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Adoption of Educational Technology: How Does Gender Matter?

George Zhou
University of Windsor

Judy Xu
University of Alberta

Gender differences have attracted attention in today's educational research and practice. Very few studies, however, explore the gender differences in the use of technology in higher education. The authors conducted a study on technology adoption at a large Canadian university. One of its purposes was to inform our understanding of how gender matters in the process of technology adoption in post-secondary teaching. A survey was administered to all full-time faculty and sessional instructors. Results suggest that females were more likely to use student-centered pedagogical approaches in teaching than males. Females had lower confidence and less experience in the use of computers in teaching. They tended to learn how to use technology from others, whereas males were more likely to learn from their own experience. Based on these findings, the paper recommends that professional development for females should involve more showcases and interactions while training for males would be more appropriate when it provides many hands-on activities.

Over the last two decades, computer technology has been changing many aspects of higher education including administration, recruitment, and the way of teaching and learning. The adoption of technology at post-secondary institutions has therefore become an important research topic. Among the reported studies, many focused on the barriers and incentives for the use of technology in higher education (Adamy & Heinecke, 2005; Ebersole & Vorndam, 2003; Green, 1998; Jacobsen, 1998; Nantz & Lundgren, 1998) or professional development that facilitates university instructors to use technology (Barone & Hagner, 2001; Stephens & Hartmann, 2004). Very few of them, however, pay attention to the faculty differences in the process of technology adoption. Since individual differences have attracted great attention in today's educational research and practice, the authors believe that a better understanding of faculty differences will benefit our effort in promoting technology integration at universities.

The authors conducted a study on technology adoption at one large Canadian university. This university adopted a technology strategic plan about 10 years ago. One of its goals was to facilitate a 50% WebCT adoption rate by 2005/2006. During the past 10 years, a couple of units were set up on campus to promote the use of technology by providing technical support and instructional design services. It was the purpose of this study to check the current use of technology on campus. This paper reports those findings that particularly address the following research question: How does gender matter in the process of technology adoption?

Theoretical Framework

During the last two decades, studies have documented gender disparity in the use of computers at different settings. For example, in schools, earlier studies found that male students, compared with their female peers, had more access to computers, felt more confident with their computer skills, and showed more positive attitude toward computers (Chen, 1986; Collise, 1985; Shashaani, 1994). Nelson and Watson (1995) reviewed research studies on gender differences in computer-based education and concluded that significant gender differences existed in regard to the equality of access and performance outcomes, and this disparity appeared to start as early as preschool where males consistently spent more time in computing activities than their female peers. Chen (1986) examined gender differences in computer attitudes and experience of adolescents. The study found that males were more interested in and more confident with computers than females. It also suggested a differential in the use of computers, finding that males had greater exposure to computers both in formal instructional settings and informal settings. Collis (1985) surveyed a large number of secondary school students and found that these attitudinal differences were clearly established by grade 8 and males spent more time with computers outside of class than females. Shashaani (1994) studied over 1700 students in secondary school and suggested that computer experience has a direct relationship with computer attitude. In her study, males had more computer experience and showed more positive attitudes. Some recent studies demonstrate that the gender gap has shrunk and has even reversed at certain grades. Volman, van Eck, Heemskerk, and Kuiper (2005) surveyed and interviewed students from elementary and secondary schools. They found that gender differences, especially in primary schools, appear to be small. In secondary schools, the computer attitude of girls is only slightly less positive than that of boys. Based on a trend analysis of data gathered from ten thousand school students in grades K-12 over the first five years of this century, Christensen, Knezek, and Overall (2005) and Collis et al. (1996) found that

boys and girls begin first grade with few or no difference in attitudes toward computers. By grades 4 and 5, girls are more positive in their enjoyment with computers. Starting about grade 6, girls' self-reported computer perception begins to become less positive than boys, and by grade 8 becomes significantly lower than boys. It is safe to conclude that even though today's elementary school kids may not show many gender differences in computers, boys in secondary schools still like computers more and are more confident to use them than girls (Colley & Comber, 2003; Vale & Leder, 2004).

The number of studies on gender differences in university settings is much smaller than in school settings. Most available studies report that gender is a significant factor in post-secondary learning. Koohand (2004) investigated university students who were enrolled in an undergraduate hybrid programm regarding their perceptions towards the use of a digital library and found that males had significantly higher positive perceptions than females. Enoch and Soker (2006) examined students' use of web-based instruction at an open university. They found that there had been a continuous increase in use of the Internet for both female and male students. However, the differences between the two gender categories were still significant and quite large. Male students were more likely to use web-based materials as an addition to the printed materials. Williams, Ogletree, Woodburn, and Raffeld (1993) reported that male college students, compared with females, experienced more computer involvement in their daily lives and perceived themselves as more competent with computers. However, some studies did not reveal significant gender differences. For example, Zhang (2005) found that gender was not a significant factor in terms of college students' receptivity for distance learning. Davis and Davis (2007) reported that no statistically significant difference was found on overall perception of computer competence based on gender

