

RCET Distance Learning Grant

Factors and Conditions which Enhance the Effectiveness of Distance Learning Instruction in an College Environment.

Fourth Quarterly (Final) Report

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30 August 2002

Almost one year ago, we set out to investigate the question: “Under what conditions do distance learning opportunities lead to increased learning as defined by traditional and non-traditional measures, with results of specific application to Ohio’s higher education institutions?”

As this report is written, we have completed the essential core of this research project. We have gathered our qualitative and quantitative data, analyzed much of it, and are now reporting our conclusions. There have been many twists and turns along the way, and the final picture looks in some ways different than we anticipated a year ago, but we are pleased with what we have been able to learn, and believe that we have addressed our stated research questions effectively. We have in hand more data than we can possibly fully digest in the short time remaining to us, and expect to continue that process for some months yet to come.

We set out to gather data from at least twenty distance education course offerings during three semesters: Fall 2001, Spring 2002, and Summer 2002. We projected that eight of

these would be web-based and twelve would be synchronous video (IVDL is the Cleveland State acronym of choice). We did in fact collect data from eight web-based and twelve IVDL classes. We had anticipated that this would represent 12-15 different instructors; in fact, 19 different instructors participated in at least some portion of the project. Eight classes were undergraduate and twelve were graduate (a trait about which we had ventured no projections). We had projected approximately 400 student responses; unfortunately, our actual number was 235 (we experienced a much lower response rate than we had anticipated).

As planned, we collected focus group and interview data from instructors and students, but experienced an extremely low response rate in this area. We had projected a total of six focus groups for students and three for instructors. As reported earlier, our Fall semester activities were delayed sufficiently that the focus groups for that semester did not meet. In Spring semester both student groups and the faculty group met; in Summer, one student group and one faculty group met. All had much lower attendance than we had expected, despite progressively more emphatic efforts at recruitment. We were able to videotape and/or directly observe the IVDL classes in the sample for content analysis. Although much of the qualitative data remains to be digested and analyzed the combination of qualitative and quantitative data was sufficient to provide some highly intriguing insights into Web-based and IVDL courses as offered at Cleveland State University. In this report, we will describe the results of our data analysis to date – we acknowledge that more time will be necessary in order to fully understand all of the implications embedded in a fairly sizable collection

Research Methodology

Subjects

By the end of summer 2002, 235 students had responded to our survey. They represented a total of 20 classes, 17 of which were complete enough to analyze. Of these respondents, 115 had taken the Web-based and 120 IVDL distance-learning classes. In addition, 19 instructors responded to the instructor surveys, of which 17 were complete. A number of these instructors also participated in interviews and focus group sessions. The project staff videotaped and/or directly observed the IVDL classes.

Measurements

The eighteen items of the student questionnaire regarding their perception of the effectiveness of distance-learning classes were factor analyzed using a rotated principle component factor analysis. Four factors were revealed with approximately 62 percent of the variance explained. The Cronbach's Alpha was used to assess the internal consistency measure of reliability of each of the four factors (or dimensions). Table 1 presents the descriptive statistics and Cronbach's Alpha coefficients for each of the four factors.

Table 1

Descriptive statistics and Cronbach's Alpha coefficient for the four factors of students' perceptions of distance-learning classes

Factor	# of items	Mean	SD	Alpha
Facilitation and mechanics	9	3.19	0.49	0.87
Feedback	3	3.42	0.52	0.78
Higher order thinking and collaboration	3	3.10	0.68	0.81
Access to resources	3	3.20	0.58	0.81

Except for one factor (*feedback*) with an alpha of 0.78, the reliability coefficient for the other three factors was greater than 0.8, indicating that the student questionnaire was very reliable.

“Facilitation and mechanics” incorporates aspects of communication, and organization. High ratings on this factor were associated with classes in which communication with the instructor and with other students was actively facilitated; organized procedures (e.g. structured Email arrangements) for communication were in place, supplemental information was provided about course objectives and concepts, and very specific information was provided about instructor expectations.

“Feedback” deals with the extent to which feedback was prompt, relevant, and perceived by the student as non-threatening.

“Higher order thinking and collaboration” refers to the extent to which the course materials and structure required students to work together and engage in activities requiring high level cognition.

“Access to resources” includes availability of resource materials and the availability of information and assistance in obtaining these resources (frequently in electronic form).

These four factors were used as dependent variables of the study. However, due to low variability and low response rate in terms of the actual student grades in the course, it was not possible to utilize course grade as an additional outcome variables of the study.

In terms of their overall perceptions, students highly rated distance-learning delivery in terms of *feedback* (mean = 3.42) but were moderate in the effectiveness of distance-learning in relation to *higher order thinking and collaboration* (mean = 3.10), *facilitation and mechanics* (mean = 3.19), and *accessibility to resources* (mean = 3.20).

