AGE AND GENDER DIFFERENCES IN ONLINE BEHAVIOR, SELF-EFFICACY, AND ACADEMIC PERFORMANCE

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The purpose of this study was to investigate whether there are differences between different age and gender groups of adult learners when they are compared simultaneously on the number of messages they post, self-efficacy improvement and academic performance in an online learning environment. A two-way MANOVA revealed significant main and interaction effects on the dependent variables. Older students posted significantly more messages, but younger students improved their self-efficacy significantly more. Female students improved their self-efficacy significantly more and scored significantly higher on the final exam than male students. Younger male students' exam scores and younger female students' exam scores were significantly different from each other.

INTRODUCTION

One of the main phenomena characterizing education since the late twentieth century is the use of Internet-based technologies. Currently, the World Wide Web is a ubiquitous pedagogical tool, and online instruction has become popular for various age groups and both gender groups of learners. However, online learning is viewed as more challenging than traditional classroom learning (Wyatt, 2005). Because computer technology must be used as a delivery vehicle during online learning, some students may have difficulties if they are not familiar with using computers. For example, older students tend to be less-competent computer users than are younger students (Yu, Kim, & Rho, 2001), and female students tend to be less familiar with or have lower self-efficacy toward computers than male students (Bradshaw & Johari, 2003; Thompson & Lynch, 2003). To help instructors design their online instruction to be effectively tailored to individual learners of different age and gender groups, research should provide an answer to the question of how age and gender influence learners' online performance.

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LITERATURE REVIEW

Age and Gender Differences in Online Behavior

Age differences in online behavior in nonacademic environments such as online shopping and purchasing (Sorce, Perotti & Widrick, 2005) or Web search (Grahame, Laberge, & Scialfa, 2004) have been often discussed in the literature, but only a small number of studies have been conducted to examine age differences in adult learners' online learning behavior in academic settings. Those studies revealed significant differences in online behavior due to age; however, it is difficult to conclude age-dependent online behavior based on the studies because of the contextual or missing definitions of "younger" and "older" used in the studies. For example, Hoskins and van Hooff (2005) reported from their study with 110 students that older students used the bulletin board to participate in discussions more often than younger students. In this study, only 10 of them were between 24 and 43 years of age and the rest of them were between 19 and 24. The average age was 20. Bradshaw and Johari (2003) reported in their study with 36 students that older students had to spend more time than younger learners in order to successfully complete online tasks. In this study, 16 participants were aged 17-25, 10 were between 26-35, and 10 were 36 or older. They did not report the average age. Wyatt (2005) reported in his study that older students indicated that online instruction provided better quality of academic experience compared to how younger learners thought it to be, but the researcher did not report the age range of the participants.

A number of studies have also been conducted to investigate gender differences in various aspects in relation to accessibility and nonacademic usage of the Internet such as Web search, chat rooms and emails (Royal, 2005). Overall, gender differences in the degree of access to the Internet existed during the 1990s, but the gaps disappeared by the turn of the twenty-first century and in fact, by 2001 women had more access to the Internet than did men (Clark & Gorski, 2002; Ono & Zavodny, 2003). However, the way men and women use the Internet and behave online seem to differ (Royal, 2005; Wesserman & Richmond-Abbott, 2005). Men and women may have an equal level of accessibility to the Internet, but women are "less frequent and less intense users of the Internet" (Ono & Zavodny, 2003, p. 111).

The gender differences in online behavior in academic as well as nonacademic settings seem context dependent, and women tend to exhibit more social behavior online than men do. For example, male students posted more messages than did female students in a formal online learning environment, but female students contributed more "interactive" social messages than did male students (Barrett & Lally, 1999). In a same-gender group, female participants wrote significantly more messages than did male participants, but when they engaged in a mixed-gender group, their online behavior changed: female participants wrote less and male participants wrote more than when they were in a same-gender group (Bostock & Lizhi, 2005). Similar gender differences were observed in nonacademic newsgroup environments as well (Savicki & Kelley, 2000; Wolf, 2000).

