

# A Comparative Study of Student Performance in Traditional Mode and Online Mode of Learning

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**ABSTRACT:** There has been interest for many decades in comparing the effectiveness of technology-delivered instruction with traditional face-to-face teaching and measurable student outcomes have been an important indicator. Having pointed to salient aspects of the current academic environment and to some of the key literature in this area, this article analyses the performance of two groups of students studying in the traditional mode and the online mode in a masters program delivered by a Department of Computing at a university in Hong Kong. Over 2,000 students have participated in the study between 2000 and 2004. This article includes a comparison of the results between different delivery modes of study each year as well as between different classes over the 4-year period. Although traditional mode students have achieved a slightly better performance in examinations in comparison with online mode students, the article concludes that there are no significant differences in overall performance between the students. With the impact of technologies on higher education and the demands of a complex and rapidly changing society in the 21st century, this Hong Kong study contributes to the literature that finds mode of study is not a key determinant of success. © 2007 Wiley Periodicals, Inc. *Comput Appl Eng Educ* 15: 30–40, 2007; Published online in Wiley InterScience (www.interscience.wiley.com); DOI 10.1002/cae.20092

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## INTRODUCTION

### The Changing Environment

Academic educators of the 21st century are facing unprecedented demands to prepare professionals for what is commonly referred to as the “knowledge society.” It is also a “learning society” because new knowledge and new ideas occur almost every moment [1]. At the same time increasing numbers of employed professionals are seeking development of their skills through part-time university education. For this cohort, flexible delivery away from campus attendance has definite attraction. Distance education has a considerable international history from the 1970s of preparing students away from the face-to-face campus [2] but, with the rapid advances of communication technologies and the Internet, students now can access courses online with their material and communication significantly enhanced from the time when print was the medium. Increasingly morphological differences between distance and mainstream education are falling away as technology allows a closer simulation of the usual educational exchange between teacher and student. Moreover, online education is legitimately seen as part of the education of all students, irrespective of their location and mode of study.

It is not only the blurring of demarcations between different modes of education, or the current global economic and political climate of restraint and accountability, that have forced the need for answers to difficult questions. The communications technologies, themselves, with their distortion of time and space and their creation of new information spaces [3] have disrupted our concept of education in profound ways. Educators are increasingly concerned, therefore, with the extent to which the technologies cause a deconstruction and reconstruction of notions of time and place, but also with the extent to which they are used to reconstitute the normative educative experience of the face-to-face classroom (often in an idealized and anachronistic sense) and/or create something that is discernibly new and different. Fundamentally they are concerned that students are not disadvantaged educationally by being taught away from the face-to-face classroom experience on-campus.

### The Research Context

Not surprisingly, since the 1970s when other forms of delivery (such as print, audio, and video) were used for teaching so-called distance students in the higher

education sector, many researchers and educationalists sought to compare these with teaching conventionally. For instance, Blackwood and Trent [4] randomly assigned a group of 71 Kansas university students to either traditional learning situations or telephone instruction. Using pre- and post-tests, they found no differences in the amount of learning between the two groups. Numerous studies undertook empirical investigations of the effects of channel type (i.e., audio, audio plus video, face-to-face) upon outcomes and attitudes and found that as an independent variable one mode of instruction was not significant. Russell cataloged at least 355 comparative studies in the period 1928–1996 and concluded that no one method of delivering instruction is demonstrably, through this research, more effective than another. The No Significant Difference Phenomenon [5] is the most widely quoted source of information in this area. For Russell [6]:

There is so much research on this matter that I find it incomprehensible that any reasonable, knowledgeable, unbiased, and professional person could deny the fact that technology can deliver instruction as well as traditional modes—at least when we look at student populations as large groups.

Russell is now listing studies that show significant difference [7]. While far less substantial than its counterpart, it does identify studies that indicate students using online learning have significantly outperformed those in traditional face-to-face classes. At the same time studies are being released that indicate students who take courses online do less well than their face-to-face counterparts when test results are compared. At Michigan State University, as one example, there was 10 percent poorer understanding by online students taking an economics class [8].