Data Analysis

Data analysis in the study followed two phases. In the first phase, the one way analysis of variance (ANOVA) was used to determine whether students’ perceptions of the effectiveness of distance-learning classes significantly vary by the mode of delivery

(Web-based or IVDL), class size and their individual demographics characteristics. Data analysis at this phase was used to address research questions 1, 4, and 5. In the second phase, a two-level hierarchical linear model (Raudenbush & Bryk, 2002) was used to determine the extent to which students' perceptions of distance-learning classes can be predicted by teacher practices and their individual characteristics such as gender, experience, technical skills. The second phase of data analysis was used to address research questions 2 and 3.

Research Findings

Phase 1

The one way analysis of variance (ANOVA) was used to determine whether statistically significant differences exist in students' perceptions of the effectiveness of distance-learning classes by mode of delivery (Web-based versus IVDL). Results of this analysis are presented in Table 2.

Table 2

Analysis of variance results for the differences in students' perceptions of the effectiveness of distances learning classes between Web-based and IVDL modes of delivery

Web-based (N=115) IVDL(N=120)

Aspect	Mean	SD	Mean	SD	F-value	P-value
Facilitation & mechanics	3.24	0.49	3.14	0.48	2.51	0.114
Feedback	3.46	0.51	3.38	0.53	1.26	0.263
Higher order thinking & collaboration	2.85	0.73	3.34	0.54	33.56	0.000**
Access to resources	3.18	0.59	3.21	0.57	0.13	0.719

* p < 0.05

** p < 0.01

Statistically significant differences in students' perceptions of the effectiveness of distance-learning related to ***higher order thinking and collaboration*** was revealed by mode of delivery (F = 33.56, p < 0.01). Students in the IVDL classes (mean = 3.34) perceived significantly greater effectiveness in the ***higher order thinking and collaboration*** than in the Web-based classes (mean = 2.85). No statistically significantly

differences were observed in the other dimensions (factors) of distance-learning by mode of delivery.

The one way analysis of variance was also used to determine the significance of the differences in the effectiveness of distance-learning in the four dimensions by individual student characteristics such as gender, minority status, computer skills and accessibility to computer resources. The results are presented in Tables 3 to 6.

Table 3 presents analysis of variance results for the differences in the effectiveness of the distance-learning instruction related to the dimension of *facilitation and mechanics* by individual student characteristics. The results shows statistically significant differences in students' perceptions of the effectiveness of distance-learning instruction in terms of *facilitation and mechanics* by minority status ($F = 4.06, p < 0.05$) and level of technology experience ($F = 6.89, p < 0.01$). Minority students perceived greater effectiveness of distance-learning in terms of *facilitation and mechanics* than their non-minority counterparts. Students' level of experience had a positive relationship with their perception of the effectiveness of the distance-learning instruction in the dimension of *facilitation and mechanics*.

Table 3

Analysis of variance results for the differences in students perceptions of the effectiveness of distances learning classes in terms of *facilitation and mechanics* by students' characteristics

Factor	Levels	N	Mean	SD	F-value	P-value
Student Gender	Male	51	3.18	0.46	0.01	0.942
	Female	183	3.19	0.49		
Minority Status	Non-minority	178	3.15	0.48	4.06	0.045*
	Minority	56	3.30	0.53		
Children	w/o children	128	3.20	0.45	0.19	0.666
	w/ children	107	3.17	0.52		
Experience	Inexperienced	119	3.10	0.53	6.89	0.009**
	Experienced	116	3.27	0.47		
Computer Skills	Unskilled	94	3.13	0.47	2.37	0.125
	Skilled	141	3.23	0.49		
Computer Access	Limited	70	3.15	0.50	0.44	0.510
	Unlimited	165	3.20	0.48		
Internet Access	Limited	82	3.18	0.50	0.00	0.966
	Unlimited	153	3.19	0.48		

* p < 0.05

** p < 0.01

Table 4 presents analysis of variance results for the differences in the effectiveness of the distance-learning instruction related to the dimension of *feedback* by individual student characteristics. No statistically significant differences were revealed in students' perceptions of the effectiveness of distance-learning instruction in terms of *feedback* by any of the seven individual student characteristics.

Table 4

Analysis of variance results for the differences in students perceptions of the effectiveness of distances learning classes in terms of *feedback* by students' characteristics

Factor	Levels	N	Mean	SD	F-value	P-value
Student Gender	Male	51	3.47	0.46	0.59	0.443
	Female	183	3.41	0.54		
Minority Status	Non-minority	178	3.43	0.52	0.17	0.678
	Minority	56	3.39	0.53		
Children	w/o children	128	3.40	0.54	0.57	0.451
	w/ children	107	3.45	0.50		
Experience	Inexperienced	119	3.37	0.53	2.58	0.110
	Experienced	116	3.48	0.50		
Computer Skills	Unskilled	94	3.36	0.54	2.27	0.134
	Skilled	141	3.46	0.51		

Computer Access	Limited	70	3.37	0.53	1.07	0.302
	Unlimited	165	3.44	0.51		
Internet Access	Limited	82	3.39	0.53	0.32	0.572
	Unlimited	153	3.43	0.52		

* $p < 0.05$

** $p < 0.01$

Analysis of variance results for the differences in the effectiveness of the distance-learning instruction related to the dimension of *higher order thinking and collaboration* by individual student characteristics are presented in Table 5. Statistically significant differences were revealed in students' perceptions of the effectiveness of distance-learning instruction in terms of *higher order thinking and collaboration* by accessibility to computer resources ($F = 12.11, p < 0.01$) and access to internet ($F = 7.49, p < 0.01$). Students who have unlimited access to computer resources and accessibility to the internet perceived significantly greater effectiveness of distance-learning in the dimension of *higher order thinking and collaboration* than those students who had limited access to computers or the internet. No statistically significant differences in students' perceptions of the effectiveness of distance learning in this dimension were revealed by any of the other individual student characteristics.