Age and Gender Differences in Self-Efficacy and Academic Performance

Self-efficacy is defined as "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations" (Bandura, 1995, p. 2). A substantial amount of evidence shows that self-efficacy is strongly related to academic performance in traditional face-to-face environments (Bandura, 1997). However, only a few studies have investigated the effects of computer-related self-efficacy and online academic performance (e.g., DeTure, 2004; Tsai & Tsai, 2003). Among them, only a small number of

studies examined age and gender differences in self-efficacy and academic performance during online learning, and the research findings are inconsistent. For example, in Chu's study (2003), gender was not a strong predictor of computer self-efficacy but age differences were. However, in Sherman and colleagues study (2000), gender differences in perceptions and self-efficacy toward the use of online technology were found significant. In Hargis' study (2001), age and gender did not influence online learning outcomes, although older students performed better with an objectivistic approach. In Hargittai and Shafer's study (2006), men and women were not different in their actual skills to navigate online, but women self-assessed their skills significantly lower than men evaluated their skills. In contrast, in Rovai and Baker's study (2005) female students not only posted more messages but also developed a stronger sense of community and a greater level of perceived learning than male students did during an online class.

In summary, more research on age and gender differences in academic online environments is needed to make conclusive implications of the impact that age and gender may have on adult learners' online behavior, self-efficacy, and academic performance. This study was conducted to answer whether adult learners' age and gender would make a difference in their online behavior, the degree of improvement in self-efficacy toward specific learning topics, and academic performance.

METHOD

Research Hypotheses

A 2×2 factorial design was used. The independent variables were two learner characteristics: age (younger and older) and gender (male and female). Three dependent variables were measured: online behavior as measured by the number of messages; self-efficacy improvement as measured by the difference between a preassessment and a postassessment; and academic test scores. The following null hypotheses were tested:

- Ho_1 (main effect): There is no significant difference between younger and older groups of adult learners when they are compared simultaneously on the number of messages they post, the degree of improvement in their self-efficacy toward specific learning topics, and their academic performance.
- Ho_2 (main effect): There is no significant difference between male and female groups of adult learners when they are compared simultaneously on the number of messages they post, the degree of improvement in their self-efficacy toward specific learning topics, and their academic performance.
- Ho_3 (interaction effect): There is no significant interaction between age and gender groups of adult learners when they are compared simultaneously on the number of messages they post, the degree of improvement in their self-efficacy toward specific learning topics, and their academic performance.

Participants

The participants were students who enrolled in a master's degree level online course titled, "Introduction to Instructional & Performance Technology," offered at a mid-sized university in the northwestern region of the United States during four semesters between fall 2004 and spring 2006. It was a four-credit, semester-long, required course. Each semester except Spring semester of 2005, two sections of the course were offered by two different instructors (seven sections and two instructors in total). Identical instructional materials including the course syllabus, weekly schedule, reading material, assessment methods and evaluation criteria were used in all seven sections of the course. Ninety-one students initially enrolled in the seven sections of the course but 10 dropouts in total occurred;

therefore, data obtained from 81 students were used in this study (the number of participants in each section was 15, 10, 15, 11, 12, 7 and 11). The course was offered both on campus and online during the fall semester and only online during the spring semester. Among 81 participants, 9 students resided near campus at a commutable distance but chose to take the course online, and 72 students were distant students who resided outside the city or the state. Thirty-seven students were female and 44 were male. The student age ranged from 22 to 57. The average age of the students was 40 (*SD* = 8.76) and the median was 39. A normality test on the age distribution failed to reject the null hypothesis that the sample was taken from a normally distributed population (Shapiro-Wilk = .971, p = .065). Figure 1 is the stem-and-leaf plot of age distribution. Using the median age as the cut point, two age groups were formed—younger (≤ 39) and older (> 39). Forty-one students were classified as younger students and 40 students were older students. Table 1 shows the distribution of participants in the age by gender groups.

