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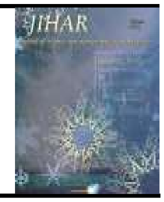

Barriers to ICT use in Science Teaching: A Comparative Analysis of Malaysian and Saudi Secondary School

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Abstract

ICT integration in the classroom is crucial for teachers to function productively in the information age. Investigating the barriers to the use of ICT in teaching, and overcoming them, may help educators become more successful technology adopters in the future. The main purpose of this study was to investigate the most common barriers to technology integration in Malaysian and Saudi secondary schools. The results indicated that Malaysian and Saudi science teachers have a genuine desire to use ICT in their classes; but they encounter serious barriers, such as lack of ICT training and ICT facilities for teachers, and lack of time to learn and master ICT skills. ICT training and facilities have been found to be the critical components of ICT integration in secondary schools. Therefore, the existence of these components will assist to improve ICT integration in teaching and learning in the schools. Generally, this research provides some useful information and recommendations for policy and decision makers in the education sector in Malaysia and Saudi Arabia, for the integration and adoption of new technologies for the teaching of science.

Key Words: *ICT, Integration, Science, Teachers*

1. Introduction

The quest for a better quality of teaching science in schools and universities has become is a priority for teachers, educators, and the government of developing nations. Consequently, most developing countries aspire for technological development because it can lead them to concomitant quality development in various aspects of life. It can be realized through commensurate education and training in schools and higher education institutions, in the teaching of scientific and technological subjects. This is anchored on the fact that technology usage can foster and enhance the teaching and understanding of scientific reasoning and its applications (Doering, 2003). This has made ICT integration into various aspects of education seems promising for teachers and students; that not withstanding, there are barriers to its full integration. Again here, there is a dearth of research conducted in the Kingdom of Saudi Arabia and Malaysia, regarding the most common impediments that hinder teachers' use of ICT in the classroom. Therefore, there is need for more studies geared towards identifying and understanding these impediments, because findings will in no doubt help in discovering strategies that will enable science teachers to employ ICT tools to strengthen their instructional capacity (Beyerbach, 2001; Brandy, 1999) because in most Arab nations and Saudi Arabia in particular, the teaching quality of scientific subjects, such as mathematics, physics, chemistry, biology and general science, has undergone significant fluctuations. Changes that took place in the school curriculum and in the teaching styles, after the digital revolution and the introduction of ICT, particularly in education have been indicted for most of these inconsistencies in the Kingdom of Saudi Arabia. In many other Muslim countries, such as Malaysia, the situation may be similar to what is obtainable in the former because, research has unveiled that Malaysia is confronted with the constrain of inadequate implementation of ICT, mostly in the teaching of scientific subjects such as Physics, Chemistry and Mathematics (Wee & Bakar, 2006) despite the fact that several studies (Mumtaz, 2000; Wachira, 2011; Vrazalic, 2009) have argue that the use of ICT in the science classrooms is essential for providing enhanced science education opportunities for students.

Nevertheless, due to the soaring importance of ICT, the Ministries of Education in both countries have initiated programs to enable the integration of computer technology into teaching, by investing a huge amount of money in a bid to produce the technical equipment towards this end. These efforts are aimed at improving the quality of education, including enhancing the academic level of student's in the public schools (Al-Moussa, 2004; Wee, 2006). ICT tools are capable of achieving this goal because it has benefits such as (Barton, 2004), allowing teachers to organize their teaching in an efficient manner; with multimedia tools, teachers can visualize abstract concepts and create real world simulations to augment students' comprehension of the concepts which enable students to understand the topic better, thereby saving teachers' time in explaining the abstract matters to students; providing teachers with a wide range of resources that are useful for their teaching by directly going to a website for the selection of materials or topics that meet their needs, and enabling teachers through Network building, in solving their teaching problems, broadening their horizon and enhancing their knowledge and professionalism (Etmer, 2006).