Table 5

Analysis of variance results for the differences in students perceptions of the effectiveness of distances learning classes in terms of *high order thinking and collaboration* by students' characteristics

Factor	Levels	N	Mean	SD	F-value	P-value
Student Gender	Male	51	3.12	0.71	0.04	0.848
	Female	183	3.10	0.66		
Minority Status	Non-minority	178	3.10	0.70	0.01	0.912
	Minority	56	3.11	0.64		
Children	w/o children	128	3.11	0.71	0.03	0.855
	w/ children	107	3.09	0.66		
Experience	Inexperienced	119	3.02	0.70	3.55	0.061
	Experienced	116	3.18	0.66		
Computer Skills	Unskilled	94	3.06	0.72	0.61	0.437
	Skilled	141	3.13	0.66		
Computer Access	Limited	70	2.87	0.80	12.11	0.001**
	Unlimited	165	3.20	0.60		
Internet Access	Limited	82	2.94	0.78	7.49	0.007*
	Unlimited	153	3.19	0.61		

* p < 0.05

** p < 0.01

Table 6 presents analysis of variance results for the differences in the effectiveness of the distance-learning instruction related to the dimension of *accessibility to resources* by individual student characteristics. No statistically significant differences were revealed in students' perceptions of the effectiveness of distance-learning instruction in terms of *accessibility to resources* by any of the seven individual students' characteristics.

Table 6

Analysis of variance results for the differences in students perceptions of the effectiveness of distances learning classes in terms of *accessibility to resources* by students' characteristics

Factor	Levels	N	Mean	SD	F-value	P-value
Student Gender	Male	51	3.22	0.55	0.11	0.742
	Female	183	3.19	0.58		
Minority Status	Non-minority	178	3.20	0.60	0.01	0.936
	Minority	56	3.19	0.52		
Children	w/o children	128	3.20	0.58	0.00	0.994
	w/ children	107	3.19	0.57		
Experience	Inexperienced	119	3.17	0.61	0.47	0.492
	Experienced	116	3.22	0.54		
Computer Skills	Unskilled	94	3.15	0.62	1.17	0.282
	Skilled	141	3.23	0.54		
Computer Access	Limited	70	3.10	0.64	2.60	0.108
	Unlimited	165	3.23	0.54		
Internet Access	Limited	82	3.17	0.63	0.19	0.665
	Unlimited	153	3.21	0.55		

* p < 0.05

** p < 0.01

The significance of the differences in students' perceptions of the effectiveness of distance-learning instruction between Web-based and IVDL was further examined while controlling for the students' age and class size. A two-way factorial analysis of variance was used in the analysis. The findings are presented in Tables 7 and 8.

Table 7 presents the two-way factorial ANOVA results for the differences in students' perceptions of the effectiveness of distance-learning instruction by mode of delivery and class size. Results in Table 7 shows that statistically significant main effects by mode of delivery were observed for the dimensions of *facilitation and mechanics* ($F = 8.57, p < 0.01$) and *feedback* ($F = 4.55, p < 0.05$) and by class size for the dimension of *facilitation and mechanics* ($F = 4.05, p < 0.05$) and *higher order thinking and collaboration* ($F = 9.36, p < 0.01$). However, statistically significant mode of delivery by class size interaction effects were also observed for the dimensions of *feedback* ($F = 7.40, p < 0.01$) and *higher order thinking and collaboration* ($F = 13.52, p < 0.01$). See also Figure 1 for an illustration of these interaction effects between mode of delivery and class size.

Table 7

Two way factorial ANOVA results for the differences in students' perceptions of the effectiveness of distance-learning instruction by mode of delivery and class size

Aspect	Mode of delivery		Class size		Interaction Effects	
	F-value	P-value	F-value	P-value	F-value	P-value
Facilitation & mechanics	8.57	0.004**	4.05	0.019*	1.59	0.205
Feedback	4.55	0.034*	0.04	0.966	7.40	0.001**
Higher order thinking & collaboration	3.21	0.075	9.36	0.000**	13.52	0.000**
Access to resources	0.85	0.358	0.72	0.489	1.64	0.197

* p < 0.05

** p < 0.01

Figure 1: Students' perception of distance-learning by mode of delivery and class size
(Facilitaion and Mechanics)

