Undergraduate Students' Sense of Efficacy, Satisfaction with, and Use of Information Technology

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Abstract

The usefulness of information technology (IT) in supporting student learning has created a plethora of research work. The present study aimed to further enhance understanding on students' experiences in IT-mediated learning environments. The first objective of this study was to examine whether the measure of satisfaction with IT use is consistent with the Rasch measurement model. The second objective was to test a correlation causal model of relationships among students' sense of efficacy, use of and satisfaction with IT. The results offer adequate representation of a commonality in meaning shared by the items, providing support for the construct-related validity of the students' use of and satisfaction with IT facilities. Also, students' use of IT facilities was found to be positively influenced by the variability of their satisfaction with the facilities; students' sense of IT efficacy only exerted indirect effect on their satisfaction, albeit substantially.

Introduction

The usefulness of information technology (IT) in supporting student learning has created a plethora of research work. The literature indicates that IT has been studied in many contexts and settings to show that it promotes learning. While some research concentrates on the utility of particular applications (Goodison, 2002), others examine the learning processes that students would undertake (Sung & Ou, 2002; Zhang, 2002). Still other researchers have focused on the outcomes of IT-mediated learning environment, which include students' sense of efficacy, motivation, and use of IT (Cavanagh, Romanoski, Giddings, Harris, & Dellart, 2003; Seltzer & Bentley, 2001).

However, to date, we are uncertain about the meaning, validity and reliability of the measures, the "satisfaction" with, and "use" of IT." Previous works were based on the collection and summary of students' responses to structured questionnaire items. However, these instruments contain different satisfaction and use items, yielding substantial variation in the interpretations of the constructs. Unlike the routinely-used measures in physical sciences, such as weight and temperature, the current measures of students' use of and satisfaction with IT are sample- and item-dependent (Bond & Fox, 2001). The meaning of these measures, therefore, is context specific, which is not universally shared and understood. Clearly there is a need to develop and use constructs that satisfy the fundamentals of measurement (Andrich, 1988; Bond & Fox, 2001). Such effort would address the shortcoming and, thereby, the application of interval-scaled

measures for comparisons is justified. In addition, the multiple interdependence of students' sense of efficacy, use of IT and their satisfaction is yet to be addressed.

In light of the preceding observations, the present study specifically aimed to (a) examine the extent to which a locally-developed measure of IT use and students' satisfaction with IT facilities for learning fits Rasch measurement model, and (b) empirically validate a model of students' use of and satisfaction with IT facilities.

Method

The student-sample consisted of 1637 students of a public-funded university in Malaysia, representing about 10% of the student population. The pool of items, which were selected for the calibration against the Rasch measurement model, was a synthesis of items appearing in the literature on IT. The initial item-sample of the use of IT comprised 31 items; the number of items on students' satisfaction with the IT facilities was 26.

The Rasch measurement model enables the study to validate the idea that the data, i.e., the students' responses to the proposed suggestions — statements on IT use/satisfaction — represent single psychological constructs; thus, appropriate inference and assignment of meanings could be made on the scores of each construct. The analysis offers a mathematical framework to evaluate the extent to which the data fit the measurement model. It facilitates the estimation of error, reliability, unidimensionality, and difficulty of the items and the ability of the respondents to endorse them. The data were fitted, using *WINSTEPS* version 3.48 (Linacre & Wright, 2000), to the Rasch Model for polytomous data.

The analysis of fit in the Rasch model analysis is defined as the extent to which the patterns of responses observed for individual items conforms to the general expected patterns (McNamara, 1996) and thus provides useful information about the quality of the results. The fit analysis will indicate response patterns that do not correspond with the overall pattern through the misfit item and person. Several guidelines are given to determine the unacceptable departures from expectations (e.g., Bond & Fox, 2001; Smith, Schumacker, & Bush, 1998) and interpretations of items diagnosed as misfitting (e.g., Linacre & Wright, 1994). In this study, all items were considered in the analysis for construct validity purposes.

Structural Equation Model (SEM) was used in this study to validate a measurement model of students' sense of IT efficacy (SE) and to test influences of the SE and students' use of IT on their satisfaction. The variables, students' "use" and "satisfaction" were the summated scores, which were created on the basis of the results of the Rasch measurement analysis. The estimation of the latent variable, students' sense of IT efficacy was on the basis of a set of measured items.

To conduct model estimation, the study used AMOS version 6.0 data-fitting program. The program adopted maximum likelihood estimation in generating estimates of the full-

fledged SEM. In addition, since the program analyzed covariance matrices, the estimation procedure satisfied the underlying statistical distribution theory, thereby yielding estimates of desirable properties. Once the models had been estimated, the study applied a set of measures to evaluate the goodness of fit of each model. The measures, guided by the conventionally accepted criteria for deciding what constitutes good fit, assessed the consistency of the hypothesized model with the empirical data, reasonableness of the estimates, and simplicity of the estimated models.

