

Effectiveness of Web-Based Instruction for ESL Students: An Empirical Study with Focus on Gender, Ethnicity and Instructional Media

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Abstract

Students with English as a Second Language (ESL) make up a growing student population across the U.S. As Web-based instruction continues to gain wide acceptance, educators need to ensure that ESL students are not placed at a disadvantage due to language and cultural barriers. This study compared the performance of ESL students in three different settings - Web, lecture, and lecture with Web. The results showed that the lecture group performed significantly better than the Web group. Ethnicity contributed to a significant difference in performance in the lecture group. The study found no differences in performance due to gender. Students with PC ownership with Internet access and those with longer residency in the U.S. performed significantly better irrespective of the setting. The paper concludes with lessons learned and offers helpful suggestions in teaching Web courses to ESL and minority students.

Keywords: Web-based instruction, English as second language, gender, ethnicity

1. INTRODUCTION

The phenomenal explosion of technology has now given educational institutions new tools to carry out the mission in ways never conceived before. Distance education is one such approach. Distance education is the process of instruction and learning via virtual classrooms where teachers and students are separated in space and sometimes in time (Porter, 1997). Today, distance education plays an important role in the rapidly changing society that places continual demands on learners. With the recent advances and popularity of the Internet, Web-based instruction has become the method of choice for the delivery of distance education (Sopova, 1996). The Internet's ability to deal with text, hypertext, graphics, multimedia, e-mail, relay chats, hypernews, all provide great appeal.

Over the past decades, research in distance education has focused on (i) its effectiveness (Kuramoto, 1984; Souder, 1993; Moore and Kearsley, 1996), (ii) course designs (Hezekiah, 1986; Coldeway, 1988, Holstein, 1992), (iii) instructor role (Baird, 1995) and (iii) cost-benefit (Rule, *et al.*, 1988; Phelps *et al.*, 1991). However, many of the studies evaluated the effectiveness of correspondence, radio and television broadcast and teleconferencing courses. Web-based instruction is a recent phenomenon and research in the area remains in its infancy (Porter, 1997). More research is needed to build a theoretical foundation for Web-based instruction that can benefit educators in design and delivery of Web-courses in a variety of settings and student audiences (Firdyiwiek, 1999).

The Internet has the potential to reach a vast audience at low cost compared with other distance education technologies. With 206 million dial-up and 17.5 million

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permanent connections expected by the year 2005 (Ovum, 1998), new research in Web-based instruction takes great significance and urgency.

2. ESL STUDENTS

One area that has not received sufficient attention is how distance instruction affects learning performance by minorities and ESL (English as Second Language) students. Many of the earlier studies have shown that student performance is at least as good in distance learning settings as the traditional classroom (Chute *et al.*, 1989; Cheng *et al.*, 1991; Martin and Rainey, 1993). But the population sample used in these studies had little or no representation of minorities or ESL students. Therefore, the conclusion reached in these studies may not be generalizable.

This uncertainty about the effectiveness of distance learning for minority and ESL students must be of concern today. Across the U.S., the student population is increasingly becoming diverse with varied cultural backgrounds, differing educational aspirations, and above all varied levels of English fluency, which still remains the primary language of instruction. During the 1980's, Maryland, Florida, Virginia, Georgia, Texas, New Mexico, Nevada, California, and Alaska all had more than a 50% increase in their foreign population (Rong and Preissle, 1998). The percentage of students with Limited English Proficiency (LEP) in the 5 to 17 years olds immigrant children stands nationally at 37.8% (US Bureau of Census, 1993). Thus, educators and policy planners need to know how Web-based instruction will impact the learning performance of ESL students in order to make changes in the way education is delivered.

3. FACTORS INFLUENCING PERFORMANCE IN ESL STUDENTS

Various factors that adversely affect learning performance among ESL students may be amplified in Web-based instructional settings. The primary one is the language factor. Studies have shown that recent immigrants and foreign students experience language barriers during their early years in the U.S. (Fischer, 1990, Stevens, 1994). They compensate their difficulty in comprehension through better use of face-to-face interaction and of non-verbal contextual cues (Collins, 1988; Chizhik, 1998). But these are lacking in Web course instruction. The good news, however, is that research has shown the language barrier disappears with the length of residency in the country (Jasso and Rosenzweig, 1990).