By way of extrapolating from the foregoing information's, one can categorically say that teachers ought to play a significant role in ensuring that ICT is successfully implemented in the science classroom. As such, factors that impede science teachers' successful integration of ICT, especially in Muslim countries such as Malaysia and Saudi Arabia, need be investigated and well-understood in a bid for effective ICT implementation strategies to be devised that is capable of promoting better science education for the Muslim *ummah* in general because, despite advancement in digital technologies, science teachers' uptake of ICT remains slow and discouraging, in many parts of the Muslim world, such as Malaysia and Saudi Arabia. The factors that hamper Malaysian and Saudi science teachers' use of ICT are not well-understood, as not enough research has been conducted in this area, especially one that is comparative in nature. The present study was an attempt to address this gap in the ICT barriers literature.

RESEARCH OBJECTIVES

Undoubtedly, the quality of science teaching in schools and universities is a priority for teachers, educators, and the government of developing nations.

With the penetration of ICT into various aspects of education, integrating ICT into classroom teaching and learning has become a necessity. Although ICT integration may sound great and promising for teachers and students, there are barriers to full integration.

The main objectives of this study were as follows:

1. To identify the underlying factors that could explain the slow uptake of ICT technologies among secondary school science teachers in Malaysia and Saudi Arabia.
2. To compare Malaysian and Saudi secondary school science teachers in terms of the factors perceived to be the barriers preventing their use of ICT to teach science.
3. To establish whether common barriers were faced by Malaysian and Saudi secondary school science teachers.

LITERATURE REVIEW

This section is designated for a review of the literature that is related to ICT integration in the teaching of science. It commences with a discussion on the barriers to ICT utilization in teaching science by giving more consideration to school level barriers and teachers' level barriers in reference to Malaysian and Saudi situations. It however culminates by critically looking at the previous studies done in Malaysia and Saudi Arabia on ICT use in the classroom. This is borne out of the fact that generally, the entire world today is witnessing instantaneous and unprecedented rapid development in scientific and technological fields, and most notable of these developments is the use of information and communication devices. Dusick (2000) claimed that this technology breakthrough is one of the most important changes that have occurred in the last three decades, and which has found its way into the world of business, industry, and education. The breakthrough of using ICT and its applications in the educational field has led to the appearance of new terms in the pedagogical field, such as e-learning, virtual class, digital contents, web-based learning and a host of others. In addition, e-learning breakthrough in the 21st Century has played a tremendous role to instructors, who were traditionally regarded as transmitters of knowledge, to take on the mantle of a facilitator, and a mentor (Chang, 2008).

CHALLENGES TO THE TEACHING OF THE SCIENCES

In most Arab countries, learning scientific subjects has always been a challenge due to the fact that its concepts and principles including their application are seen to be highly complex and difficult to comprehend, compared with other subjects. This situation is evident in many other countries, such as Malaysia, where the various scientific subjects are regarded as difficult to learn and could adversely affect students' achievement (Haddad, 1999). Students' negative attitude towards science-based subjects in these countries has been reported to invariably handicap their performance because they have developed anxiety towards learning the science subjects (Yuen, 2008). According to Al-Weshail (1997), the computer related technology consists of applications, telecommunications, and hardware. The result of this study showed a statistically significant difference among faculty members from different fields of specialty in the use of computer and its related technology. Also, the results further indicated that the faculty members possessed generally positive attitudes toward the use of computer and its related technology into their personal and professional tasks. Additionally, Alaugab (2007) explored the attitudes of the female faculty and students towards adopting online learning, its benefits and the barriers that might prevent effective implementation of online instruction. The study revealed that the faculty and students generally have positive attitudes toward online learning. Surprisingly, the students indicated a better and positive attitude towards online learning than faculty members. The study has shown that students who had a home computer were more likely to take courses online. Also, the participants generally agreed that there were several barriers preventing the implementation of online instructions.

Although the pervious literature examined the perceptions of instructors towards integrating different technologies in the area of instruction in Saudi Arabia, and the barriers militating the instructors to use the technologies, there is still a need for investigating the new technologies such as Jusur LMS in Saudi Arabia, and to face a shortage of information to clarify the level of use because, according to Gezahebn (2008), Ismail (2009) and Bingimlas (2009), many factors hamper the teaching of science to students at various levels of secondary schools. These factors are related to human and material resources, methods of teaching and the adopted curricula.