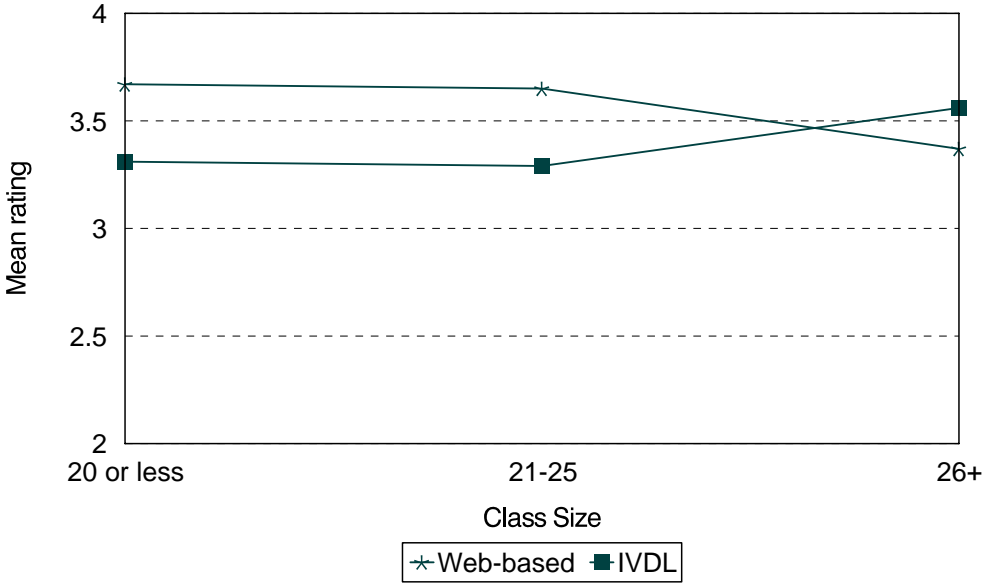
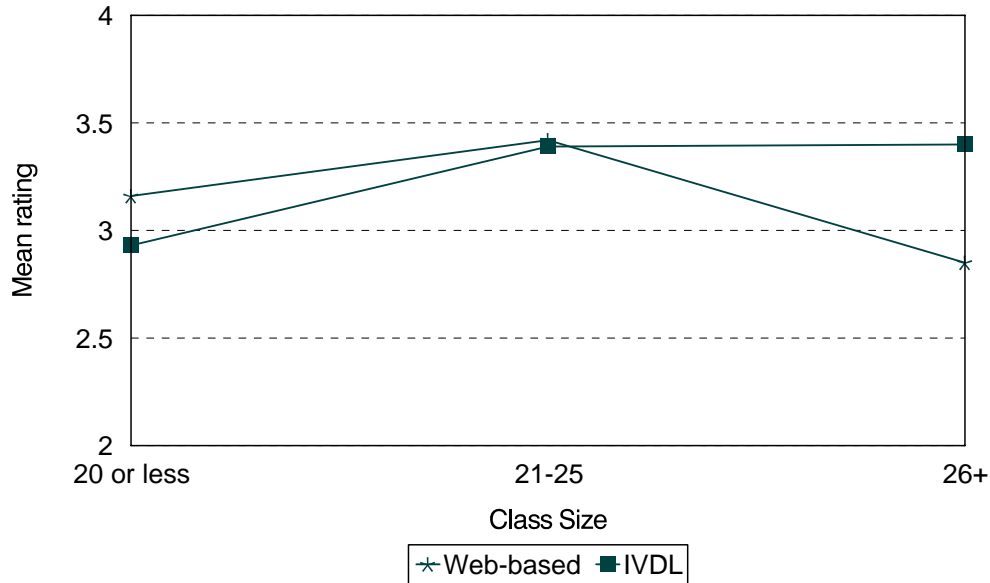


Figure 2: Students' perception of distance-learning by mode of delivery and class size
(Higher order thinking and collaboration)



The findings illustrated in Figure 1 suggests that students perceived distance-learning in the dimension of *facilitation and mechanics* to be more effective in Web-based delivered in small size classes (20 or less and 21-25) but less effective compared to IVDL in larger class sizes (26 or more). Similarly, for the dimension of *higher order thinking and collaboration* findings illustrated in Figure 2 suggests that students in large class sizes (26 or more) perceived *higher order thinking and collaboration* to be more effective in IVDL modes of delivery than in the Web-based.

Phase 2

In the second phase of data analysis, the seventeen items of the instructor questionnaire representing their instructional practices in the distance-learning classes were factor analyzed using a rotated principle component factor analysis. Four factors were revealed with approximately 68 percent of the variance explained. The Cronbach's Alpha was used to assess the internal consistency measure of reliability of each of the four factors (or dimensions). Table 8 presents the descriptive statistics and Cronbach's Alpha coefficients for each of the four factors.

From Table 8 it is shown that all three factors had an alpha greater than 0.8, indicating that the instructor questionnaire was very reliable. The three factors together with one item of modulation of course content and certain instructor characteristics were used as independent variables in the second phase of the study.