Another factor that affects performance in the Web-based instructional setting is the widely varied level of computer literacy among the ESL students. In a study by Hawkins and Paris (1997) of 570 undergraduate students, it was found that minority/ESL students enter the university with fewer info-technology skills and are

less familiar with computers than are their English fluent Caucasian counterparts. They also noted that these differences in computer usage and familiarity are not minimized by collegiate experience and may even be increased. They found that students with less computer proficiency preferred Macintosh to IBM compatible Personal Computers (PC). Thus, some students may need to be trained in Internet use at the start of Web courses for learning to be effective.

Since Web courses require at a minimum a PC and subscription to an Internet Service Provider, access to technology is fundamental to Web-based instruction. This is an important factor to be considered while designing a Web-based curriculum. In the U.S., African Americans and Hispanics lag behind Whites in PC ownership and online access by 21.5% (Muzzio, 1998). Hence, one needs to evaluate if learning performance would be adversely affected due to lack of access to Web-based courses.

A distinguishing characteristic of ESL students is the heterogeneity of their ethnicity and culture. They may bring along a variety of anxieties at having to prove themselves in a mainstream environment. They differ in academic self-concept, aspirations to higher education, family and peer influence (Kim *et al.*, 1998). Their preferences in adopting public vs. private academic programs are also different and influenced by their varied socio-economic backgrounds. Gender also plays an important role. Being male in some cultures created even more pressure to succeed educationally.

It is important to undertake research in understanding these factors. It is fundamental to designing Web-based curricula with a student audience that has a significant representation of minority and immigrant students. This study helps to fill a void in the literature by contributing to our understanding of how Web-based instruction influences ESL student performance. It is expected that the findings will be applicable to minority and immigrant students as well.

4. OBJECTIVE

This main purpose of this paper is to study the effectiveness of Web-based instruction on learning performance among ESL students and compare them with traditional lecture outcomes. Three instructional settings - Web only, lecture only, and Web plus lecture - were used as the experimental treatments. The objective is to identify which setting has the most effect on learning performance in ESL students and if there are significant differences among them. In addition, the study will explore if ethnicity, gender, access to technology, and length of residence in the U.S. influence performance in Web-based instruction. The following hypotheses were tested:

H1: There is no difference in performance among the ESL students who i) attend lectures, ii) use the Web, or iii) attend both lectures and use the Web.

H2: In each of the above three groups, there is no difference in performance among the ESL students due to ethnicity.

H3: In each of the above three groups, there is no difference in performance among the ESL students due to gender.

H4: ESL student who owns a PC with Internet access from home perform better than those who have access only at the university.

H5: Performance increases with years of residence in the U.S.

5. METHOD

The subjects for this study were ESL students selected from an undergraduate business computer concepts and applications course. The course was offered in two alternative formats, one that used traditional lectures in a classroom and the other that used Web-based format alone. The same instructor used the same textbook for both formats and covered the same content. At the beginning of the course, students were asked to choose one of the following treatments to take the course: i) attend only lectures, ii) study Web materials along with email, Hypernews (Figure 1) and Internet Relay Chat, or iii) attend both lectures and use Web materials. At the end of the course, all students together were administered the same test in a lecture hall. The test scores measured performance.

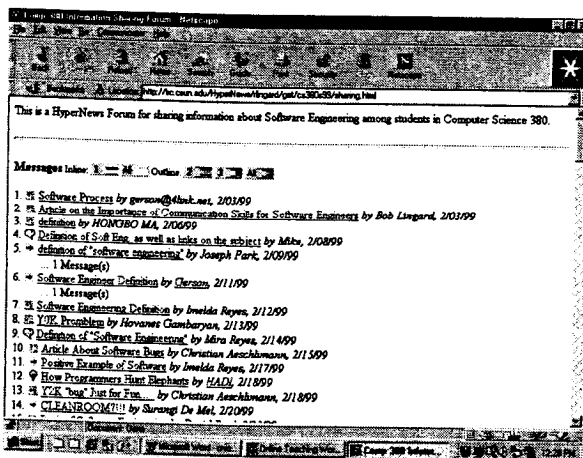
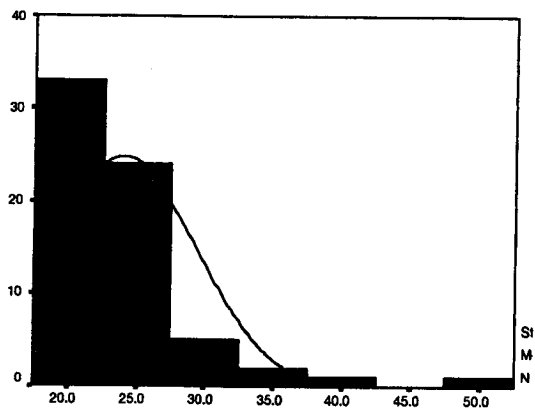
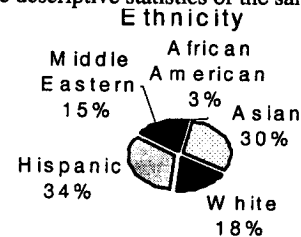


