp. 229-244). Mahwah, NJ: Lawrence Erlbaum.

Gunawardena, C. N., & McIsaac, M. S. (2004). Distance education. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology (2nd ed.)* (pp. 355-395). Mahwah, NJ: Lawrence Erlbaum.

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Table 1. Students Participants, Campuses, and Response Rates

Class	Crit Think	Hist of Psyc	Child Dev	Crit Think	Intro Psyc	Engineer
Semester	Fall 08	Fall 08	Spring 09	Spring 09	Spring 09	Spring 09
Campus	HSU	HSU	SJSU	HSU	HSU	UC Merced
LD/UD	Lower Div	Upper Div	Upper Div	Lower Div	Lower Div	Upper Div
N	108	14	29	105	87	4
% Respond	48%	71%	79%	70%	83%	100%

Table 2. Survey Results and CO_2 Calculations

Class	Crit Think	Hist of Psyc	Child Dev	Crit Think	Intro Psyc	Engineer
% Drivers	37%	50%	83%	28%	28%	100%
Distance RT	17	24	24	16	28	10
# Trips/Wk	2.5	2.4	1	2	2	1
# Trips/Sem	40	38	12	32	32	16
Miles (sample)	8840	4646	5951	11709	12928	864
Miles (class)	18360	6505	7503	16614	15621	864
MPG	26	26	26	24	25	26
Total Gallons	709	248	347	533	580	33
Total CO_2 (tons)	6.9	2.4	3.4	5.2	5.7	0.3
CO_2 per Std (lbs)	128	346	234	99	130	162

Table 3. Representative Students Reactions to the Emissions Savings

Wow, this [CO2 savings] is impressive! It certainly makes me feel good about taking this class!!! I must say that part of the reason I decided to take it was because I moved out of town.
As for the environmental savings, I certainly think that this is a good way to conserve...especially for those of us with a long commute, and considering the enormous cost and energy usage of lighting and temperature regulation in classrooms.
I hope that the university starts offering more online classes in the future so that we can continue to help save our environment by cutting down on emissions due to traveling to class. Taking this class saves me about 8 miles of driving per week.
I think this course is definitely beneficial in two ways, it helps the environment, and also it really helps us learn how to communicate through the computer which will be beneficial as we enter a more and more digital world.
It's great that this on-line class saves so much on Carbon emissions and gas. It's also great for people like me who have somewhat hectic schedules.
I am really surprised that an online course can have such an impact on the environment.
I think that is a lot, to see gallon after gallon lined up and imagine of a 4 month period of burning it all is amazing.
I also didn't really think about how it helps the environment; I do think I will be taking more online courses.
I am totally blown away by the information provided from the results of this survey. I really like the idea of taking online classes and working at your leisure. The idea of saving so much by doing so though is absolutely mind blowing.
That's very surprising, I would have guessed it be quite a difference but not that much of a savings. I'm very happy then to have taken this course to participate in the CO2 reduction.
Wow! That is definitely interesting. I would've never guessed that an online course could have an effect on the co2 emissions,