Studies on the use of computers by males and females in workplace and household settings have told a similar story. Earlier studies revealed that, in general, women seem to have less experience with computers and tend to be less skilled in the use of computers (Harrison & Rainer, 1992). In addition, women seem to suffer greater levels of computer anxiety (Igbaria & Chakrabarti, 1990). The more recent studies claim that these gender differences have shrunk. For example, Morris, Venkatesh, and Ackerman (2005) studied over a half year the reactions and use behaviors among 342 workers being introduced to a new computer application. They found that gender effects in individual adoption and use of technology differed based on age. Specifically, gender difference in technology perceptions became more pronounced among older worker, but a unisex pattern of results emerged among younger workers. Ono and Zavodny (2005) conducted a comparative study between USA and Japan. They found that there were significant gender differences in computer and internet usage in both countries during the middle 1990s. By 2001, these gender differences had disappeared in the US but persisted in Japan. However, controversy exists in regard to the recently reported smaller gender differences. Some recent studies still document fairly visible gender differences. Schumacher and Morahan-Martin (2001) found that in general, men tend to have more favorable attitudes toward computers. Ong and Lai (2006) surveyed 156 employees from six international companies in Taiwan and found that men's rating of computer self-efficacy, perceived usefulness, perceived ease of use, and behavioral intention to use e-learning are all higher than that of women.

While many studies have investigated possible gender differences among school students, university students, as well as adults in workplace and household settings, very few studies have addressed gender differences related to faculty use of educational technology in higher education. The available studies have even portrayed a contradictory picture. Spotts, Bowman, and Mertz (1997) found that male faculty reported greater knowledge and experience in computer technology. This difference was also reflected in their responses to the factors influencing the use of educational technology. In their study, females rated ease of use, time to learn, and training as more important factors than males. Thompson and Lynch (2003) reported that, compared to women faculty, men were significantly more likely to express confidence in their ability to organize and execute courses of internet actions. However, Anduwa-Ogiegbaen and Isah (2005) did not find any significant difference between male and female faculty in their internet usage. Gerlich (2005) found gender plays little role in faculty perceptions of teaching online. Parry and Wharton (1995) found that male faculty do not use network more than females.

Scholars who believe in gender differences have tried to provide explanations for their existence. Cockburn and Ormond (1993) claim that technology has traditionally played a gendered role in the western society. In the area of information technology, males are main designers and developers. This may cause a mismatch between technology and women's learning, working and living styles. For example, Wilson (1992) found that the language used in technology fields is male-oriented. This may alienate females and prevent them from participating in these fields. Campbell and Varnhagen (2002) argued that some computer applications in education such as self-paced tutorials

may not work for the benefit of women who are more relational learners than males. Gender stereotype does not favor women either in the use of technology. Some studies suggest that the higher computer anxiety of girls is related to the sex bias of teachers, who were found to make more eye contact with boys when discussing technology and computers (Okebukola, 1993). Since university faculty may haven been affected by consistently reported gender-related barriers, one can hypothesize that male faculty have advantages over female faculty in their skills, perspectives, and use of educational technology. However, this prediction does not exactly match what current studies inform us. This study is significant because it has the potential to contribute to the debate over whether or not gender differences exist in faculty use of technology.

An instructor's concept of teaching has an impact on how he or she uses technology (Mitchem, Wells, & Wells, 2003; Zhou, Brouwer, Nocente, & Martin, 2005). Studies on faculty pedagogy suggest that female faculty tend to embed curricular and instructional decisions in their students' personal experiences and understanding (Elijah, 1996; Lacey, Saleh, & Gorman, 1998; Robin & Harris, 1998). They may be less concerned with control and more inclined to prefer teaching and learning decisions constructed by learners (Lacey, Saleh, & Gorman, 1998). In more detail, females were described to prefer, to a greater degree than males, student-centered teaching approaches such as class discussion, cooperative learning, fieldwork, group projects, student-developed activities, and peer assessment (Park, 1996). Since the literature has demonstrated the gender differences in pedagogy, we hypothesize that males and females would perceive and approach technology differently. This difference, compared with gender differences in knowledge and skills of computers, is more subtle and therefore harder to explore. Very few studies have been done in this area. One exception is the study of Campbell and Varnhagen (2002). They argue that, since females are more likely to prefer interactive instructional methods, those technologies that support increased interaction and participatory networks are more likely to appeal to female faculty.

Methods

All full time faculty and sessional instructors at the studied university were invited to complete an online survey. The survey used Likert scale, ranking, yes/no, fill-in-the-blank, and open-ended questions. It had 30 questions, but most of them included multiple components. The survey took approximately 30 minutes to complete.