Figure 1 Hypernews: A Forum for Information Sharing

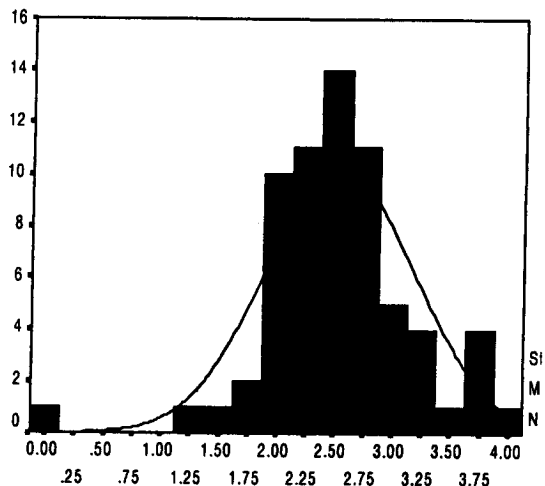
Student data on GPA, age, gender and ethnicity was available in the university admissions database. Additional background data such as years of residency in the U.S., ownership to PC, and access to Internet from home was collected using a survey.

Sample

There were 66 ESL students in the sample from a class of 116 students, of which 26 were men and 40 were women. The mean age of the sample was 24 years with a standard deviation of 5.3. There were 2 African Americans, 20 Asians, 12 Whites, 22 Hispanics, and 10 Middle Easterns. Nineteen students had a residency of 5 years or less in the U.S., 32 had a residency between 5 and 10 years, and 15 had over 10 years. The five-year residency intervals were chosen because they were found to differentiate best the language proficiency and cultural integration among international and new immigrant students (Sankaran and Bui, 1999). The mean GPA was 2.54 with a standard deviation of 0.64. The maximum score attainable on the test was 75. Figure 2 summarizes the descriptive statistics of the sample.



AGE



GPA

GRADE			
	N	Mean	Std. Deviation
Web Group	15	37.7333	9.7282
Lecture Group	28	45.5000	7.7196
Lecture+Web Group	23	43.3478	6.2929
Total	66	42.9848	8.2266

Figure 2 Descriptive Statistics of the Sample

6. RESULTS

H1: Influence of instructional format

One-way analysis of variance (ANOVA) and Scheffe's multiple comparison were conducted to determine if there were significant differences among the test scores of the three groups (H1). The results are shown in Table 1a.

It can be seen from the table that the mean scores for the Web, Lecture and the Lecture-Web groups were 37.7, 45.5 and 43.3 respectively. The ANOVA shows that the F-ratio was 4.916 ($p=0.010$) and was significant at 0.01 level. Therefore, the hypothesis (H1) that there would be no difference between test scores among the three treatment groups was rejected. The Scheffe's test for mean differences between the Web group and the Lecture group was significant at 0.05 level, with the

Dependent Variable: GRADE
Scheffe

(I) W L LW	(J) W L LW	Mean Difference (I-J)	Std. Error	Sig.
Web Gp	Lecture Gp	-7.7667*	2.487	.011
	Lecture+Web	-5.6145	2.579	.102
Lecture Gp	Web Gp	7.7667*	2.487	.011
	Lecture+Web	2.1522	2.187	.618
Lecture+Web Gp	Web Gp	5.6145	2.579	.102
	Lecture Gp	-2.1522	2.187	.618

*. The mean difference is significant at the .05 level.

Lecture group scoring 7.67 points above that of Web group.

Table 1a Results for H1

The performance of ESL students was also compared with that of the non-ESL students. The t -value was .837 ($p=.404$). This showed that there were no differences in

scores between the Web and lecture groups due to ESL as a factor (Table 1b)

H2: Influence of ethnicity

ANOVA was performed to find if there were differences in the test scores in each of the three treatment groups attributable to ethnicity. The results are discussed below in the group order - Web, lecture, Web and lecture.