Procedures

The following procedures were implemented in each section of the course.

```
Frequency    Stem &  Leaf

    1.00        2 .  2
    8.00        2 .  56667899
   19.00        3 .  0001122223333333444
   13.00        3 .  5567788899999
   10.00        4 .  0000112344
   17.00        4 .  55555666677888899
    9.00        5 .  000124444
    4.00        5 .  5567

Stem width:        10
Each leaf:       1 case(s)
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FIGURE 1
Stem and Leaf Plot of Age

TABLE 1
Number of Participants in Age by Gender Groups

	Gender		
Age	*Male*	*Female*	*Total*
Younger	14	27	41
Older	23	17	40
Total	37	44	81

- Online behavior: The online course was delivered using a Lotus Notes database that provides an asynchronous message threading function. The system also provides instructors with an "instructor view" that presents messages sorted by author and date, enabling them to easily recognize how many messages each student posted each day. The researcher retrieved the total number of messages that each student posted during the course.
- Self-efficacy: An ENtry-Knowledge Assessment (ENKA) was administered during the first week of the semester. The ENKA measured students' self-efficacy levels toward 40 specific course topics on a 5-point scale (*1 = no confidence* and *5 = most confident*). An EXit-Knowledge Assessment (EXKA) using the same 40 items was administered before the final exam during the last week of the semester. The gap between the ENKA score and the EXKA score represents the degree of self-efficacy improvement.
- Academic performance: A final exam of 30 questions was administered at the end of the course. It was an open-book test, measuring students' accomplishment of the main objectives covered in the course.

RESULTS

Descriptive Statistics

Since the online course was delivered asynchronously, students were able to participate in discussions anytime during the week. Available days during the fall semester and the spring semester were 111 days and 118 days, respectively (including the prep week prior to the first day of the semester). On average, students participated in 42 of the available days, producing 117 messages, which indicates that they posted 2-3 messages whenever they participated in class discussions. The average score of ENKA was 80.09 (SD = 25.08) and the average score of EXKA was 179.62 (SD = 15.23). The average degrees of self-efficacy improvement for male and female students were 90.11 (SD = 28.11) and 107.45 (SD = 23.28), respectively. The average degrees of self-efficacy improvement for younger and older students were 106.80 (SD = 24.14) and 92.08 (SD = 27.78), respectively. The final exam scores ranged from 72.67 to 100.00, and the average score of the final exam was 92.75 (SD = 5.99).

Table 2 presents descriptive statistics of dependent variables including ENKA and EXKA results by age and gender groups. Because data were obtained from four semesters (seven classes), z scores of the individual numbers of messages obtained from each class were used for the following analyses.

Inferential Statistics

The null hypotheses were tested using a two-way multivariate analysis of variance (MANOVA). To use MANOVA, the multiple dependent variables should be related with each other at a low to moderate level (Leech, Barrett, & Morgan, 2005). The correlations among the three dependent variables in this study were low, as shown in Table 3.

MANOVA is robust to violations of homogeneity of variance/covariance matrices if the sizes of groups are nearly equal or if the size of the largest group is less than about 1.5 times the size of the smallest group (Leech et al., 2005). Although the largest group in this study (n = 27) was about 1.9 times larger than the smallest group (n = 14), the multivariate homogeneity of covariance matrices tested with Box's M test revealed that the M value of 17.27 was not significant (p = .59). Therefore, the assumption of homogeneity of covariance matrices was satisfied.

The MANOVA revealed a significant multivariate effect for age-group, Wilks' lambda = .77, $F(3, 75) = 7.11$, $p < .01$, partial $\eta^2 = .22$, observed power = .97, and a significant multivariate effect for gender, Wilks' lambda = .84,