Table 8

Descriptive statistics and Cronbach's Alpha coefficient for the four factors of instructor instructional practices in the distance-learning classes

Factor	# of items	Mean	SD	Alpha
Providing resources and communication	9	2.99	0.59	0.90

Self confidence of course effectiveness	3	2.96	0.70	0.86
Providing opportunity for student interaction	4	3.21	0.50	0.81
Modulation of course content	1	2.35	1.00	-

A two-level hierarchical linear model commonly referred to as HLM (Raudenbush & Bryk, 2002) was used to determine the extent to which students' perceptions of the effectiveness of distance-learning classes can be predicted by teacher practices and characteristics such as gender, experience, technical skills.

In using HLM, linear models are specified at two levels. At level-1, students' perceptions are modeled as a function of their individual characteristics such as gender and minority status. A linear prediction model is specified for each context, such as classroom (or course). Parameter estimates at level-1 are treated as outcome variables at the level-2 model with teacher practices and their individual characteristics as predictors. Results for this analysis are presented in Tables 9 and 10.

Mode of delivery was a statistically significant predictor of the adjusted classroom average of students' perceptions of the effectiveness of distance learning in the dimensions of *facilitation and mechanics* ($\beta = 0.42, p < 0.01$) and *access to resources* ($\beta = 0.24, p < 0.05$). In both cases, the adjusted average was significantly higher in the IVDL than in the Web-based classes. Teachers' technological skills were positive relationship with the adjusted classroom average of students' perception of the effectiveness of distance learning in the dimensions of *facilitation and mechanics* ($\beta =$

0.67, $p < 0.01$) and *access to resources* ($\beta = 0.56$, $p < 0.01$). The same but weaker relationships were observed for teachers' level of experience for the dimension of *facilitation and mechanics* ($\beta = 0.22$, $p < 0.05$) and *access to resources* ($\beta = 0.24$, $p < 0.01$).

Adjusted classroom average of students' perceptions of the effectiveness of distance learning in the dimension of *higher order thinking and collaboration* was significantly predicted by teacher instructional practices that were grouped into the factor of providing resources and communication ($\beta = 0.53$, $p < 0.01$) and the one item of modulation of course content ($\beta = -0.30$, $p < 0.05$). The data seems to suggest that, modulation of course content has a negative impact on *higher order thinking and collaboration* while providing resources and communication has a positive impact on *higher order thinking and collaboration*. Providing opportunity for student interaction also has a statistically significant impact on the dimension of *facilitation and mechanics* ($\beta = 0.41$, $p < 0.01$).

Table 9

Level-2 HLM results for the prediction of the adjusted classroom average (β_0) perception of the effectiveness of distance-learning by teacher practices and their individual characteristics

	Facilitation &		Higher order thinking	Access to
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Predictor	mechanics	Feedback	& collaboration	resources
Mode of instruction	0.42**	NS	NS	0.24*
Experience	0.22**	NS	NS	0.09*
Technological skills	0.67**	NS	NS	0.56**
Teacher's gender	NS	NS	NS	NS
Providing resources and communication	NS	NS	0.53**	NS
Self confidence of course effectiveness	NS	NS	NS	NS
Providing opportunity for student interaction	0.41**	NS	NS	NS
Modulation of course content	NS	NS	-0.30*	NS

Table 10 presents the level-2 HLM results for the prediction of the gender-gap (β_1) in the students' perception of the effectiveness of distance-learning by teacher practices and their individual characteristics. The results shows that gender-gap in the students perceptions of the effectiveness of distance-learning related to the dimension of *facilitation and mechanics* was significantly narrower in the IVDL than in Web-base classes ($\beta = -0.28, p < 0.01$) and the magnitude of the gender-gap was negatively related to teachers' level of experience ($\beta = -0.13, p < 0.01$). Similarly, the gender-gap in the

students perception of the effectiveness of distance-learning related to the dimension of *feedback* was significantly narrower in the IVDL than in Web-base classes ($\beta = -0.22, p < 0.05$) and the magnitude of the gender-gap in this dimension was negatively related to teachers' technological skills ($\beta = -0.42, p < 0.05$). A similar but opposite relationship was observed for the dimension of *access to resources*. In this case, the gender-gap in the students perception of the effectiveness of distance-learning related to the dimension of *access to resources* was significantly wider in the IVDL than in Web-base classes ($\beta = 0.24, p < 0.05$) and the magnitude of the gender-gap in this dimension was positively related to teachers' technological skills ($\beta = 0.56, p < 0.01$). No other teacher practices or individual characteristics had a statistically significant relationship with the gender-gap in students' perceptions on the effectiveness of distance-learning instruction.