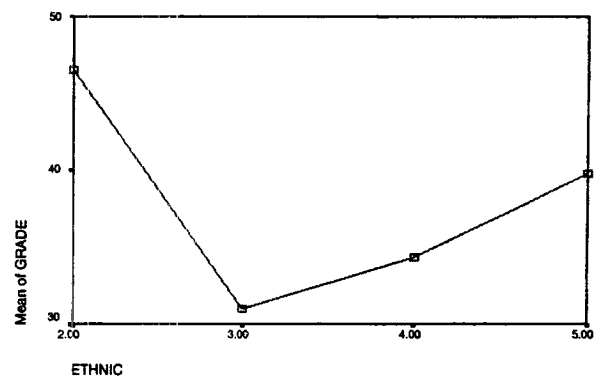
Web group: The mean score for the Asian ethnic group was 46.5, White 31, Hispanic 34.3 and Middle Eastern 39.75 (Table 2a).

Dependent Variable: GRADE

NEWW L	ESL	Mean	Std. Deviation	N	
Web	Non-ESL	45.8500	9.2240	20	
	ESL		41.4615	8.1840	26
			43.3696	8.8301	46
Lecture	Non-ESL	44.2121	10.1697	33	
	ESL		44.8649	7.4093	37
			44.5571	8.7587	70

Table 1b ESL as an influencing factor

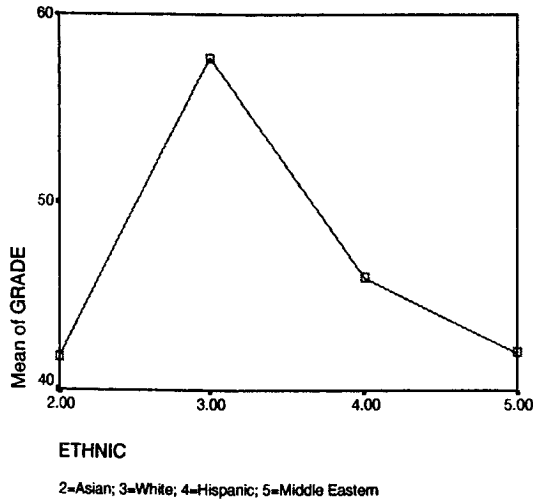
There were not sufficient observations for the Black students and hence they were not included in this part of the analysis. The F-ratio was 2.408 ($p=0.128$) and was not significant at 0.05 level. Therefore, the hypothesis that there was no difference between test scores among the ethnic groups (H2) was supported for the Web group. Even though the mean score of the Asians was notably higher than the other ethnic students in the Web group, the large variability in the individual scores did not render it significant enough statistically.



Grade (ANOVA)	Df	F	Sig.
Between Groups	3	2.408	.128

Table 2a Results of H2 (Web Group)

Lecture group: The mean score for the Asian ethnic



GRADE

	df	F	Sig.
Between Groups	2	4.916	.010

group was 41.7, White 57.6, Hispanic 46 and Middle Eastern 42 (Table 2b). The ANOVA showed that the F-ratio was 4.675 ($p=0.011$) and was significant at 0.05 level.

Therefore, the hypothesis (H2) that there was no difference between test scores among the ethnic groups was not supported for the lecture group. Scheffe's test shows that Whites did better than Asians and Middle Easterners by 15.9 and 15.6 points and that it was statistically significant. It can be observed from the table that Whites scored higher than Hispanics also by 11.6 points but it was not significant.

Lecture and Web group: The mean score for the Asian ethnic group was 41.4, White 45.6, and Hispanic 42.8. There were not sufficient observations on Middle Eastern students thus they were not included for this analysis. The F-ratio was only 0.657 ($p=0.53$) and hence was not significant at 0.05 level.

Table 2b Results of Hypothesis (Lecture Group)

H3: Influence of gender

ANOVA were performed to find if there were differences in the test scores in each of the three treatment groups attributable to gender. Similar to the discussion on H2, the results are discussed below in the group order - Web, lecture, Web and lecture.

Web group: The mean score for women in

Group Statistics

	GENDER	Mean	Std. Deviation	Std. Error Mean
GRADE	Women	37.33	9.7297	3.9721
	Men	38.00	10.3078	3.4359

for independent samples was used. The t value came out to be .125 ($p=0.902$) and was not significant at 0.05 level. Therefore, the hypothesis (H3) that there was no difference in test scores due to gender was supported for the Web group.