TABLE 2
Descriptive Statistics of Dependent Variables

	Age Group		
Gender	*Younger*	*Older*	*Combined*
Male (*N*)	14	23	37
Online messages (*z*)			
M	–.70	.26	–.10
SD	.66	1.02	1.01
ENKA			
M	78.14	93.13	87.46
SD	28.70	27.24	28.63
EXKA			
M	179.29	176.52	177.57
SD	19.18	16.93	17.60
SE improvement			
M	101.14	83.39	90.11
SD	28.66	26.14	28.11
Exam scores			
M	89.42	92.27	91.19
SD	5.33	6.21	5.98
Female (*N*)	27	17	44
Online messages (*z*)			
M	–.13	.43	.08
SD	.73	1.08	.91
ENKA			
M	72.37	76.29	73.89
SD	16.45	24.87	19.94
EXKA			
M	182.11	180.12	181.34
SD	12.25	14.06	12.85
SE improvement			
M	109.74	103.82	107.45
SD	21.43	26.21	23.28
Exam scores			
M	95.17	92.29	94.06
SD	5.40	6.00	5.75
Combined (*N*)	41	40	81
Online messages (*z*)			
M	–.32	.33	–.00
SD	.75	1.04	.96
ENKA			
M	74.34	85.98	80.09
SD	21.24	27.51	25.08
EXKA			
M	181.15	178.05	179.62
SD	14.80	15.69	15.23
SE improvement			
M	106.80	92.08	99.53
SD	24.14	27.78	26.88
Exam scores			
M	93.21	92.28	92.75
SD	5.98	6.05	5.99

TABLE 3
Correlation Matrix

Dependent Variable	*1*	*2*	*3*
Online messages	—	.132	–.163
SE improvement	—	—	.108
Exam score	—	—	—

$F(3, 75) = 4.58$, $p < .01$, partial $\eta^2 = .15$, observed power = .87. A significant multivariate effect for interaction was also found, Wilks' lambda = .89, $F(3, 75) = 2.85$, $p < .05$, partial $\eta^2 = .10$, observed power = .66. Therefore, all three null hypotheses were rejected.

Based on the significant effects found from the MANOVA, a separate two-way univariate analysis of variance (ANOVA) for each of the dependent variables was conducted without undue inflation of the experimentwise Type I error (Grimm & Yarnold, 1995). The Levene's test revealed that the assumption of homogeneity of variances was met for self-efficacy improvement [$F(3, 77) = .88$, $p > .05$] and for exam scores [$F(3, 77) = .65$, $p > .05$] but not for online messages [$F(3, 77) = 4.07$, $p < .05$]. Therefore, when the follow-up ANOVAs were conducted, results for online messages were interpreted with caution.

The ANOVA results as shown in Table 4 revealed significant age effects on the number of messages [$F(1, 77) = 13.85$, $p < .05$, partial $\eta^2 = .15$, observed power = .95] and self-efficacy improvement [$F(1, 77) = 4.20$, $p < .05$, partial $\eta^2 = .05$, observed power = .52]. Older

TABLE 4
Combined Univariate ANOVA Table

Source	*Dependent Variable*	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*	*Partial* η^2	*Observed Power*
Age	Messages (*z*)	11.12	1	11.12	13.85	.00	.15	.95
	SE improvement	2657.95	1	2657.95	4.20	.04	.05	.52
	Exam scores	.00	1	.00	.00	.99	.00	.05
Gender	Messages (*z*)	2.59	1	2.59	3.22	.07	.04	.42
	SE improvement	3998.47	1	3998.47	6.32	.01	.07	.70
	Exam scores	157.60	1	157.60	4.74	.03	.05	.57
Age	Messages (*z*)	.76	1	.76	.94	.33	.01	.16
*	SE improvement	664.48	1	664.48	1.05	.30	.01	.17
Gender	Exam scores	155.59	1	155.59	4.68	.03	.05	.57
Error	Messages (*z*)	61.83	77	.80				
	SE improvement	48656.84	77	631.90				
	Exam scores	2557.85	77	33.21				
Total	Messages (*z*)	74.00	81					
	SE improvement	860230.00	81					
	Exam scores	699727.92	81					

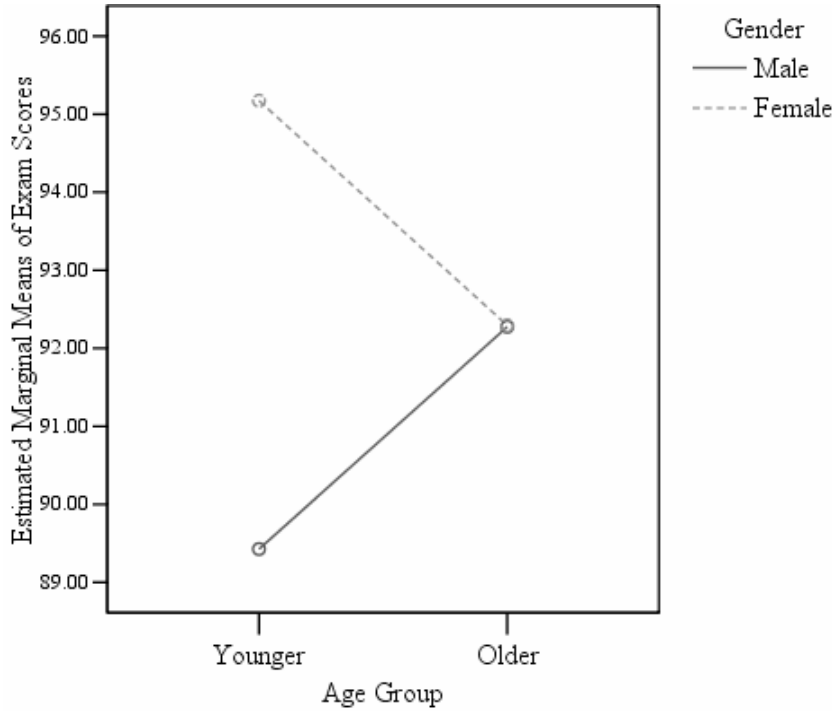

FIGURE 2
Estimated Marginal Means of Exam Scores by Age and Gender

students posted significantly more messages than did younger students, but younger students improved their self-efficacy significantly more than did older students. Significant gender effects on self-efficacy improvement [$F(1, 77) = 6.32$, $p < .05$, partial $\eta^2 = .07$, observed power = .70] and academic performance [$F(1, 77) = 4.74$, $p < .05$, partial $\eta^2 = .05$, observed power = .57] were found. Female students improved their self-efficacy significantly more and scored significantly higher on the final exam than did male students. A significant interaction effect on academic performance was found [$F(1, 77) = 4.68$, $p < .05$, partial $\eta^2 = .05$, observed power = .57]. As shown in Figure 2, younger male students' average exam score and younger female students' average exam score were significantly different from each other, although older male and female students performed at the same level.

DISCUSSIONS