The survey consisted of three parts. The first part assessed university instructors' concept of teaching from four aspects: use of student-centered teaching approaches, understanding of teaching, goals of teaching, and criteria for the measurement of teaching success. Participants were first asked to report how frequently they used student-centered teaching approaches (e.g. encouraging students to share ideas with neighbors in the classroom) by picking a response on a 1-3 scale: (3) whenever applicable, (2) not always when applicable, and (1) never. Then participants were provided with several statements that describe the nature of teaching (e.g. to teach is to facilitate students' learning). They were asked to rank these statements from 1 (most descriptive) to 5 (least descriptive) based on the extent to which each statement describes their understanding of teaching. Instructors' understanding of teaching goals was assessed using a Likert scale from (1) much less important to (5) much more important. They were asked to compare the importance of several high order goals (e.g. develop students' critical thinking skills) with the goal of teaching subject content. At the end of the part one, participants were asked to consider the importance of several criteria for the measurement of their teaching success (e.g. students' marks in exams) on a Likert scale from (1) not at all important to (5) very important.

The second part of the survey focused on instructors' current use of computers, expertise with computer technologies, perceived impacts of computers on teaching and learning, factors influencing their use of computers, barriers to the use of computers, experiences and preferences in professional development. Participants were asked how long they had used computers in teaching. Possible responses were rated on a 1-4 scale: (1) never, (2) less than two years, (3) between two and five years, and (5) more than five years. Their comfort with the use of computers was assessed with a Likert scale from (1) not at all comfortable to (5) very comfortable. Participants were asked to report their expertise in various computer technologies, such as web searching, course management system, and spreadsheets, by indicating a level on a scale: (1) none, (2) little, (3) fair, (4) substantial, and (5) extensive. Participants were then provided with a number of statements describing the impacts of computers on teaching and learning in higher education, and various statements about factors that motivate instructors to use computers. They were asked to indicate their agreement or disagreement with these statements on a Likert scale from (1) strongly disagree to (5) strongly agree. Regarding the barriers to the use of computers, participants were asked to report the importance of each barrier by indicating a level on a Likert scale from (1) not at all important to (5) very important. At the end of the part two, the survey assessed the importance of common sources such as workshops and courses for instructors acquiring

TABLE 1
Demographic Data (Sample and Population)

Demographics		Sample	Population
Gender	Male	56	52
	Female	44	48
Age	Younger than 35	17	10
	36-45	33	32
	46-55	33	34
	Older than 55	17	24
Rank	Full professor	29	33
	Associate professor	24	14
	Assistant professor	18	19
	Sessional instructor	29	34

knowledge and skills to use computers in teaching. Participants were asked to pick a level on a Likert scale. They were also asked to rank their preference among these sources.

The third part of the survey collected demographic information including gender, age, position, and subject area. At the end of the survey, a couple of open-ended questions provided participants with an opportunity to give more detailed feedbacks on any topic covered in the survey.

Data analysis was conducted for the following variables: participants' concept of teaching, comfort and experience in the use of computers, expertise in computer technologies, perceived computer impacts on teaching and learning, motivations for the use of computers, barriers to the use of computers, and experience and preference in professional development. These variables were compared between males and females using t-tests or Chi-square tests, depending on the nature of each variable. The analysis was validated by at least two researchers.

Results

A web link for the online survey was sent through an automatic email dispatch program to approximately 2500 email addresses in April of 2005. These email addresses were provided by the Department of Human Resources with a mixture of all full time faculty members (1376), sessional instructors (729), and graduate assistants. The cover letter that went along with the survey was addressed to faculty and sessional instructors only. In other words, we only expected return surveys from 2105 faculty and sessional instructors. A total of 341 valid surveys were received. The return rate was approximately 16.2%. Participants came from all Faculties on campus. Their demographic data are reported in Table 1 along with the population data, which were obtained from the university Data Books. Male instructors, instructors younger than 35 years old, and associate professors are slightly over-represented in the sample. Findings therefore need to be interpreted with caution.

Male participants had an average of ten years of teaching experience while females had eight. However, this difference was not statistically significant. There was no significant age difference either between male and female participants. The average age fell at the middle point between the choices 3 (36-45 years old) and 4 (46-55 years old). Their teaching load was similar as well with an average of two courses for one semester.

Concept of Teaching

Participants were asked to report how frequently they used student-centered teaching strategies. T-test results demonstrate that, compared with male participants, females more frequently applied student-centered teaching strategies such as "encourage students to share ideas with neighbors in classroom," "engage students in small group discussion," "question student ideas before introducing new concepts or providing solutions," and "students' presentations." Females also tended to "engage students in small group work" more frequently than their male colleagues although this difference was not statistically significant. Females and males had no significant difference in their frequencies of using "hands-on activities" (Table 2).