Another high-profile commentator in this area, Tony Bates, has for a long time been very skeptical of the sort of research that consistently found no significant differences. In 1981 Bates contended that most research into the effectiveness of educational media had been “spectacularly unproductive,” “totally unhelpful,” “sterile,” and “impractical for decision-making purposes.” As Bates [9] pointed out, difficulties caused by the lack of adequate theory can be seen by the failure to identify those variables which are most likely to influence experimental outcomes. Consequently the consistent finding of “no significant difference” does not mean that there are, in fact, no important differences due to different media treatments, but that the experimental design is too crude to measure them—“it is an artefact of the design.” A review undertaken by the Institute for Higher

Education Policy [10], of 40 research studies conducted in the 1990s was similarly highly critical concluding that existing research in this area left too many questions unanswered, especially in providing causal connections.

This study, cognizant of such reservations, has identified the variables that are most likely to influence the outcomes such as course materials, school calendar, teaching staff, educational background of students, and it has been framed to provide students with the same experience except in the key area: mode of delivery. However, there is recognition that, as for any group of students, there are a multitude of variables that explain learning outcomes: student learning preference, socio-economic factors, state of health, time of day, ambient temperature . . . and so the list continues. As Ramage [11] concluded:

It is difficult, if not impossible, to apply scientific methods to social science hypothesis. Human cognition has, to date, provided no quantifiable absolutes or baselines from which research can benchmark.

This does not mean that comparative studies, if undertaken in a scholarly way, cannot help us understand more fully the implications of teaching and learning in different modes. In this study, as the discussion below will show, there is recognition of important differences as a consequence of the different method of delivery. There is also recognition that, by choosing to concentrate attention on the performance of students as quantified by results (numerical scores) and to analyze the data with scholarly rigor, we can draw conclusions about the effectiveness of online instruction for these cohorts of students over 4 years.

This article provides further insight into the effects and impacts of study modes including traditional mode and online mode by introducing a comparative study of a masters program in computing. The article begins with an introduction to the research methodologies and then describes the research findings. These findings include a comparison of the results between different delivery modes each year as well as between different classes over the 4-year period. It is followed by discussion and conclusions are drawn from these findings.

## RESEARCH METHODOLOGY

### Data Collection Method

In this research, an approach of comparing the performance in academic records between students

studying the same postgraduate program in the traditional and online mode has been adopted in order to evaluate the effects and impacts of the online learning method.

**Data Source.** To achieve this, a postgraduate program of Master of Science in E-Commerce has been selected as the primary data source in the research. This program is delivered by the Department of Computing of The Hong Kong Polytechnic University in Hong Kong. The program is designed to provide the education and training of a new generation of knowledge and technical workers in e-commerce. It offers students the opportunity to examine various aspects of conducting business as related to networked and on-line commerce, with a focus on the enabling technologies and techniques. The program has been selected for investigation because of the following reasons:

1. The program is delivered to two classes simultaneously: traditional mode (face-to-face teaching) and online mode (non face-to-face teaching) since the academic year 2000/2001. Both classes follow the same school calendar, and they start and end at the same time.
2. The entry requirements of both classes are the same. Students normally have similar educational background and work experience. They usually have a relevant degree with 1st or 2nd class Honors and a minimum of 2 years of relevant IT professional experience.
3. The course design and the learning materials of both classes are identical. Moreover, the materials are designed and delivered by same group of teaching staff.
4. The assessment criteria of both classes are exactly the same. All students are required to participate in the same examination to provide a fair evaluation.

These factors enable the program to be an appropriate object for conducting a comparative study of the two modes of delivery in the research.

**Program Structure.** To be awarded the masters degree, a student should successfully complete a total of 7 taught subjects (21 credits) and a dissertation (9 credits) to receive a total of 30 credits. A list of subjects currently offered in the program is provided in the following table: Table 1.