RESEARCH METHODOLOGY

This study employed a cross-sectional survey method in data collection. In a cross-sectional survey, an entire population or a subset of the population under investigation is selected and data is collected to help answer the research questions. This paradigm was opted for this study because it have the capacity of enabling a researcher in gathering information's from subsets of two populations – Malaysian and Saudi secondary school science teachers.

POPULATION

This was comprised of two populations namely, the Malaysian science teachers as first, and their Saudi counterparts as second. The first and second population entails all teachers teaching the various science subjects in secondary schools of both countries.

SAMPLE

The sample of the study consisted of 282 science teachers from Malaysia and Saudi Arabia. Malaysian teachers represented 53.5% of the respondents, while Saudi teachers 46.5%. Gender wise, 33.3% of the total sample of teachers were male, and the remaining 66.7% were female. Moreover, more than half of the respondents (56.5%) have less than 10 years of teaching experience at schools and only 10% had teaching experience of more than 20 years. Regarding

ICT training, 58% of the Saudi teachers and 51% of their Malaysian counterparts, have received some degree or some form of training.

SAMPLING TECHNIQUE

Purposive sampling strategy was used sample. Amongst the 282 teachers criteria such as respondents must be science teachers; must be teaching in public secondary schools in Malaysia and Saudi Arabia respectively; and finally, MUST be teachers who are not using ICT in teaching science at the time of data collection were set as benchmark for being included in the study.

INSTRUMENT DEVELOPMENT

The instrument utilized to investigate the issues raised in this study was a self-developed questionnaire. It was validated by two experts in ICT, a psychometrician, an educational psychologist and a statistician. Statements measuring barriers in using ICT while teaching science in Saudi and Malaysian secondary schools were contained therein. The items were drawn from a number of previous research articles on barriers to ICT use, and previously developed questionnaires on barriers to ICT utilization. The items were phrased to suit the Malaysian and Saudi context of science teaching. A reliability test was performed on the statements involving 31 science teachers by running a Cronbach alpha test on the 27 items, yielding a value of 0.81 for the 27 items, which is considered very high for social science research. Thus, all 27 items were retained for the main data collection.

The questionnaire consisted of two sections. Section A contained six (6) questions related to some demographic characteristics of the respondents, such as gender, computer training, qualification, age, teaching experience including a question regarding the purpose of using ICT. Section B contained twenty-eight (27) statements that reflected the most common barriers faced by science teachers in using ICT to teach. The items were arranged on a five-point Likert scale with the following anchors: “1” = "Strongly Agree", “2” = "Agree ", “3” = "Neutral", “4” = "Disagree" and “5” = "Strongly Disagree."

DATA COLLECTION PROCEDURE

The data were collected using a self-developed ICT-barriers questionnaire. A total number of 200 questionnaires were distributed in Malaysia, and another 200 in Saudi Arabia, to the respondents was done with the help of the headmaster in each selected school. The questionnaires were collected after two weeks of being dropped off at the schools in order to give ample time to all the respondents. Several follow-ups were made to ensure the return of the questionnaire. Finally, the researcher managed to obtain a return of 131 out of 200 questionnaires distributed in Saudi Arabia, which constitutes a 65.5% response rate, while a total of 171 questionnaires were obtained from the Malaysian sample, which constitutes an 85.5% response rate. After scrutinizing the data from every respondent, 282 questionnaires were found to be complete from the 302 returned. Twenty (20) questionnaires had to be taken out due to too many missing values. This figure therefore represents a 70.3% response rate for the study (Table 3.1).

DATA ANALYSIS

In order to address the research questions posed, the questionnaire data were analyzed using descriptive statistics, principal component analysis (PCA) and t-test. Descriptive statistics were used to profile the demographic characteristics of the Malaysian and Saudi respondents, while PCA was employed to extract the factors or dimensions that constituted the barriers to ICT use among the respondents. Following the extraction of the factors using PCA, the mean scores for each factor or dimension were computed for the Malaysian and Saudi samples. A series of t-tests were run on the mean scores of the two groups to identify if significant differences existed between the Malaysian and Saudi respondents with respect to the ICT barriers.