Regarding instructors' understanding of the nature of teaching, participants were asked to rate how descriptive each of the following five statements was of their understanding: (a) I am the subject knowledge authority in the classroom, (b) To teach is to pass on knowledge to students, (c) To teach is to facilitate student learning, (d) My primary job is to explain the subject as clear as possible, and (e) My primary job is to create an environment for learning to occur. Statements (a) and (b) represent a teacher-centered perspective of teaching and (c) and (e) reflect a student-centered perspective while (d) falls between these two perspectives. Participants' number one rank, the most

TABLE 2
The Use of Student-centered Teaching Strategies

		Mean	SD	t	p
Encourage students to share ideas with neighbors in classroom	Male	2.50	0.73	-3.69	0.00**
	Female	2.77	0.51		
Engage students in small group discussion	Male	2.40	0.79	-2.76	0.00**
	Female	2.63	0.63		
Question student ideas before introducing new concepts	Male	2.48	0.65	-2.16	0.03*
	Female	2.63	0.56		
Students' presentations	Male	2.31	0.78	-2.29	0.02*
	Female	2.51	0.77		
Engage students in small group work	Male	2.50	0.74	-1.79	0.07
	Female	2.65	0.65		
Use hands-on activities	Male	2.32	0.80	-1.27	0.20
	Female	2.44	0.81		

Note. 1 = Never, 2 = Not always when applicable, 3 = Whenever applicable. *p < .05, **p < .01

TABLE 3
Participants' Understanding of Teaching

		Mean	SD	t	p
Most descriptive statement for teaching perspective	Male	2.62	0.70	-0.29	0.76
	Female	2.64	0.70		

TABLE 4
The Importance of High Order Teaching Goals Relative to Teaching Content

		Mean	SD	t	p
Facilitate student intellectual development	Male	2.67	0.54	-2.13	0.03*
	Female	2.79	0.47		
Relate subject matter to social issues	Male	1.74	0.77	-5.10	0.00**
	Female	2.19	0.78		
Develop students' critical thinking skills	Male	2.77	0.49	-1.78	0.07
	Female	2.85	0.37		
Prepare students for a specific career	Male	1.68	0.82	-1.86	0.06
	Female	1.85	0.85		
Relate subject matter to other courses or subjects	Male	2.00	0.77	-1.87	0.06
	Female	2.17	0.81		

Note.1 = Much less important, 2 = Less important, 3 = Just as important, 4 = More important, 5 = Much more important. *p < .05, **p < .01.

descriptive statement, was selected as an indicator to the estimation of their understanding of teaching. The participants were scored 1 if they chose statements (a) or (b) as their most descriptive statement. The participants who picked up statement (d) were scored 2. The rest who considered statements (c) or (e) were scored 3. A t-test for this variable does not show a significant gender difference (Table 3).

Participants were asked to compare five high-order teaching goals with the goal of teaching subject content. As Table 4 reports, females had a higher means than males on each of these five goals, which means they tended to consider, to a higher degree than males, the importance of these goals. This gender difference was significant for two goals, "facilitate student intellectual development" and "relate subject matter to social issues," but not for the other three.

Regarding the criteria university instructors used to measure their success of teaching, t-test results show that significant gender differences existed for three criteria: students' ratings of instruction, students' active involvement in the course, and students' attendance in class. Females were more likely to consider the importance of these three criteria. There were no significant gender differences for the rest two criteria: students' mark in exams and students' increased interest in the subject (Table 5).

In order to compare male and female instructors' overall understanding about teaching, nine selected questions addressing the four studied aspects of

TABLE 5
Criteria to Measure the Success of Teaching

		Mean	SD	t	p
Students' ratings of instruction	Male	2.03	0.80	-2.86	0.00**
	Female	2.27	0.71		
Students' active involvement in the course	Male	2.87	0.38	-2.46	0.01*
	Female	2.95	0.21		
Students' attendance in class	Male	2.31	0.74	-5.68	0.00**
	Female	2.72	0.56		
Students' increased interest in the subject	Male	2.91	0.32	-1.23	0.21
	Female	2.94	0.23		
Students' marks in exams	Male	2.19	0.68	-1.65	0.09
	Female	2.32	0.67		

Note. 1 = Not at all important, 2 (unmarked), 3 = Somewhat important, 4 (unmarked), 5 = Very important. *p < .05, ** p < .01.