As shown in Table 1, there are mainly three types of subjects: (i) theoretical, (ii) technical, and (iii) mathematical. The theoretical subjects introduce

**Table 1** Subjects Offered in the Program

Subject code	Subject title
COMP513	Multimedia systems and applications
COMP515	Internet computing
COMP542	Object-oriented methods in information system development
COMP546	Software quality assurance
COMP564	Information system and e-commerce strategy
COMP575	Electronic commerce and applications
COMP578	Data mining and data warehouse

the basic concept and provide in-depth knowledge on a specific topic in a theoretical base. In contrast, the technical subjects provide hand-on programming experience to the students. For example, students are required to design and develop a system in the subject of COMP513. The mathematical subjects involve mainly mathematical formulas and calculations.

Teaching arrangements are shown in Table 2. The traditional mode students have a total of 42 h of contact time in the form of lectures and tutorials. On the other hand, the online mode students have a total of 24 h of contact time in the form of online tutorials and group discussions. Moreover, the assessment of both classes is similar except that 5% of online participation has been allocated to encourage active participation in online tutorials and group discussion.

**Sample Size.** The research data are taken from the academic year 2000/2001 to 2003/2004. A summary of research data is presented in the following table: Table 3.

In the research, the number of samples is mainly based on the number of subject enrolments. As a student will study at least 7 subjects in the program, the number of the sample size will be greater than the total number of students studied in the program. As shown in Table 3, the total sample size is 2,071. Seven hundred ten students and 1,361 students participated in the traditional mode of study and online mode of study, respectively.

**Data Analysis Method**

The approach of comparing the academic records of students is used to evaluate the performance of students enrolled in two delivery modes in the research. Referring to the university academic regulations, performance of students is measured in terms of their grade points in a particular subject according to grading system listed in Table 4.

To compare the two groups, *t*-tests are used to investigate the overall performance of traditional and online students on a subject basis, and the performance of individual groups of students. In addition, the mean scores of the results of the students are used as a measure of whether traditional students performed better, the same, or worse than online students.

**RESEARCH RESULTS**

**Overall Results**

The student examination results have been analyzed following the data analysis method described in earlier. The research results are summarized in the following tables.

Table 5 shows that the significance level values of all subjects except COMP546 are smaller than the value of 95% confidence interval (0.05) and thus, significant differences are reported to exist among these subjects. The mean values range between 2.51 (COMP542, online mode) and 3.16 (COMP564, traditional mode). Moreover, the values of the traditional mode students range from 2.83 (COMP542) to 3.16 (COMP564), and the online mode students range from 2.51 (COMP542) to 3.00 (COMP564). Their ranges are 0.33 (traditional mode) and 0.49 (online mode), respectively. These figures illustrate that the overall mean value of the traditional mode students (3.02) is generally higher than the online mode students (2.77). This indicates that the traditional mode students usually achieve slightly better performance in examination results in comparison with the online mode students.

**Table 2** Teaching Arrangements for the Program

	Traditional mode	Online mode
Teaching	Lecture (2 h) × 14 weeks Tutorial (1 h) × 14 weeks Total: 42 h	Online tutorial (9 h) Online group discussion (15 h) Total: 24 h
Self study	Printing materials	Web-based interactive materials
Assessment	Course work (45%) Examination (55%)	Online participation (5%) Course work (40%) Examination (55%)

**Table 3** Subject Enrolment in the Program

Subject code	Subject title	Delivery mode	Number of samples (N)	Total
COMP513	Multimedia systems and applications	Traditional	85	236
		Online	151	
COMP515	Internet computing	Traditional	159	395
		Online	236	
COMP542	Object-oriented methods in information system development	Traditional	70	222
		Online	152	
COMP546	Software quality assurance	Traditional	56	208
		Online	152	
COMP564	Information system and e-commerce strategy	Traditional	83	343
		Online	260	
COMP575	Electronic commerce and applications	Traditional	108	341
		Online	233	
COMP578	Data mining and data warehouse	Traditional	149	326
		Online	177	

The standard deviation values range between 0.414 (COMP564, traditional mode) to 0.937 (COMP542, online mode). Moreover, the values of the traditional mode students range from 0.414 (COMP564) to 0.803 (COMP515), and the online mode students range from 0.689 (COMP564) to 0.937 (COMP542). Their ranges are 0.389 (traditional mode) and 0.248 (online mode), respectively. These figures show that the overall standard deviation value of the online mode students (0.829) is generally higher than the traditional mode students (0.651). This suggests that the traditional mode students generally have a stronger central tendency toward the mean value in a particular subject. But their performance fluctuates more when compared with other subjects. Further analysis has been undertaken to explore the results between the modes of delivery and the trend of fluctuation over the 4-year period in details. Their results are presented and discussed in the following sections.