RESULTS/DISCUSSIONS

The findings of the statistical analysis undertaken in the study are presented here in four sections. The first and second sections present the descriptive statistics that describe the demographic profile of the respondents and the type of ICT they use. The third section presents the principal components analysis (PCA) procedures run to extract the underlying factors that constitutes barriers to ICT use in science teaching. The fourth section presents the T-test results to show statistically significant differences between Malaysian and Saudi science teachers with respect to the extracted factors.

PROFILE OF THE RESPONDENTS

Amongst the 282 respondents surveyed in this study 151 are Malaysian and 131 are Saudi, with 33.3% male and 66.7% female, and an average age of 34.6 years and average teaching experience of 9.7 years. Most of them (91.5%) are degree holders, with some having a diploma (4.6%), and a very small number with a master's degree (2.5%). In terms of teaching experience, 78% have less than 15 years of teaching experience. A comparative summary of the Malaysian and Saudi respondents is given in Table 4.1.

TYPES OF ICT USE AMONG MALAYSIAN AND SAUDI SCIENCE TEACHERS

As depicted in figure 4.1, majority of the respondents are familiar with most of the various types of ICT use asked in the questionnaire, such as using the email, online news reading, internet surfing and preparing power point presentations. Less than 15% on both sides reported familiarity with blogging, while only 15% (Saudis) to 25% (Malaysians) are familiar with Skyping. In general, the reported ICT use among the Malaysian and Saudi respondents did not appear to differ markedly. Differences between them are marginal, except with respect to the use of spreadsheets (where twice as many Saudi teachers use them compared to Malaysian teachers), and database (where less than 17% of Saudi teachers reported using it compared to more than 50% of their Malaysian counterparts).

Figure 4.1: A comparative summary of ICT use among Malaysian and Saudi respondents.

FACTORS UNDERLYING THE BARRIERS TO ICT USE AMONG MALAYSIAN AND SAUDI SCIENCE TEACHERS

The data from the 282 Malaysian and Saudi Respondents were subjected to an explanatory principal component analysis (PCA) using the varimax rotation method. This was geared towards determining if there are any independent underlying factors within the ICT barriers data. This is aimed at reducing the number of questions or variables in the questionnaire down to their principal components. For an item to load on a factor, it must have a minimum absolute value of 0.35 and must not load on another factor at an absolute value of 0.35 or greater.

Tests of Assumptions of Principal Component Analysis

The data from the 282 respondents were first analyzed to see whether they fulfilled the assumptions of PCA, namely adequacy in terms of (i) sampling and (ii) inter-correlation among the items.

In terms of sampling adequacy, factor analysis is a statistical procedure that requires a large sample size. It is a method based on the correlation matrix of the variables involved, and correlations usually need a large sample size before they stabilize. Several recommendations have been made regarding the minimum sample size for running factor analysis, but this study has adopted the sample size recommended by Gorsuch (1983), who recommended five subjects per item with a minimum of 100 subjects regardless of the number of items. The present study utilized a questionnaire with 27 items. Therefore the minimum sample size that should be satisfied is 135 respondents (i.e. 27 items multiplied by 5 respondents per item). The total number of science teachers surveyed in the study was 282 and far exceeded the required size. In addition, according to Comrey and Lee (1992), 50 cases is very poor, 100 is poor, 200 is fair, 300 is good, 500 is very good, and 1000 is excellent. Based on this rule of thumb, the present study's sample size is considered good and justified the use of PCA.

The Kaiser-Meyer-Olkin (KMO) measure was used to assess the study's sampling adequacy. This measure varies between 0 and 1, and values closer to 1 are better. To fulfill the requirement for sampling drawn from the data in the study shows a value of 0.858, which met the sampling adequacy requirement of PCA.

Table 4.2 below shows the correlation matrix of the ICT barriers items. The determinant value should not exceed 0. In this study, the determinant of the correlation matrix is 0.00004. Furthermore, Bartlett's test of sphericity produced a statistically significant inter-item relationship ($\chi^2(351) = 2.726E3, P \leq 0.001$) with an overall MSA of 0.858. In summary, these results justified the use of PCA in the data analysis.