The consistency of the model with the data was determined using three measures of model fit. The first measure was the chi-square statistic which determined if the nonzero in the residual matrix could have occurred simply due to chance. A "reject of null-hypothesis" decision indicates that the hypothesized model lacks fit, and that the model is somewhat inconsistent with the data. On the other hand, the "fail to reject decision" suggests that the model fits the data. The second index is the root mean square error of approximation (RMSEA). A value of RMSEA, approximating the discrepancy that could be expected in the population, of less than .08, is judged reasonable for a fitting model. Third, the study examined the AGFI, the adjusted goodness of fit index (which is analogous to the adjusted coefficient of determination in multiple regression), with a value of .90 or more reflecting good fit of the model to the data. The study examined the magnitude and direction of individual parameter estimate to determine its reasonableness. This examination sought for offending estimates, such as negative error variances and theoretically inconsistent coefficients, which could undermine the validity of the model.

Results

Students' Use of IT Facilities

The Rasch analysis found that both the items reliability and persons (n = 697) reliability estimates were high. While the internal consistency index for items was .99, the alpha for person was .89, with a standard error of .12 and .02 respectively. The considerably high reliability index for items (r = .99) indicates the high likelihood for the items to be placed similarly in the difficulty continuum if they were given to another set of students of comparable characteristics. From the high item reliability, we have confidence to infer that the instrument developed has a series of items ranging from the more difficult to the easier ones. Similarly, the high person reliability index suggests that an equivalent ordering of student placement is reasonable if similar analysis is conducted on this sample of students using another set of items that measures the same phenomenon.

The calibration of the 28 items demonstrated reasonable fit to the model; item difficulties ranged from 1.37 to -1.50 logits (SD = .62). Analysis of the 28 items in the Students' Use of IT instrument indicated that only one was found to have infit and outfit values of more than 1.6 (Instant messaging). Nevertheless, all 28 items were included in the analysis in order to support construct-related validity of the students' use of IT facilities.

The results showed that the "frequent use of digital camera" was the most difficult item to be endorsed. Additionally, the "frequent use of search engine, www, and word processor" were the least difficult items.

Table 1: Item Statistics of Students' Use of ICT: Measure Order

ITEMS	TOTAL SCORE	COUNT	MEASURE	ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEA CORR.	ITEMS
Digital camera	3468	1679	1.37	.03	1.31	8.3	1.34	7.9	.42	q22g
Thumb drive	4598	1681	.70	.02	1.09	2.9	1.09	2.9	.57	q22d
VCD/DVD	4681	1680	.66	.02	1.02	.5	1.02	.7	.54	q22e
Online forum	4826	1684	.58	.02	.97	-1.0	.99	-.2	.50	q21e
Graphics	5082	1683	.44	.02	.89	-3.8	.90	-3.1	.58	q20d
File/folder backup	5099	1678	.43	.02	.99	-.3	1.00	-.1	.51	q23f
Fime management	5090	1671	.42	.02	.65	-9.9	.65	-9.9	.66	q23d
Wireless Internet	5184	1680	.38	.02	1.14	4.4	1.12	3.6	.57	q22f
Video conferencing	5260	1677	.34	.02	.71	-9.9	.72	-9.6	.64	q23c
Doc processing (PDF)	5415	1687	.27	.02	.94	-1.9	.98	-.7	.53	q20g
Newsgroup	5433	1683	.25	.02	1.00	.1	1.04	1.3	.46	q21d
CD writer/CDROM	5412	1675	.25	.02	.63	-9.9	.64	-9.9	.68	q23b
Antivirus	5526	1688	.21	.02	1.09	2.9	1.18	5.3	.50	q20f
Spreadsheet	5607	1689	.16	.02	1.19	5.9	1.33	9.2	.34	q20b
Doc editing/compose	5784	1676	.03	.02	.88	-4.0	.90	-3.2	.60	q23j
File/folder protect	5799	1676	.02	.02	.81	-6.2	.80	-6.3	.63	q23e
Instant messaging	5940	1681	-.05	.02	1.64	9.9	1.62	9.9	.45	q21f
Web browser (L)	5971	1687	-.06	.02	1.08	2.4	1.06	1.6	.53	q20e
File/folder recovery	5934	1677	-.06	.02	.79	-6.9	.79	-6.5	.59	q23g
LCD projector	5999	1675	-.10	.02	.90	-3.2	.87	-3.9	.56	q23a
Program install/rem	6159	1677	-.20	.03	.82	-5.5	.83	-5.0	.61	q23h
Estab network connec	6305	1677	-.30	.03	1.03	.7	.97	-.8	.59	q23i
Presentation	6626	1688	-.50	.03	.90	-2.9	.91	-2.4	.48	q20c
SMS/MMS	6718	1683	-.59	.03	1.34	8.3	1.31	7.2	.42	q22b
E-mail	7079	1689	-.88	.03	1.36	8.1	1.35	7.7	.35	q21a
Word processor	7317	1690	-1.12	.03	1.34	7.2	1.37	7.5	.36	q20a
World wide web	7358	1690	-1.17	.03	1.11	2.6	1.07	1.5	.43	q21b
Search engine	7621	1690	-1.50	.04	1.12	2.6	1.07	1.4	.37	q21c
MEAN	5755.	1681.	.00	.03	1.03	.0	1.03	.2		
S.D.	915.	5.	.62	.00	.23	5.7	.23	5.7		