**Table 4** Grades and Grade Point of Student Performance

Grade	Description	Grade point
A+	Outstanding	4.5
A	Excellent	4.0
B+	Very good	3.5
B	Good	3.0
C+	Wholly satisfactory	2.5
C	Satisfactory	2.0
D+	Barely adequate	1.5
D	Weak	1.0
F	Inadequate	0.0

### Analysis of the Results Between the Delivery Modes

It is noted that the subjects offered in the program might not be delivered on a regular base and their schedules are summarized in following table: Table 6.

Figures from Table 6 show that the mean values of the traditional mode students are higher, around 8%, than of the online mode students except the classes of COMP515 (01/02) and COMP578 (03/04). Their differences range from the lowest value of  $-0.35$  (COMP578, 03/04) to the highest value of  $0.61$  (COMP513, 02/03). This result is similar to the finding from Table 5 that the traditional mode students have achieved better performance in the examination results in comparison with the online mode students. Moreover, the overall percentage of difference in mean value of COMP513 (13%), COMP542 (10%), and COMP515 (9%) are the top ranking in comparison with others. All these subjects are reported to have the largest discrepancy in examination results. This reveals that the overall performance of traditional mode and online mode students is usually better than the online mode students, which is similar to the findings derived from the Table 5.

Besides, the figures also illustrate that the standard deviation values of the online mode students are higher, around 37%, than the traditional mode students except for the subjects of COMP513 (02/03), COMP515 (02/03), COMP542 (01/02), COMP575 (03/04), and COMP578 (03/04). Their differences range from the lowest value of  $-0.476$  (COMP542, 02/03) to the highest value of  $0.252$  (COMP515, 02/03). In addition, the overall percentage of difference in standard deviation values of COMP564 ( $-77\%$ ),

**Table 5** Summary of the Research Results

Subject	Delivery mode	Number of samples (N)	Standard deviation	Sample mean	Mean difference	Mean difference in (%)	Sig. <sup>a</sup>
COMP513	Traditional	85	0.736	2.99	0.38	13	0.001 <sup>b</sup>
	Online	151	0.868	2.61			
COMP515	Traditional	159	0.803	2.99	0.28	9	0.001 <sup>b</sup>
	Online	236	0.862	2.71			
COMP542	Traditional	70	0.631	2.83	0.32	11	0.011 <sup>b</sup>
	Online	152	0.937	2.51			
COMP546	Traditional	56	0.601	3.14	0.19	6	0.076
	Online	152	0.718	2.95			
COMP564	Traditional	83	0.414	3.16	0.16	5	0.043 <sup>b</sup>
	Online	260	0.689	3.00			
COMP575	Traditional	108	0.588	3.00	0.24	8	0.011 <sup>b</sup>
	Online	233	0.882	2.76			
COMP578	Traditional	149	0.781	3.05	0.20	6	0.031 <sup>b</sup>
	Online	177	0.847	2.85			

<sup>a</sup>Equal variances assumed.

<sup>b</sup>Significant differences existed as the *P* value is <0.05.

COMP542 (−68%), and COMP575 (−59%) are the top ranking in comparison with others. These subjects have the widest dispersion in examination results. This suggests that the overall variance of the online mode students is usually higher than for the traditional mode students, which is also similar to the findings derived from Table 5.

### Analysis of the Results Over the 4-Year Period

In order to investigate the trend of fluctuation in both the traditional mode students and online mode of students over the 4-year period, a comparison between different classes of the same subjects delivered in 2000–2004 was undertaken and their results are summarized in Table 7.