TABLE 6
Participants' Concept of Teaching

		Mean	SD	t	p
Concept of teaching	Male	23.56	2.81	-4.10	0.00**
	Female	24.72	2.14		

FIGURE 1
Comfort Level with the Use of Computers in Teaching

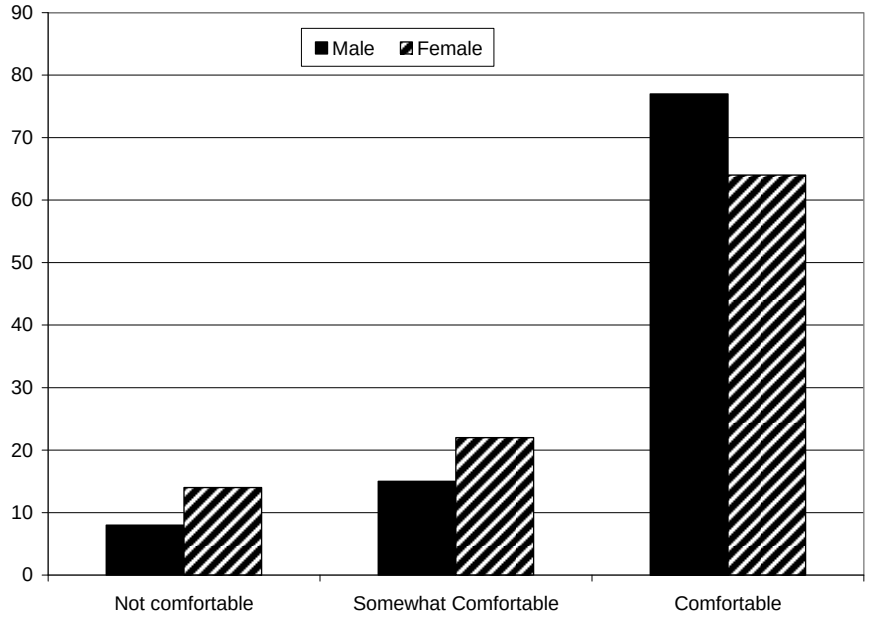

TABLE 7
Comfort and Experience with the Use of Computers in Teaching

		Mean	SD	t	p
Comfort with the use of computers in teaching	Male	4.23	1.05	2.94	0.00**
	Female	3.85	1.22		
Compare the use of computers with colleagues	Male	3.77	1.08	1.86	0.06
	Female	3.55	1.03		
Years of using computers in teaching	Male	3.49	0.65	2.65	0.00**
	Female	3.27	0.72		

Note. **p < .01.

teaching concept were selected and clustered into to one variable. In specific, four statements about teaching strategies (Table 2) were selected: "encourage students to share ideas with neighbors in the classroom," "engage students in small group discussion," "question students' ideas before introducing new concepts or providing solutions," and "use hands on activities." We did not select "engage students in small group work" and "students' presentations" because they were represented by the four selected strategies. Two high order teaching goals (Table 4) were selected: "developing students' critical thinking skills" and "facilitate students' intellectual development." The rest three goals were not selected because they were not as strong indicators as the selected questions in determining whether instructors had a student-centered or teacher centered concept of teaching. For a similar logic, two of the five criteria for teaching success (Table 5) were selected: "students' active involvement through the course" and "increased interest in the subject among students." Participants' number one rank, the most descriptive statement for their understanding of teaching (Table 3), was selected as the ninth contributor to the estimation of their concept of teaching.

To make all nine selected questions use the same kind of scales, the five scales were compressed to three scales. Specifically, for the questions about teaching goals, the two scales at the negative end namely "much less important" and "less important" were combined into one scale "less important (1)." The middle scale "just as important" still stayed in the middle (2). The two scales at the positive end, "more important" and "much more important," were combined into "important (3)." A similar operation was applied to the Likert scale used in the criteria questions about the measurement of teaching success.

The clustered measurement of teaching concept has therefore a minimum value of 9 and maximum value of 27, with the small number end representing a teacher-centered teaching concept and the big number end for a student-centered teaching concept. T-test results show a significant gender difference in participants' concepts of teaching (Table 6). Females were more likely to have a student-centered concept of teaching than males.

Use of Computer Technology

Comfort and Experience in the Use of Computers. Approximately 92% of males and 87% of females reported that they had used computer technologies in teaching. A Chi-square test shows that this difference was not significant. Participants were asked to report how comfortable they were with the use of computers in teaching. After compressing five levels into three, approximately 77% of males felt comfortable; 15% felt somewhat comfortable; and only 8% did not feel comfortable. In contrast, approximately 64% of females report comfortable, 22% somewhat comfortable, and 14% not comfortable (Figure 1). The t-test results show that males reported a significantly higher comfort level with the use of computers (Table 6). Participants were asked to rate their use of computers in teaching compared with their colleagues. A Likert scale from "well below average (1)" to "well above average (5)" was provided. While males tended to rate their use of computers higher than females, this gender difference was not significant (Table 6). Participants were asked to report how many years they had used computers in teaching. A t-test on participants' responses to this question demonstrated that males reported significantly more experience than females in the use of computers in teaching (Table 7).