Table 10

Level-2 HLM results for the prediction of the gender-gap (β_1) in the students' perception of the effectiveness of distance-learning by teacher practices and their individual characteristics

Predictor	Facilitation & mechanics	Feedback	Higher order thinking & collaboration	Access to resources
Mode of instruction	-0.28**	-0.22*	NS	0.24*
Experience	-0.13**	NS	NS	NS

Technological skills	NS	-0.42*	NS	0.56**
Teacher's gender	NS	NS	NS	NS
Providing resources and communication	NS	NS	NS	NS
Self confidence of course effectiveness	NS	NS	NS	NS
Providing opportunity for student interaction	NS	NS	NS	NS
Modulation of course content	NS	NS	NS	NS

Table 11 presents the level-2 HLM results for the prediction of the minority/non-minority-gap (β_2) in the students' perception of the effectiveness of distance-learning by teacher practices and their individual characteristics. The results shows that minority/non-minority-gap in the students perception of the effectiveness of distance-learning related to the dimension of *facilitation and mechanics* was significantly narrower in the IVDL than in Web-base classes ($\beta = -0.58, p < 0.01$) and the magnitude of the minority/non-minority-gap was negatively related to teachers' technological skills ($\beta = -0.68, p < 0.01$) and providing opportunity for student interaction ($\beta = -0.49, p < 0.01$), but positively related to providing resources and communication ($\beta = 0.51, p < 0.01$). Modulation of course content was also found to significantly widen the minority/non-minority-gap in

the dimension of *facilitation and mechanics* ($\beta = 0.13, p < 0.05$). Teachers' technological skills had a significantly negative relationship ($\beta = -0.61, p < 0.01$) with the minority/non-minority-gap related to students' perceptions of the effectiveness of distance-learning in the dimension of *feedback*, but teacher practices of providing resources and communication was positively related to the minority/non-minority-gap for the same dimension ($\beta = 0.44, p < 0.01$). Modulation of course content was also found to significantly widen the minority/non-minority-gap in the dimension of Higher order thinking and collaboration ($\beta = 0.45, p < 0.05$). No other teacher practices or individual characteristics had a statistically significant relationship with the minority/non-minority-gap in students' perceptions on the effectiveness of distance-learning instruction.

Table 11

Level-2 HLM results for the prediction of the minority/non-minority-gap (β_2) in the students' perception of the effectiveness of distance-learning by teacher practices and their individual characteristics

Predictor	Facilitation & mechanics	Feedback	Higher order thinking & collaboration	Access to resources
Mode of instruction	-0.58**	NS	NS	NS
Experience	NS	NS	NS	NS
Technological skills	-0.68**	-0.61**	NS	NS

Teacher's gender	NS	NS	NS	NS
Providing resources and communication	0.51**	0.44**	NS	NS
Self confidence of course effectiveness	NS	NS	NS	NS
Providing opportunity for student interaction	-0.49**	NS	NS	NS
Modulation of course content	0.13*	NS	0.45*	NS

Summary

Instruments used for both student and teacher surveys were found to be highly reliable with most of the factors registering a Cronbach's reliability Alpha greater than 0.8. Data analysis was done in two phases. In phase one, factorial analysis of variance was used to examine the significance of the differences in students' perceptions of the effectiveness of distance-learning by the mode of course delivery and their individual characteristics, such as gender and minority status. At the second phase, a two-level hierarchical linear model (HLM) was used to determine the extent to which students' perceptions of the effectiveness of distance-learning can be predicted by teacher's instructional practices

and their individual characteristics. The extent to which independent variables can predict the gender- and minority/non-minority-gap in students' perceptions was also analyzed.

Though not statistically significant, students' perception of the effectiveness of distance-learning in the dimension of *facilitation and mechanics*, *feedback*, and *access to resources* were generally higher in Web-based than in the IVDL classes. However, students in IVDL classes, perceived distance-learning instruction to be significantly more effective in terms of *higher order thinking and collaboration* than in the Web-based classes. These findings reflect the general comparison of students' perceptions by mode of delivery regardless of students' demographic characteristics.

In comparing students' perceptions of the effectiveness of distance-learning by their demographics characteristics regardless of mode of delivery of instruction, significant variations were only observed in the dimensions of *facilitation and mechanics* and *higher order thinking and collaboration*. In this case, minority and experienced students perceived greater effectiveness of distance-learning in *facilitation and mechanics* than non-minority and inexperienced students. In addition, accessibility to computer resources or the internet access were both found to significantly enhance students' perceptions of the effectiveness of distance-learning in *higher order thinking and collaboration*.

Given the mixed nature of the findings by students' demographics characteristics and mode of delivery, it was also necessary to compare the relative effectiveness of mode of delivery of delivery of instruction while controlling for class size and age of the students.

Using this approach, main effects in the dimension of *facilitation and mechanics* and *feedback* were found to be significant by mode of delivery and significant main effects in the dimensions of *facilitation and mechanics* and *higher order thinking and collaboration* by class size. However, significant mode of delivery by class size- interaction effects, were revealed for the dimension of *feedback* and *higher order thinking and collaboration*. The general trend revealed was that, students in the Web-based classes perceived distance-learning to be more effective than in IVDL only in smaller class sizes (less than 26 students), but less effective than IVDL in larger class sizes (26 or more students).

When individual students' characteristics such as gender and minority status are controlled for, analysis by hierarchical linear model revealed that the adjusted classroom average was significantly higher in IVDL than in the Web-based in the dimension of *facilitation and mechanics*. In addition, students' level of experience, technological skills, and the instructors' practice of providing opportunity for student interaction were positively related to the adjusted classroom average in the dimension of *facilitation and mechanics*. Providing resources and communication was also found to enhance *higher order thinking and collaboration* while teachers' technological skills were found to enhance students' perceptions of the effectiveness of distance-learning in the dimension of *access to resources*.