Table 7 illustrates that both traditional and online modes examination results only have a slightly fluctuation over the 4-year period starting from 2000 to 2004. Their percentages of difference in mean value range from the lowest value of −61% (COMP542, traditional mode, 02/03–03/04) to the highest value of 19% (COMP542, online mode, 01/02–02/03) for all classes in the 4-year period. Considering the subjects, their overall percentages of difference in mean value ranges from the lowest value of −28% (COMP542, traditional mode) to the highest value of 7% (COMP578, traditional mode).

Moreover, the table demonstrates that significant improvements in the examination results exist in both traditional mode and online mode classes. For

example, the mean values of COMP578 (online mode, 01/02–02/03) with the significant values of 0.008 increase sharply from 2.60 to 3.02 (−16%).

### DISCUSSION OF THE RESEARCH RESULTS

This study reveals that the examination results of traditional mode students and online mode students are very similar and only some minor differences are reported in reference to results from Tables 5 and 6. This suggests that there are no significant differences in overall performance between them. Nevertheless, the study shows that the traditional mode students usually outperform the online mode students to a limited extent. Two reasons are suggested below:

- Online learning method is different to the traditional method used in most Hong Kong's secondary schools and tertiary institutions. This method is relatively new to local students and they need more time to feel familiar with it.
- The online classes of the program are still in an infant stage while the traditional classes have been implemented for a longer period. Hence, the delivery of the online classes needs to go through the necessary learning curve, which may affect the performance of the students.

The research results also show that the traditional mode students have a stronger central tendency towards the mean value in their examination results.

**Table 6** A Comparison of the Results Between Different Delivery Modes Each Year

Year offered	Delivery mode	No. of samples	Mean [1]				Standard deviation				Sig. <sup>a</sup>
			Value	Diff.	Diff. (%)	Overall (%)	Value	Diff.	Diff. (%)	Overall (%)	
COMP513											
00/01	Traditional	—	—	—	—	13	—	—	—	—19	—
	Online	—	—	—	—		—	—	—	—	—
01/02	Traditional	35	3.01	0.53	18		0.612	-0.291	-48		0.003 <sup>b</sup>
	Online	58	2.48				0.903				
02/03	Traditional	18	3.28	0.61	19		0.712	0.120	17		0.001 <sup>b</sup>
	Online	47	2.67				0.592				
03/04	Traditional	32	2.80	0.09	3		0.831	-0.210	-25		0.684
	Online	46	2.71				1.041				
COMP515											
00/01	Traditional	29	3.07	0.42	14	9	0.942	-0.115	-12	-9	0.081
	Online	48	2.65				1.057				
01/02	Traditional	44	2.75		-0.02	-1		0.686	-0.337	-49	
	Online	60	2.77				1.023				
02/03	Traditional	36	3.04	0.36	12		0.840	0.252	30		0.012 <sup>b</sup>
	Online	67	2.68				0.588				
03/04	Traditional	50	3.13	0.38	12		0.761	-0.022	-3		0.012 <sup>b</sup>
	Online	61	2.75				0.783				
COMP542											
00/01	Traditional	—	—	—	—	10	—	—	—	-68	—
	Online	—	—	—	—		—	—	—	—	—
01/02	Traditional	35	2.89	0.09	3		0.758	0.034	4		0.636
	Online	41	2.80				0.724				
02/03	Traditional	18	2.78	0.50	18		0.428	-0.476	-111		0.028 <sup>b</sup>
	Online	52	2.28				0.904				
03/04	Traditional	17	2.78	0.26	9		0.534	-0.512	-96		0.351
	Online	59	2.52				1.046				
COMP546											
00/01	Traditional	—	—	—	—	4	—	—	—	-17	—
	Online	—	—	—	—		—	—	—	—	—
01/02	Traditional	—	—	—	—		—	—	—	—	—
	Online	38	2.80				0.810				
02/03	Traditional	36	3.17	0.07	2		0.644	-0.052	-8		0.657
	Online	54	3.10				0.696				
03/04	Traditional	20	3.10	0.19	6		0.528	-0.133	-25		0.243
	Online	60	2.91				0.661				
COMP564											
00/01	Traditional	22	3.27	0.28	9	7	0.369	-0.360	-98	-77	0.087
	Online	74	2.99				0.729				
01/02	Traditional	11	3.36	0.21	6		0.323	-0.374	-116		0.319
	Online	61	3.15				0.697				
02/03	Traditional	38	3.03	0.13	4		0.385	-0.321	-83		0.315
	Online	60	2.90				0.706				
03/04	Traditional	12	3.21	0.25	8		0.542	-0.066	-12		0.194
	Online	65	2.96				0.608				
COMP575											
00/01	Traditional	21	2.79	0.09	3	8	0.768	-0.346	-45	-59	0.744
	Online	48	2.70				1.114				
01/02	Traditional	30	2.87	0.24	8		0.540	-0.464	-86		0.233
	Online	61	2.63				1.004				