4.3.2 Initial Extracted Factors of ICT Barriers

The initial results of PCA produced six factors or components underlying ICT use barriers among Malaysian and Saudi secondary science teachers. The six-factor structure collectively accounted for 57.5% of the variance explained. The portion of variance for each factor is shown in the following communalities presented in table 4.3 below:

Table 4.3

Communalities

		Extraction
1	No ICT facilities in the class or lab	.662
2	Science curriculum not appropriate for ICT	.594
3	Time too short to use ICT	**.489**
4	School does not provide enough ICT facilities	.574
5	Not enough computers for teachers	.594
6	Not provide ICT training for teachers	**.474**
7	Doesn't encourage ICT use	.692
8	Not enough ICT technicians	.555
9	No access to computers at school	.574
10	No Internet access at school	**.498**
11	Have not the required ICT skills	.619
12	Don't know how to teach using ICT	.561
13	Don't feel confident to use ICT to teach	.609
14	ICT requires a lot of time	.619
15	Workload doesn't allow to use ICT	.604
16	No time to learn ICT skills	**.484**
17	Teach just as well without ICT	.591
18	Students learn equally well without ICT	.520
19	ICT doesn't improve my teaching	.524
20	Don't see how ICT helps students to understand science	.695
21	Science classes are too big	.530
22	Troublesome to use ICT	.578
23	Hardware is outdated	.515
24	Software for science is not available	.610

25	Not interested in using ICT to teach	.671
26	Other science teachers do not use ICT	.522
27	Science courseware are written in English	.565

Extraction Method: Principal Component Analysis.

The values in the extraction column indicate the proportion of each variable's variance that can be explained by the retained factors. Variables with values greater than 0.5 were deemed acceptable and variables with values less than 0.5 are not acceptable. In this analysis four (4) items had particularly low values, namely, items 3 (Time too short to use ICT), 6 (Not provide ICT training for teachers), 10 (No Internet access at school), and 16 (No time to learn ICT skills). Therefore, these items are not well represented in the extracted factors.

The initial 6 factor structure extracted through the PCA procedures is presented in Table 4.4 below with the eigenvalues shown in the total column.

Table 4.4

The Extracted Factors and Total Variance Explained

	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.881	25.484	25.484	4.002	14.822	14.822
2	3.242	12.008	37.492	3.250	12.036	26.858
3	1.589	5.884	43.376	2.910	10.777	37.635
4	1.427	5.286	48.662	2.135	7.908	45.543
5	1.278	4.735	53.397	1.772	6.561	52.104
6	1.107	4.100	57.497	1.456	5.392	57.497

Extraction Method: Principal Component Analysis.

The first factor accounted for 25.5% of the variance explained, the second factor 12% of the variance, the third factor 5.9%, the fourth factor 5.2%, the fifth factor 4.7% and the sixth factor

4.1%. To further ascertain an acceptable number of factors to be retained from the extraction, the scree plot and rotated component matrix were examined.

The scree plot shown below has two lines: the lower line shows the number of components, while the upper line shows the total variance explained by the first N components. The principal components are sorted in decreasing order of variance, so the most important principal component is always listed first. The point of interest is where the curve starts to flatten. It can be seen that the curve begins to flatten beyond factor 6. Based on this plot the first six factors have eigenvalues greater than one, thus six factors might be retained.