Computer Expertise. Participants were asked about their expertise in using a variety of computer tools including web searching, webpage development, course management system, database, spreadsheets, presentation software, drawing or photo programs, listservs, and discussion board. Males reported a higher level of expertise in all these tools except discussion board. Statistically significant differences existed in the following computer tools: webpage development, spreadsheet, and drawing or photo programs.

Perceived Impacts of Computers. Participants were asked about how they agreed or disagreed with several statements describing the potential influences of

TABLE 8
Expertise in Computer Tools

		Mean	SD	t	p
Web searching/browsing	Male	4.42	0.73	1.63	0.103
	Female	4.28	0.82		
Presentation package (e.g. PowerPoint)	Male	4.12	0.99	1.52	0.12
	Female	3.93	1.20		
Spreadsheets	Male	3.65	1.17	3.52	0.00**
	Female	3.16	1.29		
Drawing/photo program (e.g. Photoshop)	Male	3.23	1.25	4.73	0.00**
	Female	2.56	1.27		
Database	Male	2.95	1.30	0.66	0.50
	Female	2.85	1.34		
Webpage creation, editing, publishing	Male	2.96	1.45	4.57	0.00**
	Female	2.25	1.25		
CMS (WebCT, Blackboard, etc.)	Male	2.65	1.25	-0.01	0.98
	Female	2.65	1.38		
Listserves, News groups	Male	2.57	1.26	0.62	0.53
	Female	2.48	1.34		
Discussion board	Male	2.24	1.36	-0.838	0.40
	Female	2.37	1.39		

Note. 1 = None, 2 = Little, 3 = Fair, 4 = Substantial, 5 = Extensive. *p < .05, **p < .01.

computers on teaching and learning (Table 9). The t-test results revealed that males and females responded with no significant differences to five statements. However, males and females gave significantly different responses to two statements, "students can learn the material more easily or thoroughly" and "faculty are better able to present more complex material to students." Males, compared to females, were more likely to think computers could help them to teach and students to learn the course materials better.

Motivations for the Use of Computers. Participants were asked about their agreement or disagreement with various motivators for their use of computers. Males and females had very similar responses for all motivators except the last one on the list, namely "I don't want to fall behind my colleagues who use computers in teaching." (Table 10). That is, females were more likely to consider the pressure from colleagues as an important motivator than males.

Barriers to the Use of Computers. Participants were asked about the importance of seven barriers to the use of computers including the lack of time to develop computer-based instruction, no time in the already intensive curriculum, unstable hardware or

TABLE 9
Perceived Impacts of Computers on Teaching and Learning

		Mean	SD	t	p
Faculty can spend more time with individual students	Male	2.85	1.07	-0.33	0.73
	Female	2.89	1.10		
Faculty can spend less time lecturing to the entire class	Male	2.84	1.11	0.14	0.88
	Female	2.82	1.16		
Faculty can spare time from teaching for research	Male	2.19	1.01	0.91	0.36
	Female	2.08	1.05		
Students communicate better with the instructor and classmates	Male	3.66	1.06	-0.99	0.32
	Female	3.78	0.93		
Students are better able to manage their learning activities	Male	3.66	1.05	0.57	0.56
	Female	3.59	0.94		
Students can learn the material more easily or thoroughly	Male	3.57	1.15	2.24	0.02*
	Female	3.28	1.04		
Faculty are better able to present more complex material to students	Male	3.57	1.17	2.08	0.03*
	Female	3.30	1.14		

Note. 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree. *p < .05.

TABLE 10
Motivations for the Use of Computers

		Mean	SD	t	p
Computers have the potential to enhance teaching and learning	Male	4.17	0.82	-0.35	0.72
	Female	4.20	0.66		
I enjoy figuring out how to use computers in teaching	Male	3.35	1.30	0.17	0.85
	Female	3.33	1.20		
Computers enable me to make a subject more interesting,	Male	3.79	1.06	0.11	0.90
	Female	3.77	0.99		
Students expect instructors to use computers in teaching	Male	3.66	1.06	-0.37	0.70
	Female	3.71	1.01		
Computers provide an environment appealing to different learning styles	Male	3.73	1.03	-1.47	0.14
	Female	3.90	0.96		
Computers enable students to collaborate in learning	Male	3.56	1.04	-1.53	0.12
	Female	3.74	0.94		
University policies encourage faculty to use computers in teaching	Male	3.04	0.97	-1.49	0.13
	Female	3.23	1.21		
I don't want to fall behind my colleagues who use computers in teaching	Male	2.75	1.14	-3.66	0.00*
	Female	3.20	1.03		

Note. 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree. *p < .01.

software, mismatch between available computer software and courses, not enough training opportunities for faculty, limited research evidence showing the effectiveness of computer integration, and no recognition or reward for using computers in teaching. Gender differences were found statistically significant for three barriers: unstable hardware or software, not enough training opportunities, and limited research evidence (Table 11). Compared with males, females were more likely to consider these three barriers having significant influences on the use of computers.