(Continued)

Table 6 (Continued)

Year offered	Delivery mode	No. of samples	Mean [1]			Standard deviation				Sig. <sup>a</sup>	
			Value	Diff.	Diff. (%)	Overall (%)	Value	Diff.	Diff. (%)		Overall (%)
02/03	Traditional	16	3.16	0.36	11	0.397	-0.315	-79		0.060	
	Online	66	2.80			0.712					
03/04	Traditional	41	3.15	0.24	8	0.539	-0.139	-26		0.061	
	Online	58	2.91			0.678					
COMP578											
00/01	Traditional	42	3.36	—	—	2	0.727	—	—	-8	
	Online	—	—				—				
01/02	Traditional	44	3.13	0.53	17	0.692	-0.309	-45		0.002 <sup>b</sup>	
	Online	83	2.60			1.001					
02/03	Traditional	—	—	—	—	—	—	—		—	
	Online	50	3.02			0.631					
03/04 0.014 <sup>b</sup>	Traditional	63	2.79		-0.35	-13		0.797	0.223	28	
	Online	44	3.14				0.574				
Overall						8				-37	—

<sup>a</sup>Equal variances assumed.

<sup>b</sup>Significant differences existed as the *P* value is <0.05.

In short, the variance of the traditional mode students is smaller and they have a narrower dispersion in examination results in comparison with the online mode students. On the other hand, the performance of online students tends to fall into two extremes although both groups of students have similar backgrounds. One of the possible reasons is that the online mode students have less regular contact hours with lecturers who can closely monitor their progress. They require a higher level of discipline to keep pace with their own schedules and thus, there is a larger variation in their examination results.

Based on the figures from Table 7, the negative figures of percentage difference in mean value indicate that there are improvements in the performance of online students from 00/01 to 03/04. It is because some modifications have been made to improve the program according to the experience gained by teaching staff from previous years. In addition, the table reports an irregular fluctuation in the examination results for both traditional mode students and online mode students. There is insufficient evidence to draw any conclusions regarding the relationship between fluctuation and modes of study in the research.

Online learning has the significant advantage of providing greater flexibility to learners to study anytime, anywhere, and at their own pace. However, this method may result in frustration and isolation with stress and anxiety due to lack of face-to-face interaction. As mentioned before, students are

required to be more disciplined and responsible for their study. Hence, online learning is likely to be more suitable for postgraduate students who are more mature and who have experience with the demands of tertiary study. In addition, the method is beneficial to teaching staff. For instance, it enables staff to deliver the teaching anytime, anywhere, and at their own pace. For example, they can conduct online tutorials for part-time students at home during the weekend. It also enables them to apply the multi-media technology to improve teaching.

Many changes are occurring in our society affecting the ways that we work and live. These changes are leading to a new concept of education for those who have irregular working schedules and strong family commitments. For example, the working environment in Hong Kong is highly demanding. There is a growing trend of people working in the industry who want to improve themselves without leaving their work for an extensive period of time. Hence, more and more students are interested in looking for alternative learning methods, which are of similar quality to traditional learning. This also explains why enrolments in the online classes have been increasing steadily over the past few years.