Both the gender- and minority/non-minority-gap was found to be generally narrower in IVDL than in the Web-based classes, particularly in the facilitation and *feedback*, but the

gender-gap was significantly wider in the IVDL classes than in Web-based in the dimension of *access to resources*. Teacher's technology skills were found to significantly narrow the minority/non-minority-gap in the dimension of *facilitation and mechanics*. Overall therefore, the effectiveness of distance-learning instruction depends to a larger extent on the dimension, the size of the classroom, the level of the teacher's technology skills, and certain students' demographic characteristics. For instance, Web-based mode of instructional delivery is not as effective in promoting *higher order thinking and collaboration* and tends to widen the minority/non-minority-gap in the students perception of the effectiveness of distance-learning, particularly in the dimension of *facilitation and mechanics*.

Discussion

Students perceived the major strength of distance education in general to be **feedback**. That is, they perceived distance classes as being characterized by prompt, relevant, and non-threatening feedback from the instructor. This fits well with Young's (2002) characterization of distance education teaching assignments as requiring faculty to be constantly on call. Our qualitative data strongly support speed and frequency of instructor response as a major factor in students' perceptions of distance education offerings. Our quantitative data indicate that none of the individual student characteristics (e.g. gender; minority status) affected students' perception of the role of feedback. We suggest that

students from all groups thus found feedback to be an equally important factor in their learning experience.

Students perceived IVDL classes as being significantly more effective than web-based classes in promoting higher order thinking and collaboration than Web-based classes. This ties in with qualitative data indicating that interaction among students in IVDL classes contributes markedly to the learning experience, and that many students in Web-based courses perceived their courses as being lacking in this component. There was a distinct indication that some students found web courses to be impersonal or “not real courses” due to this lack of interaction with other students.

Students were more likely to perceive distance education classes as high on the “facilitation and mechanics” variable if they were a member of a minority group, or if they had prior experience with other distance education offerings. We are not quite sure what to make of the minority group factor in this case. Since the facilitation and mechanics variable is concerned with class organization, structure, and communication, it may be that the more technologically oriented procedures used by distance education instructors (e.g. online assignment submission; Web-based access to handouts and materials; threaded asynchronous discussions) are fully functional only for students who have had sufficient prior exposure to achieve a moderate level of comfort. Our qualitative data contains repeated references to students’ needs for introductory training and practice with class technologies which many instructors take for granted (e.g. pressing a student microphone button in an IVDL setting; logging in to a structured online environment

such as WebCT). Students also perceived a course as having superior facilitation and mechanics if the course structure actively provided for interaction and/or sharing of work among students, seeming to indicate a sense that this component could be critical.

Students with better access to computers resources and the Internet were more likely to perceive distance education classes as more effective in promoting higher order thinking and collaboration. One might infer that better access would be associated with more frequent use, and thus with more frequent participation. Qualitative data reinforced the role of interactivity among students in promoting collaboration and higher order thinking; in a Web-based course, more frequent use may well be associated with a higher level of interactivity with classmates.

Class size turned out to have fascinating interactions with the mode of delivery. Our data suggest that students perceived Web-based classes as having better facilitation and mechanics than IVDL classes only when the class size remained relatively small (25 or less). However, the IVDL classes came out ahead when class size rose above 25. Once the class size rose into this larger category (26 or above), the students also perceived IVDL classes to be more effective in the area of higher order thinking and collaboration. In attempting to account for this relationship, we were led to consider the fundamentally group-oriented nature of IVDL course offerings. Pedagogically speaking, we as educators have long years of practice in working with assembled groups of students, and there is a sense in which IVDL courses continue rather closely in that tradition. Web-based course delivery is a relative newcomer, and many faculty are still learning how best to work in

this medium. In many ways Web-based courses often more closely resemble a parallel set of independent study classes, and it may well be that the organization and management of such an arrangement passes a critical threshold of difficulty as class sizes rise. Our qualitative data emphasizing the critical role of instructor responsiveness would fit well with this line of reasoning; with a large Web-based class, instructors may experience increasing difficulty in responding promptly on an individual basis to all students in the class.

Students were more likely to perceive IVDL classes as having better facilitation and mechanics, and as having better access to class resources. IVDL pedagogy more closely resembles traditional classroom instruction than does Web-based pedagogy. What we may be seeing here is that faculty are more practiced with many of the techniques used in IVDL (course organization and management are often similar to traditional classes), and may be more likely to use traditional media access procedures to which students are more accustomed. Being a Web-based student requires a separate skill set, just as does being a Web-based instructor – and students emphasized the critical nature of that skill set, as well as their need for instruction and support in developing it before being expected to rely upon it. Being an IVDL student requires a smaller, but still genuine, set of new skills.

There were two other predictors for the “facilitation and mechanics” and “access to resources” variables, and they fell on the instructor side of the equation. The strongest was the instructor’s own technology skills. The weaker was the instructor’s experience with the distance education environment. It’s hardly a surprising conclusion that more

skilled, experienced instructors were better able to structure and manage these courses, and to ensure good student access to class resources – but it does reinforce the importance of good training and preparation for faculty assigned to distance education sections.