Students' Satisfaction with IT Facilities

The Rasch analysis found that both the items reliability and persons (n = 1685) reliability estimates were high. While the internal consistency index for items was .99, the alpha for person was .89, with a standard error of .09 and .05 respectively. The data-to-model fit was satisfactory. Analysis of the 20 items indicated that the instrument measures one common underlying trait with no infit and outfit values found to be greater than 1.6 found in any of the item. The analysis (Table 2) showed that infit statistics (MNSQ) of the items ranged from .68 to 1.43; the average error rate was .03. Table 2 shows that items difficulty ranged from .45 to -.72 logits (SD = .37).

The results showed that the "processing speed" was the least satisfying IT facilities; it was the most difficult item to be endorsed. On the other hand, the facilities related to campus information systems (i.e., academic calendar and course schedule) were the easiest to endorse; the students seemed to be easily satisfied with these facilities. Nevertheless, there is sufficient support for the 20 items to represent students' satisfaction with IT facilities; hence the construct-related validity of the data.

Table 2: Items Statistics of Students' Satisfaction with ICT: Measure Order

ITEMS	TOTAL SCORE	COUNT	MEASURE	ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEA CORR.	ITEMS
Processor speed	5208	1679	.45	.03	1.01	.4	1.02	.6	.57	q29a2
Technical support	5235	1679	.42	.03	.68	-9.9	.69	-9.9	.69	q29b2
AV up-to-date	5190	1665	.42	.03	.94	-1.7	.93	-2.0	.63	q30d
Internet connection	5273	1678	.38	.03	1.10	3.0	1.11	3.2	.60	q29a3
AV technical support	5273	1667	.34	.03	.84	-5.1	.83	-5.2	.65	q30e
IS registration	5312	1675	.33	.03	1.43	9.9	1.44	9.9	.62	q28c
Accessibility	5330	1678	.33	.03	.81	-6.1	.82	-5.5	.65	q29b3
Reliability	5455	1678	.20	.03	.64	-9.9	.67	-9.9	.66	q29b1
Hard disk capacity	5512	1678	.14	.03	.81	-6.1	.82	-5.7	.62	q29a4
AV reliability	5495	1665	.11	.03	.68	-9.9	.69	-9.9	.65	q30c
AV accessibility	5575	1665	.02	.03	.73	-8.8	.74	-8.2	.66	q30b
University's circular	5671	1677	-.03	.03	.96	-1.2	.96	-1.3	.57	q28e
University's event	5719	1677	-.08	.03	1.04	1.1	1.05	1.3	.56	q28f
Memory	5729	1678	-.09	.03	.82	-5.6	.80	-6.1	.60	q29a1
AV availability	5743	1668	-.15	.03	.84	-4.8	.86	-4.3	.61	q30a
Examination results	5961	1677	-.35	.03	1.41	9.9	1.38	9.5	.57	q28d
Intranet/Website	6102	1678	-.51	.03	1.51	9.9	1.43	9.9	.54	q28h
Library	6116	1679	-.53	.03	1.50	9.9	1.49	9.9	.45	q28g
IS Academic calendar	6249	1678	-.69	.04	1.24	6.0	1.23	6.0	.48	q28a
IS Course schedule	6266	1678	-.72	.04	1.15	4.0	1.12	3.2	.54	q28b
MEAN	5615.	1673.	.00	.03	1.01	-.8	1.00	-.7		
S.D.	348.	5.	.37	.00	.28	7.0	.26	6.9		