This study is primarily designed to compare the learning performance of traditional mode students and online mode students by evaluating their academic results in examinations. It is known that areas such as student satisfaction with the use of online learning, and student performance relating to the subject nature

**Table 7** A Comparison of the Results Between Different Classes Over the 4-Year Period

Subject	Delivery mode	Year offered	Number of samples	Mean value	Mean			Sig. <sup>a</sup>	Sig.
					Diff.	Diff. (%)	Overall (%)		
COMP513	Traditional	00/01	—						
		01/02	35	3.01	—	—			
		02/03	18	3.28	-0.27	-9	3	0.166	0.081
		03/04	32	2.80	0.48	15		0.045 <sup>b</sup>	
	Online	00/01	—						
		01/02	58	2.48	—	—			
		02/03	47	2.67	-0.19	-8	-5	0.223	0.363
COMP515	Traditional	00/01	29	3.07					
		01/02	44	2.75	0.32	10		0.099	
		02/03	36	3.04	-0.29	-11	-1	0.091	0.117
		03/04	50	3.13	-0.09	-3		0.613	
	Online	00/01	48	2.65					
		01/02	60	2.77	-0.12	-5		0.549	
		02/03	67	2.68	0.09	3	-1	0.550	0.859
COMP542	Traditional	00/01	—						
		01/02	35	2.89	—	—			
		02/03	18	2.78	0.11	4	2	0.579	0.754
		03/04	17	2.78	0.00	0		0.937	
	Online	00/01	—						
		01/02	41	2.80	—	—			
		02/03	52	2.28	0.52	19	4	0.003 <sup>b</sup>	0.026
COMP546	Traditional	00/01	—						
		01/02	—						
		02/03	36	3.17	—	—	2		0.695
		03/04	20	3.10	0.07	2		0.695	
	Online	00/01	—						
		01/02	38	2.80	—	—			
		02/03	54	3.10	-0.30	-11	-2	0.061	0.121
COMP564	Traditional	00/01	22	3.27					
		01/02	11	3.36	-0.09	-3		0.493	
		02/03	38	3.03	0.33	10	0	0.011 <sup>b</sup>	0.035 <sup>b</sup>
		03/04	12	3.21	-0.18	-6		0.023 <sup>b</sup>	
	Online	00/01	74	2.99					
		01/02	61	3.15	-0.16	-5		0.214	
		02/03	60	2.90	0.25	8	0%	0.055	0.234
COMP575	Traditional	00/01	21	2.79					
		01/02	30	2.87	-0.08	-3		0.660	
		02/03	16	3.16	-0.29	-10	-4	0.066	0.044
		03/04	41	3.15	0.01	0		0.947	
	Online	00/01	48	2.70					
		01/02	61	2.63	0.07	3		0.743	
		02/03	66	2.80	-0.17	-6	-3	0.265	0.354
COMP578	Traditional	03/04	58	2.91	0.11	-4		0.417	
		00/01	42	3.36					
		01/02	44	3.13	0.23	7		0.133	
		02/03	—				7%	—	0.000 <sup>b</sup>

(Continued)

Table 7 (Continued)

Subject	Delivery mode	Year offered	Number of samples	Mean value	Mean			Sig. <sup>a</sup>	Sig.
					Diff.	Diff. (%)	Overall (%)		
	Online	03/04	63	2.79	—	—			
		00/01	—						
		01/02	83	2.60	—	—			
		02/03	50	3.02	-0.42	-16	-10	0.008 <sup>b</sup>	0.111 <sup>b</sup>
		03/04	44	3.14	-0.12	-4		0.354	

<sup>a</sup>Equal variances assumed.

<sup>b</sup>Significant differences existed as the *P* value is <0.05.

have not been covered in the study. Further work will be conducted to explore these aspects in detail in the near future.

## CONCLUSION

Profound changes in the ways that we work and live are leading to a new concept of education for those who have irregular working schedules and both family and employment commitments. Online learning provides greater flexibility to learners allowing them to study anytime, anywhere, and at their own pace. This study illustrates that there are no significant differences in overall performance between students who study in this mode and those who study face-to-face. Although the traditional mode students usually achieve a slightly better performance in examination in comparison with the online mode students, their examination results are very similar with only some minor differences are reported in the research. It is expected that, in the future, there will be more and more potential students interested in online learning method because of its learning flexibility. For this reason, studies such as this offer some reassurance to tertiary educators and to students.

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