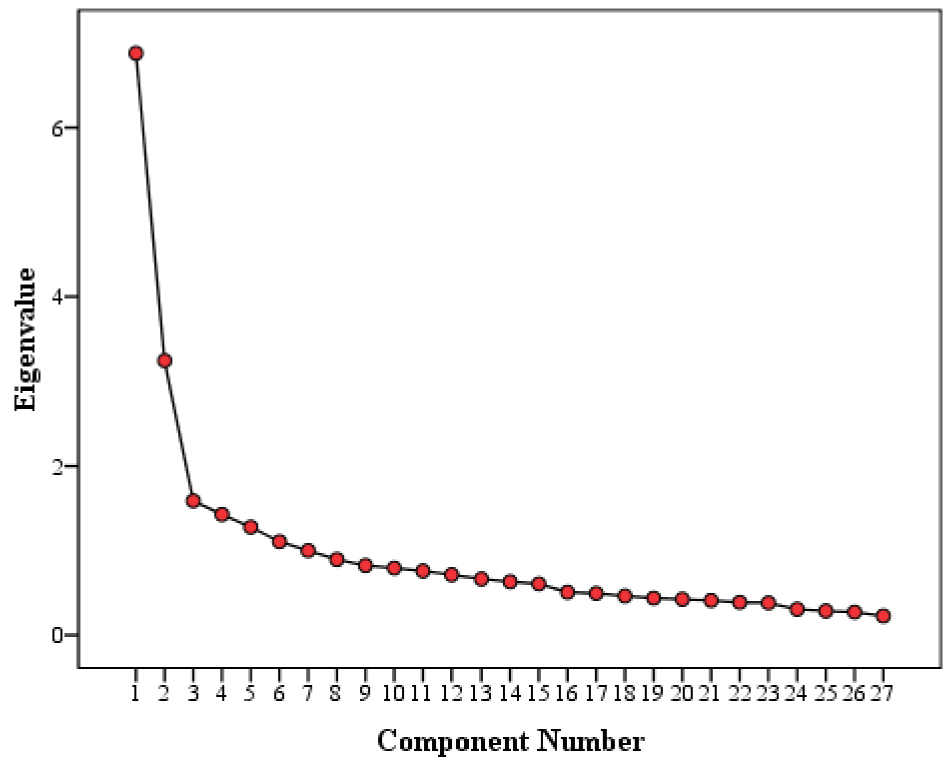

Figure 4.2: The Scree Plot

Additionally, the rotated component factor loadings which are the correlations between the variable and the factor were also employed in determining the acceptable number of extracted factors. Because these are correlations, possible values range from -1 to +1 and values less than 0.5 as well as the common items between more than two factors should be ignored. These loadings are listed in table 4.5 below:

Table 4.5

The Rotated Component Matrix

Items	Components				
	1	**2**	**3**	**4**	**5**
1 No ICT facilities in the class or lab		.716			
2 Science curriculum not appropriate for ICT	.434				.526
3 Time too short to use ICT		.455			.453
4 School does not provide enough ICT facilities		.645		.383	
5 Not enough computers for teachers		.645			
6 Not provide ICT training for teachers				.481	
7 Doesn't encourage ICT use	.523				.415
8 Not enough ICT technicians		.554			.427
9 No access to computers at school		.690			
10 No Internet access at school		.628			
11 Have not the required ICT skills	.685				
12 Don't know how to teach using ICT	.633				
13 Don't feel confident to use ICT to teach	.680		.374		
14 ICT requires a lot of time			.681		
15 Workload doesn't allow to use ICT			.697		
16 No time to learn ICT skills			.602		
17 Teach just as well without ICT			.671		
18 Students learn equally well without ICT			.604		
19 ICT doesn't improve my teaching	.628				
20 Don't see how ICT helps students to understand science	.760				
21 Science classes are too big					
22 Troublesome to use ICT					
23 Hardware is outdated				.652	
24 Software for science is not available				.719	
25 Not interested in using ICT to teach	.744				
26 Other science teachers do not use ICT				.540	.402
27 Science courseware are written in English					.702

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 10 iterations.

However, the results shown in the above table indicated that the last two factors (factor 5 and 6) cannot be accepted since factor five contains only two items with a correlation greater than 0.5, one of which crossloaded on factor one (item2: the science curriculum is not appropriate for ICT use), while factor six has only two acceptable items. For a factor to be meaningful there should be at least three items that represent it. Therefore, factors 5 and 6 were removed from the analysis, leaving a four-factor solution shown in table 4.6. For each factor, only items with no cross-loading were retained to represent the corresponding factor. The guidelines for interpreting significant loadings provided by Hair et al. (2010) state that a loading above 0.35 is considered statistically significant for a sample size of 250 or more. Based on this rule of thumb, all items with cross loadings greater than 0.35 were removed.