	GENDER	Mean	Std. Deviation	Std. Error Mean
GRADE	Women	46.1053	8.3593	1.9177
	Men	44.2222	6.4183	2.1394

Table 3a Results of H3 (Web Group)

Dependent Variable: GRADE
Scheffe

(I) ETHNIC	(J) ETHNIC	Mean Difference (I-J)	Std. Error	Sig.
Asian	White	-15.9524*	4.546	.018
	Hispanic	-4.2857	3.133	.607
	Middle Eastern	-.2857	3.857	1.000
White	Asian	15.9524*	4.546	.018
	Hispanic	11.6667	4.252	.084
	Middle Eastern	15.6667*	4.811	.031
Hispanic	Asian	4.2857	3.133	.607
	White	-11.6667	4.252	.084
	Middle Eastern	4.0000	3.506	.731
Middle Eastern	Asian	.2857	3.857	1.000
	White	-15.6667*	4.811	.031
	Hispanic	-4.0000	3.506	.731

*. The mean difference is significant at the .05 level.

Lecture group: The mean score for women in the lecture group was 46.1 and for men 44.2. The t -value was 0.596 ($p=0.557$) and was not significant at 0.05 level (Table 3b). Therefore, the hypothesis (H3) was not rejected.

Table 3b Results of H3 (Lecture Group)

Lecture and Web group: The mean score for women in this group was 43.3 and for men 43.4. The F-ratio was 0.056 ($p=0.815$), not significant at 0.05 level. Thus, the hypothesis (H3) was not rejected for those who took the lecture plus Web format.

	OWNP	Mean	Std. Deviation	Std. Error Mean
GRADI No		34.0000	9.0000	5.1962
Yes		43.4127	8.0154	1.0098

H4: Influence of PC ownership and Internet access

This hypothesis was intended to test if students who own PCs will perform better. The descriptive results show that those who owned PC had a mean score of 43.4 whereas those who did not scored 34 (Table 4). Since the hypothesis was directional, one-tail test was used. The t-value was -1.979 ($p=0.026$). Thus, H4 was supported.

Table 4 Results of H4

H5: Influence of length of residency

ANOVA and Scheffe's multiple comparison were conducted to determine if there were significant differences among the test scores of the three groups with different years of residency. It can be seen in Table 5 that the mean scores for those who were residents for less than five years was 32.9, five to ten years was 44.3, and greater than 10 years was 52.9. The F-ratio was 118.5, significant at 0.05 level. The Scheffe's test for mean differences between each group was also significant. Therefore, the hypothesis (H5) that the test scores will improve with length of residency in the U.S. was supported.

ANOVA

GRADE					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3475.387	2	1737.7	118.5	.000
Within Groups	923.598	63	14.660		
Total	4398.985	65			

GRADE

	N	Mean	Std. Deviation	Std. Error
<5 years	19	32.89	5.2376	1.2016
5-10 years	32	44.31	2.9451	.5206
>10 years	15	52.93	3.3905	.8754
Total	66	42.98	8.2266	1.0126

Dependent Variable: GRADE

Scheffe

(I) YRSRES	(J) YRSRES	Mean Difference (I-J)	Std. Error	Sig.
<5 years	5-10 years	-11.4178*	1.109	.000
	>10 years	-20.0386*	1.322	.000
5-10 years	<5 years	11.4178*	1.109	.000
	>10 years	-8.6208*	1.198	.000
>10 years	<5 years	20.0386*	1.322	.000
	5-10 years	8.6208*	1.198	.000

*. The mean difference is significant at the .05 level.

Table 5 Results of Hypothesis H5

7. ADDITIONAL ANALYSIS AND IMPLICATIONS

Billings (1989) proposed a model for correspondence courses where GPA was a student background factor that would positively influence a variable referred to as Course Completion. Assuming the test scores in our study represented a measure of the same concept as course completion, a correlation analysis was done between GPA and test scores. The Pearson r came out to be 0.431 with $p=0.000$. Such high significance as indicated by the p-value not only validates Billings model as extensible to Web-instruction but also adds external validity to the current study.