Professional Development. The participants who had used computers in teaching were asked to evaluate the importance of seven sources where they acquired computer skills related to teaching. There was no significant gender difference for the source named "learning from experience." However, females reported significantly higher importance than males on other six sources including formal courses, colleague mentoring, student assistance, support staff assistance, workshops or presentations, and family members (Table 12).

The participants who had used computers in teaching were also asked to reflect the importance of six sources where they acquired pedagogical knowledge for using computers in teaching. Again, there was no significant gender difference on "learning from experience." Males and females considered literature similarly as well. However, for other four sources

TABLE 11
Barriers to the Use of Computers in Teaching

		Mean	SD	t	p
Lack of time to develop computer-based instruction	Male	3.66	1.35	-0.46	0.64
	Female	3.73	1.26		
No reward from administration for using computers in teaching	Male	3.09	1.48	-1.15	0.24
	Female	3.29	1.42		
No time in the curriculum for computer-mediated instruction	Male	2.60	1.26	-0.93	0.35
	Female	2.74	1.40		
Available computer tools don't fit the course I taught	Male	2.32	1.32	0.70	0.48
	Female	2.21	1.27		
Unstable hardware or software	Male	2.52	1.27	-3.29	0.00**
	Female	3.01	1.31		
Not many training opportunities for university teachers	Male	2.33	1.28	-2.59	0.01*
	Female	2.73	1.30		
Limited research literature convincing the use of computers	Male	2.44	1.34	-2.23	0.02*
	Female	2.84	1.32		

Note. 1 = Not at all important, 2 (unmarked), 3 = Somewhat important, 4 (unmarked), 5 = Very important. *p < .05. **p < .01.

TABLE 12
Sources Where Instructors Acquired Computer Skills for Teaching

		Mean	SD	t	p
Learning from experience	Male	4.57	0.72	1.07	0.28
	Female	4.47	0.86		
Formal courses	Male	2.66	1.24	-4.23	0.00**
	Female	3.28	1.17		
Colleague mentoring	Male	2.91	1.21	-7.25	0.00**
	Female	3.92	1.07		
Student assistance	Male	2.30	1.15	-4.17	0.00**
	Female	2.94	1.37		
Support staff assistance	Male	3.32	1.33	-3.92	0.00**
	Female	3.93	1.21		
Workshops or presentations	Male	2.91	1.25	-5.28	0.00**
	Female	3.68	1.15		
Family member assistance	Male	1.83	1.12	-4.80	0.00**
	Female	2.63	1.64		

Note. 1=Not at all important, 2 (unmarked), 3 = Somewhat important, 4 (unmarked), 5 = Very important. **p < .01.

TABLE 13
Sources Where Instructors Gained Pedagogical Knowledge for Using Computers

		Mean	SD	t	p
Learning from experience	Male	4.27	0.87	1.30	0.19
	Female	4.40	0.79		
Literature	Male	2.70	1.26	-1.17	0.24
	Female	2.88	1.24		
Workshops or presentations	Male	3.02	1.31	-4.34	0.00**
	Female	3.69	1.20		
Instructional designers	Male	2.79	1.45	-5.53	0.00**
	Female	3.77	1.39		
Colleague mentoring	Male	2.99	1.27	-5.48	0.00**
	Female	3.81	1.20		
Formal courses	Male	2.53	1.15	-4.07	0.00**
	Female	3.12	1.20		

Note. 1=Not at all important, 2 (unmarked), 3 = Somewhat important, 4 (unmarked), 5 = Very important. **p < .01.

TABLE 14
Instructors' Ranking of Sources for Gaining Knowledge and Skills to Use Computers

		Mean	SD	t	p
One-on-one assistance from expert	Male	2.72	1.58	3.66	0.00**
	Female	2.10	1.37		
Learning from experience	Male	2.36	1.49	-3.60	0.00**
	Female	2.99	1.54		
Courses or training programs	Male	4.21	1.60	3.28	0.00**
	Female	3.61	1.52		
Literature	Male	4.76	1.58	-2.62	0.00**
	Female	5.22	1.39		
Workshops or presentations	Male	3.38	1.54	1.86	0.06
	Female	3.07	1.31		
Colleague mentoring	Male	3.57	1.58	1.40	0.16
	Female	3.32	1.45		

Note. **p < .01

including workshops or presentations, instructional designers, colleague mentoring, and formal courses, females were more likely to consider them important than males (Table 13).