Table 4.6

The Four Latent Factors Related to ICT Integration

Factor	Items	Loadings	Mean	SD
1	Don’t see how ICT helps students to understand science.	0.760	3.55	0.856
	Not interested in using ICT to teach	0.744		
	Have not the required ICT skills	0.685		
	Don’t feel confident to use ICT to teach	0.680		
	Don’t know how to teach using ICT	0.633		
	ICT doesn’t improve my teaching	0.628		
2	No ICT facilities in the class or lab	0.716	2.76	0.92
	No access to computers at school	0.690		
	Not enough computers for teachers	0.645		
	No Internet access at school	0.628		
3	Workload doesn’t allow ME to use ICT	0.697	2.80	0.82
	ICT requires a lot of time	0.681		
	Teach just as well without ICT	0.671		
	Students learn equally well without ICT	0.604		
	No time to learn ICT skills	0.602		
4	Software for science is not available	0.719	2.82	0.84
	Hardware is outdated	0.652		
	Not provide ICT training for teachers	0.481		

Labeling of the Factors

The factors were labeled based on the characteristics they share and the idea they commonly describe.

A) Factor 1: Attitude Towards ICT Use

This factor accounted for 25.48% of the variance explained. Items that loaded on this factor were: teachers don't see how ICT helps students to understand science (0.76), teachers are not interested in using ICT for teaching (0.744), teachers not having the required ICT skills (0.685), Don't feel confident to use ICT to teach (0.68), teachers not knowing how to teach using ICT (0.633), and teachers believing that ICT doesn't improve their teaching (0.628).

B) Factor 2: Access to ICT Facilities in Schools

This factor explained 12% of the total variance. Items that loaded on this factor were the lack of ICT facilities in the class or lab (0.716), lack of computers for teachers (0.645), lack of access to computers at schools (0.69), and lack of Internet access at school (0.628).

C) Factor 3: Beliefs about ICT

This factor contributed 5.88% of the total variance explained. Items that loaded on this factor were: ICT requires a lot of time (0.681), workload doesn't allow teachers to use ICT (0.697), lack of time to learn ICT skills (0.602), teachers can teach just as well without ICT (0.671), and students learn equally well without ICT (0.604).

D) Factor 4: Technical Support for ICT Use

This factor explained 5.28% of the total variance of the combined factors. Items that loaded on this factor were hardware is outdated (0.652), software for science is not available (0.719) and lack of ICT training for teachers (0.481).

DIFFERENCES BETWEEN MALAYSIAN AND SAUDI SCIENCE TEACHERS WITH RESPECT TO THE FACTORS UNDERLYING THE BARRIERS TO ICT USE

To find out the differences between Malaysian and Saudi science teachers with respect to the four extracted factors, their factor scores and means were computed. After computing the factor scores and means for the Malaysian and Saudi samples, four independent sample *t*-tests were run to investigate the variation in the four factors (Attitude towards ICT use, Access to ICT facilities, Beliefs about ICT and Teaching support for ICT Use), between Malaysian and Saudi science teachers. The results of the *t*-test are shown in the following table:

Table 4.7

Independent Sample *t*-Tests Results for the Extracted Four Factors between Malaysian and Saudi Science Teachers

Factor	*t*	*df*	*P-value*
1. Attitudes towards ICT use	-0.098	280	**0.922**
2. Access to ICT Facilities in Schools	7.261	280	**0.000**
3. Beliefs about ICT	0.821	280	**0.412**
4. Teaching support for ICT Use	3.561	280	**0.000**

The results of the *t*-tests, reveals a strong evidence that Malaysian and Saudi secondary schools science teachers did not differ significantly in terms of their attitude towards ICT use ($Mean_{Saudi}$= 3.55 and $Mean_{Malaysia}$=3.54) and believes in ICT use ($Mean_{Saudi}$= 2.75 and $Mean_{Malaysia}$=2.83), but the difference is significant in terms of technical support for ICT use ($Mean_{Saudi}$= 2.63 and $Mean_{Malaysia}$=2.98) and access to ICT at school ($Mean_{Saudi}$= 2.37 and $Mean_{Malaysia}$=3.1).