Our data indicate some gender gap issues, but in a somewhat complex pattern. In the cases of facilitation and mechanics and of feedback, IVDL courses had less of a gender gap, and a higher level of technology skills and experience was also associated with a lessened gender gap. In the case of access to resources, the opposite pattern applies: IVDL is perceived as worse than the Web, and higher levels of instructor technology skills are associated with a worsened gender gap.

With respect to the facilitation and mechanics variable, the minority/non-minority gap followed the same pattern as the gender gap. The gap was less for IVDL than for web-based instruction, and the gap was lessened by higher levels of instructor technology skill. In the case of the minority gap, providing opportunities for student interaction also reduced this gap in student perceptions.

It is important to mention one factor which was not covered at all in our quantitative data, but which resonated very strongly throughout our qualitative data: that of equipment reliability (as opposed to either equipment failure or equipment misuse). In some cases this particular message threatened to overwhelm other factors. Students were very clear that the equipment in many distance education classes was in no way transparent to the

learning experience. Equipment failures were far more common than they felt should be the case. In some cases faculty were insufficiently familiar with the correct operation of the equipment; in others, the equipment was simply trouble-prone. In either case these instances interfered markedly with students' learning experiences. The problem seemed more pronounced with IVDL courses, where the technology is more elaborate and a single failure affects an entire class simultaneously. In a number of cases students indicated that this factor alone would be sufficient to prevent them from taking another IVDL course.

Implications

For institutions which wish to offer either IVDL or web-based coursework, this study has some clear implications with respect to groundwork which needs to be laid and principles which need to be observed.

- **Feedback & responsiveness.** Distance education classes need explicit procedures and mechanisms for feedback from instructors to students. Instructors should place a high priority on providing rapid, non-threatening feedback on an ongoing basis. The absence of such feedback is a major flaw in students' perceptions of coursework.
- **Interaction.** Distance education classes need explicit procedures and mechanisms for communication among students, including where possible collaborative activities and the sharing of student work. This enhances students' perception

that a distance education class is a “real” class, and may be associated with increased success in the area of higher order thinking skills and collaboration. The procedures will often be very different for IVDL and Web-based offerings but serve the same purpose in both cases.

- **Training & experience for students.** Before students can be maximally effective learners in a distance education setting, it is crucial that they have an opportunity for training and practice with whatever technologies will be involved. An issue as seemingly minor as pressing a student microphone button in an IVDL room can have major consequences, and in the case of Web-based courses students may be asked to use a wide variety of different technologies on a regular basis. Higher levels of student technology skill may also be associated with higher levels of multimedia literacy, which Maki & Maki (2002) found to be a predictor of success in web-based courses.
- **Training & experience for instructors.** This should go without saying, but it appears that many instructors are asked to provide distance instruction with little or no preparation. Our data link higher levels of instructor training and experience to perceived improvements in higher order thinking skills and collaboration and in course facilitation & mechanics, as well as to reduced gender and minority/non-minority gaps. Better instructor training also reduces the impact of equipment malfunction and failure, which continues to be a major issue in its own right
- **Equipment reliability.** Especially in the case of IVDL courses , equipment reliability is still a problem, and when it’s a problem the cognitive “noise” created

often overwhelms the actual course content. Instructor training helps; so does ready availability of technical support during instruction.

- **Higher order thinking skills & collaboration.** Many instructors and curricula value the inclusion of higher order thinking skills and collaboration as an important component in their classes. There appears to be a strong tie between such skills and the presence of course mechanisms and activities which encourage or require interaction among students and in some cases the sharing of student work. This can be particularly demanding to implement in the case of a Web-based course, and within our sample IVDL courses came out ahead on this dimension.
- **The choice between Web-based and IVDL venues.** In our modest sample, Web-based instruction seems to work best for small course enrollments (<26); this finding is in direct contradiction to the idea that Web-based instruction opens up the possibility for enormous course enrollments within a single course. While we do not have definitive results in this area, it appears that the “facilitation and mechanics” and “feedback” components appear to be gaining the upper hand as enrollment rises. If this is in fact the case, large Web-based courses would then need to be provided with a relatively high level of instructor assistance in the form of teaching assistants or equivalent personnel. In our sample, IVDL instruction seems to work better for larger course enrollments. This may be because the interaction among students so prominently mentioned by our respondents is maximized in such a setting, or it may simply be the most instructors have more experience in managing a larger class in this type of setting. Given that IVDL

equipment can be relatively expensive such a larger enrollment may help to offset some of the cost.

References

Maki, W.S., & Maki, R.H. (2002) Multimedia comprehension skill predicts differential outcomes of web-based and lecture courses. *Journal of Experimental Psychology: Applied* .8, 2, 85-98.

Raudenbush, S. W., & Bryk, A.f (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd edition). Newbury Park, CA: Sage Publications.

Young, J.R. (2002, May 31) The 24-hour professor. *The Chronicle of Higher Education*, A31—A33.