All participants were asked to rank six common methods of acquiring knowledge and skills to use technology with 1 represents the most preferable choice and 6 the least. Females were more likely to rate "one-on-one assistance from experts" higher, especially ranking it as the number one option (50% females vs. 33% males). Males were more likely to rank "learning from experience" as number one (42% males vs. 25% females). These differences were significant based on the t-test results (Table 14). The t-test results also show that females were more likely to rate "courses or training programs" higher than males, and males were more likely to rate "literature" higher than females although both males and females rated it very low, mostly 6th (50% males vs. 68% females). Males and females rate workshops and colleagues mentoring similarly.

Discussion

This study found that female instructors, compared with their male colleagues, more frequently used student-centered teaching strategies such as questioning students' ideas before introducing new concepts, encouraging students to share ideas with neighbors in classroom, engaging students in small group discussion, and asking students to give presentations. They were more likely to consider "facilitate student intellectual development" as a more important high order teaching goal compared with teaching subject content and "students' active involvement in the course" as an important indicator for teaching success. Although their understanding of teaching, measured by their number one rank of statement about the nature of teaching, was not different (Table 3), females' overall concepts of teaching examined through multiple aspects including the use of student-centered teaching approaches, understanding of teaching, goals of teaching and criteria for the measurement of teaching success, to a larger extent than males, demonstrated a nature of student-centered concept. These findings draw us a picture that female instructors might possess stronger preference for student-centered pedagogy than males. This conclusion is consistent with the findings from previous studies on faculty pedagogy (Campbell & Varnhagen, 2002; Park, 1996; Robin & Harris, 1998).

Regarding the use of computers in teaching, this study found that females reported less computer expertise than males in one third of computer tools. They also reported less comfort and experience in the use of computers in teaching. Females' less expertise, comfort, and experience with computers were also reflected in their responses to the barrier questions. More females than males considered unstable hardware or software and lack of training opportunities as significant barriers to the use of computers. These findings are consistent with the study results of Spotts, Bowman, and Mertz (1997), who claimed that females were less confident with their skills and experience in the use of computers than males. However, our study found that a compatible percentage of males and females had used computers in teaching and that their motivations to use computers did not have many significant differences.

Spotts, Bowman, and Mertz (1997) reported that there was a significant gender difference in one of the barriers to the use of technology: lack of time. In their study, females rated lack of time as a greater barrier than did their male colleagues. Our study found that this difference was not significant at the studied university. However, we found that gender differences were significant for three barriers: unstable hardware or software, not enough training opportunities, and limited research evidence. In regard to the motivations, females were more likely to consider "I don't want to fall behind my colleagues who use computers in teaching" as a significant motivator. In other words, females were more likely than males to take pressure from colleagues as a significant motivator for their use of technology. Regarding the measurement of teaching success, students' attendance in class and their ratings of instruction were considered as significant criteria by more females than males. These findings lead us to think that females might be more subjective to external influence on their teaching in general and use of technology in particular.

Studies in sociology report that women are more expressive and tend to focus on social-oriented activities, whereas men focus more on task-orientated activities (Wood & Rhodes, 1992). Our study provides some evidence for these claims in the context of technology adoption. In this study, we found that females preferred to learn how to use technology from others, whereas males were more likely to learn from their own experience. Given the gender difference in socialization, it makes sense that that females were found to be more subjective to the external influences from their colleagues on their attempt to use technology.

Based on a couple of faculty surveys conducted earlier at the same university as this study, Campbell and Varnhagen (2002) claim that male and female faculty may approach technology through different routes. Males tend to pick up technology first and then consider its application in teaching, whereas females tend to start with their instructional needs. In other words, females put greater emphasis on pedagogy than technology, while males tend to be attracted by the

technology first. From this stance, they suggest different models of professional development for males and females. They argue that females may prefer pedagogically based training where relevant tools are presented. Males may prefer training featuring a technology where instructional methods are also addressed. Since this study found that females might be more subjective to external influences in the use of technology and more likely to learn knowledge and skills from others, in addition to the suggestions made by Campbell and Varnhagen, we recommend that professional development for females should involve more showcases and interactions while training for males would be more appropriate when it provides many hands-on activities.

Conclusion

In summary, this study demonstrates that male instructors might have greater expertise and feel more confident in the use of computers than females. Females are more likely to have a student-centered overall concept of teaching. They might be more subjective to the external influences from their colleagues on their attempt to use computers in teaching and prefer to learn how to use technology from others. Therefore, in regard to the question whether or not males and females approach technology differently, our current answer is positive. However, to produce a more comprehensive and clear understanding of gender differences in technology adoption, it is important to examine how males and females actually use technology in their classrooms.

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DR. GEORGE ZHOU is an assistant professor at the Faculty of Education, University of Windsor. His current research interests include the use of technology in science education, technology and teacher education, and faculty adoption of computer technology.

DR. JUDY XU is a program coordinator at the University of Alberta. She received her PhD in physical chemistry. Her research areas include computational physics and the use of technology in teaching and learning in higher education.