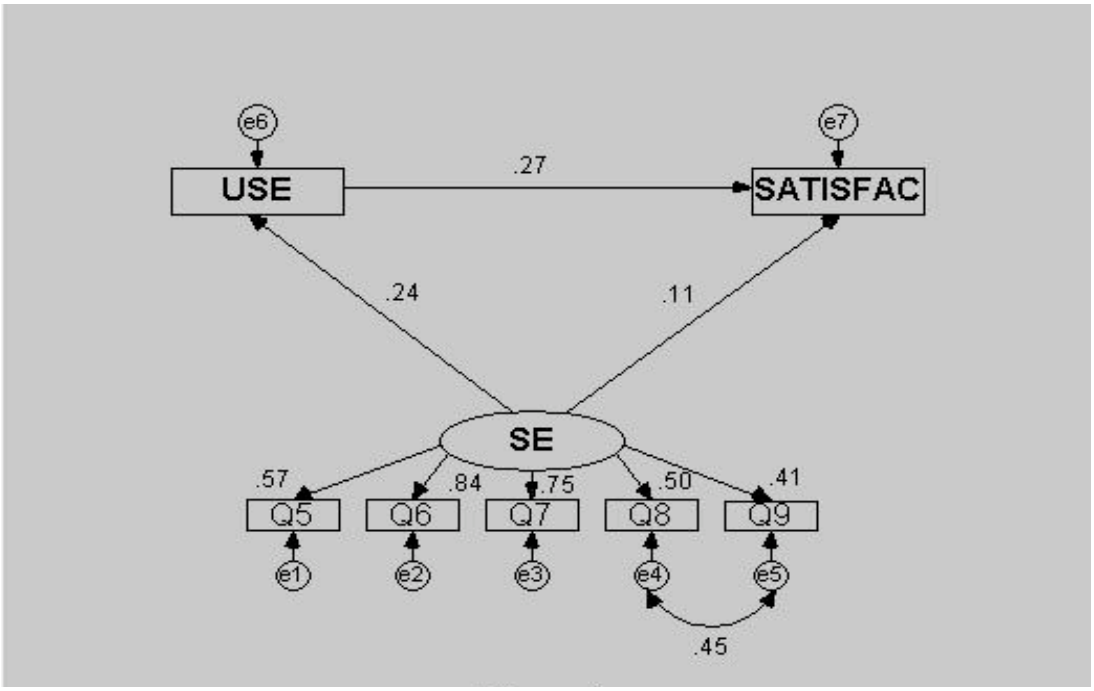
Students' Satisfaction, Use of, and, Sense of IT Efficacy

The results of the structural equation modeling (Figure 1), which used AMOS data-fitting program, supported the hypothesized relationships. Specifically, the analysis found statistically significant path coefficients, implying the following causal links:

- Students' use of IT facilities positively influenced the variability of their satisfaction with the facilities.
- Students' sense of IT efficacy did not affect their levels of satisfaction directly.
- Students' sense of IT efficacy, however, exerted substantial indirect effect on their satisfaction.
- Students' sense of IT efficacy directly and positively influenced their use of the facilities.

The maximum likelihood estimation of the model fitted the data adequately; the results of the chi-square test of overall model fit resulted with a statistically insignificant discrepancy between the model and the data (CMIN/df = 2.695). The other overall fit indices (RMSEA = .09; GFI = .96; AGFI = .90) also supported the adequacy of the model. The model was free from offending estimates. With the exception of the path between SE and students' satisfaction, the parameter estimates were statistically significant at .05 level, and were of practical importance, since each standardized structural coefficient was larger than 0.1. The directions of the estimates were theoretically justifiable.

Figure 1: Students' Use of and Satisfaction with ICT Facilities



1. Q5, Q6, Q7, Q8 and Q9 refer to questions that represent the dimension in the study (please refer to items listed in Table 1 and Table 2.)
2. e1, e2, e3, e4, e5, e6, and e7 refer to the error used to balance the structural equation model in the study (please refer to Table 1 and Table 2.)

Table 3 summarizes the estimated direct and direct effects of the exogenous variables, namely sense of IT efficacy and use of IT.

Table 3: A Summary of Standardized Causal Effects of the Students' ICT Satisfaction Model

Outcome	Determinant	Causal Effects		
		Direct	Indirect	Total
Satisfaction	Use	.268	-	.268
	Efficacy	-	.176	.176
Use	Efficacy	.244	-	.244

Conclusion

Its limitations notwithstanding, the present study further extends the understanding on students' IT-mediated learning experiences. First, the undergraduates' responses to a structured questionnaire yielded valid and reliable measures of students' IT use and

satisfaction with IT facilities. The self-reported perceptions of IT use and satisfaction clearly fit the requirements of the Rasch measurement model. In other words, the data offered adequate support that each of the two set of items is represented by a common meaning; the results of the analysis provide evidences for construct-related validity of students' use of and satisfaction with IT facilities. Thus, the calibrated items would be useful in measuring students' use of, and satisfaction with IT facilities creation of scales, each of which is unidimensional with the properties of an interval variable.

Second, the study found a valid model of undergraduate students' use of IT. The results of the study indicated that students' sense of IT efficacy directly significantly and substantially affects their IT use, which in turn determines their levels of satisfaction with IT facilities. In addition, the study also found that students' sense of IT efficacy exerted substantial indirect effect on their satisfaction.

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