RECOMMENDATIONS AND CONCLUSION

Based on the findings of this study the Ministries of Education in Malaysia and Saudi Arabia should ensure consistent provision and availability of ICT facilities across all national secondary schools. The provision of enough ICT facilities will assist teachers in the two countries to implement effective teaching and learning in the classroom. The move will also fall in line with the Ministry of Education's goals to enhance the quantity and quality of education through greater ICT utilization and integration in schools. Additionally, the following recommendations are suggested for school management and future research directions:

A) School management:

In terms of the ICT facilities available at Malaysian and Saudi secondary schools, the directors should make some intervention to standardize the availability of ICT facilities across the schools. More efforts should be made to provide the technical support for ICT as well as the access to ICT facilities. School managements may identify the ICT requirements of science teachers in which they can carefully assess and identify whether the ICT facilities they wish to purchase would be relevant to what science teachers need to enhance their teaching performance.

References

Alaugab, A. M. (2007). *Benefits, barriers and attitudes of Saudi faculty and students toward online learning in higher education*. Unpublished doctoral dissertation, University of Kansas, United States of America.

Al-Moussa, A. (2004, March 22). The integration the information technology to Gulf cooperation council countries. *Al-Riyadh Newspaper*, p. 10.

Al-Weshail, A. S. (1997). *Use and integration of computer related technology by faculty members at the Institute of Public Administration in Saudi Arabia.* Unpublished doctoral dissertation, Mississippi State University, United States of America.

Barton, R. (2004). *Why use computers in practical science? Teaching secondary science with ICT.* New York: Open University Press.

Beyerbach, B., Walsh, C., & Vannatta, R. (2001). From teaching technology to using technology to enhance student learning: preservice teachers' changing perceptions of technology infusion. *Journal of technology and teacher education*, 9(1), 105- 127.

Bingimlas, K. A. (2009). [Barriers to the successful integration of ICT in teaching and learning environments: A review of the Literature]. *Eurasia Journal of Mathematics Science and Technology Education,* vol.5, no.3, 234-245.

Brandy, T. (1999). *So what? Teaching children what matters in math*. Portsmouth: Heinemann.

Chang, C. L. (2008). *Faculty perceptions and utilization of a learning management system in higher education.* Unpublished doctoral dissertation, Ohio University, United States of America.

Comrey, A. L. & Lee, H. B. (1992). *A first course in factor analysis* (2nd edn.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Doering, A., Huffman, D. & Hughes, J. (2003). Are We Thinking with Technology? *Journal of Research on Technology in Education*, 35, 6-19.

Dusick, D.M. & Yildirim, S. (2000). Faculty computer use and training: identifying distinct needs for different populations. *Community College review,* 27(4), 33-47.

Etmer, P. A. (2006). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development,* 53(4), 25-39. http://dx.doi.org/10.1007/BF02504

Gezahebn, Y. B. (2008). *Barriers to teaching and learning mathematics in grade four*. Norway: University of Oslo.

Haddad, W. D. & Jurich, S. (2002). *The potential of technologies for the enhancement of science and mathematics teaching and learning*. Paris: UNESCO and AED

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data analysis*. New Jersey: Prentice Hall.

Ismail, R. T. (2009). Teachers' views on factors affecting effective integration of information technology in the classroom: developmental scenery. *Journal of Technology and Teacher Education,* 16, 233–263

Mumtaz, S. (2000). [Factors affecting teachers' use of Information and communications technology: a review of the literature]. *Journal of Information Technology for Teacher Education,* vol.9, no. 3, 319-341

Vrazalic, L. (2009). E-learning barriers in the United Arab Emirates: Preliminary results from an empirical investigation. *IBIMA Business Review*, (4), 232-244.

Wachira, P., Keengwe, J. Onchwari, G. (2008). Mathematics pre-service teachers' beliefs and conceptions of appropriate technology use. *Assoc. Adv. Computer and Education Journal*, 16(3), 293–306.

Wee, M. C. & Abu Bakar, Z. (2006). Obstacles towards the use of ICT tools in teaching and learning of information system in Malaysian universities. *The International Arab Journal of Information Technology,* 3(3), 203-209.

Yuen, H. K., & Ma, W.K. (2008). Exploring teacher acceptance of e-learning technology. *Asia-Pacific Journal of Teacher Education*, 36(3), 229-243.