A recent study by Ede and Panigrahi (1998) on minority students showed that there was a positive correlation between Age and GPA. The same relationship was tested in our sample to find out if this is true for the ESL students as well. As mentioned in the methodology section, data on GPA and age of all the students who participated in study was collected from the university admission records. The Pearson r -value of 0.206 ($p=.096$) was significant at 0.10 level. Such conformance to earlier finding obtained by independent researchers adds further validity to the current study. The students in our study were allowed to choose which course setting - Web, lecture or lecture and Web they were going to adopt for the course. To lend credibility to the conclusions made on the five hypotheses, it thus became necessary to verify whether group memberships were randomly distributed. ANOVA performed on the data showed that both GPA ($F=1.146$; $p=0.324$) and age ($F=0.379$; $p=0.686$) were indeed randomly distributed. This ensured that conclusion reached in H1 was truly contributed by the instruction settings alone. This brings us to the single most conclusion of this study: ESL students, especially those who have been in the U.S.

only recently, perform better when they take the course in the traditional lecture setting. This appears to be a reasonable conclusion as well considering that ESL students do learn better when they have opportunities to gather information through non-verbal cues and personal interactions which are missing in a Web setting.

It was reported while discussing H2 that the mean score of the Asians was notably higher than others in the Web group. Yet the hypothesis could not be rejected due to the large variability in the individual scores. The data was further analyzed for the source of this variance. The answer was traced to the wide range in the length of residency in the U.S. of the individual students. This in fact provided additional support for conclusion reached in H5.

It was seen in H3 that there were no differences in scores between men and women in each of the setting they took the course. Additional analysis was done to compare the overall test scores between gender irrespective of what format they attended by aggregating the individual group data. The F ratio was 0.134 ($p=0.716$) and was not significant inferring that there was no statistical difference in performance between men and women irrespective of what format they took the course.

Several lessons were also learned in this study. In our data sample, PC ownership and Internet access was over 90%. With such widespread accessibility, Web courses do offer a feasible alternative to traditional teaching. With longer ownership, students are more likely to have polished their computer skills that will be helpful while taking Web courses. There are also lessons for designers of online courses. Web pages should have detailed narration and interactive capabilities built into it. Video streams can also better convey information than static slides. Since the biggest barrier in a Web setting for a ESL student is the lack of a human tutor who could clarify as the study progresses, universities must offer an online or a toll-free telephone help line operated by tutors that students could use for this purpose.

However, ESL students who have been in the U.S. fewer than five years should be advised to take lecture classes where they are most likely to perform better. Otherwise, universities can provide additional support mechanisms to compensate for the language barrier. Further, in this study, student performance was correlated to their GPA. Assuming GPA to be an indicator of self-direction and motivation, Web courses seem to be more suited to students with above average GPA. Students perform significantly better in Web classes if they have a PC with Internet access at home; therefore, universities may consider lending PCs to students. They may also negotiate with Internet service providers for better student pricing.

8. CONCLUSION

It would be useful to replicate the study with a larger sample. Comparison of the results with those of non-ESL students indicate that the Web design used in the study was equally effective as the lecture and did not contribute to any confounding. Similar studies should also be undertaken across regions that have different demographic make up and technology diffusion levels. Various university support mechanisms specifically designed for ESL students taking Web courses in distant learning mode should be implemented and their effectiveness on performance should be evaluated. Earlier studies in correspondence and teleconferencing have shown that distance learning reduces drop out rates (McGowan, 1992) and it will be appropriate to see if Web instruction has similar impact. It is also important to investigate how course content (e.g., theory vs. lab courses) impact on Web design, especially when ESL students are the audience. There must also be an ongoing program for research into adapting evolving Internet technologies and provide insight into the changing role of the instructor. Finally, there is a wide diversity with in the ESL population, in terms of culture and computer preparation that make them an important pool of subjects for studies to benefit one of the fastest growing student population in America.

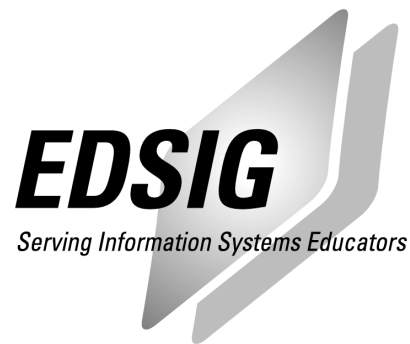
Web-based instruction is ushering in an educational revolution today. Demographic data indicate our society is undergoing large ethnic transformations as well. To be able to reap the full benefits of distance education, it is important for educators to match technology with the background and needs of the learners if education is to be effective. Despite the language barriers, ESL learners work hard constantly trying to adapt in order to fulfill their goals and aspirations. For those of us who are educators, it is our solemn duty to help them fulfill their American dream.

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