This study revealed significant age effects on the number of messages and self-efficacy improvement, significant gender effects on self-efficacy improvement and academic performance, and a significant interaction effect on academic performance. Although the effect sizes for the significant results were smaller than typical (.15, .05, .07, .05, and .05, respectively), practical importance of the results is noted as they help online instructors understand their learners' characteristics and behavior and adjust their online instruction accordingly.

In this study, younger students were defined as 22 to 39 years of age, and older students were 40 to 57 years of age. Older students posted significantly more messages than did younger students. This finding is supported by the result of Hoskins and van Hooff's study

(2005), although the average age of participants in their study was 20 years younger than the age of those in this study. Nonetheless, an interesting hypothesis can be said that as adult learners get older and have more work experience, they may be able or willing to make more comments based on their experiences during online discussions. However, as noted earlier, this outcome should be interpreted with caution due to the failure to meet the assumption of homogeneity of variances on online messages.

Interestingly, younger students who were less active online improved their self-efficacy significantly more than did older students. Female students also improved their self-efficacy significantly more and scored significantly higher on the final exam than did male students, although online visibility between male and female students was not significantly different from each other. The significant degrees of self-efficacy improvement by younger students and female students are partially explained by the significant age and gender differences in ENKA scores. Younger students and female students started the semester with lower self-efficacy levels, compared to older students and male students. However, it is important to note that younger students' average EXKA score and female students' average EXKA score at the end of the semester were actually higher than older students' average EXKA score and male students' average EXKA score, although the group differences on EXKA results were not different at a significant level. This study does not provide an explanation of how younger students and female students improved their self-efficacy so much by the end of the semester, but it provides an implication that the degree of online participation and the improvement of self-efficacy are not in parallel relationship.

The interaction effect shows that the average exam scores of younger male students and younger female students were significantly different from each other. Due to the small sample sizes of the interaction groups and based on the medium level of observed power on the interaction effect, this finding may not have a strong implication about age and gender interaction on online academic performance. However, it is important to note that young male students in this study posted the lowest number of messages and produced the lowest average exam score. This finding is worthy of online instructors' attention because it may imply that more effectively tailored online instruction is required for the specific target group of learners. Other research on online visibility and learning outcomes without factoring age and gender interaction into the analysis has shown inconsistent results. In Wu and Hiltz's study (2004) without taking into account age, no gender differences in perceptions of learning were found. In Webb, Jones, Barker, and van Schaik's study (2004), students' participation in online discussions was positively associated with actual learning outcomes, but in other studies, online participation levels were not significantly correlated with academic exam scores (Beaudoin, 2002; Picciano, 2002; Wang, 2004). Further research on age and gender interaction effects on online behavior and metacognitive characteristics such as self-monitoring and self-evaluation, and academic achievement during online learning is recommended.

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