

## Technology Readiness of School Teachers - An Empirical Study of Measurement and Segmentation

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### Abstract

Technology Readiness Index (TRI) developed by Parasuraman was adapted to measure technology readiness of public school teachers in Abu Dhabi, United Arab Emirates. The study aims at better understand the factors (mostly demographics) that affect such readiness level. In addition, Abu Dhabi teachers are segmented into mainly five groups with the highest percentage being “laggards” and “explorers”. The findings of this study suggest that the TRI could be considered a cross-culturally valid measurement scale for Abu Dhabi teachers too. Sample of study was (796) teachers in (105) different public schools. The teachers’ overall mean technology readiness level was (3. 5767). With regard to TRI self-perception, there are no significant differences across subject area of the teachers and the grade level they teach. There are significant differences with regard to teacher’s gender, background (nationality), and the number of students a teacher is responsible for. Other variables such as teacher’s age, experience, education, and work location had partial effects.

**Keywords:** Technology readiness index; TRI; Technology integration; Teachers; Public schools; Teacher segmentation; Abu Dhabi

### Introduction

Most educators define the integration of Information and Communication Technology (ICT) into education as using ICT effectively and efficiently in all dimensions of the educational process including the necessary infrastructure, curriculum and teaching-learning environments [1-3]. In order to realize the potential benefits of ICT, it is imperative that school teachers receptive to the integration of new technologies into their teaching practice settings. The literature currently suggests information on technology to be integrated throughout the curriculum and not taught as a separate course [4]. This method allows students to incrementally develop an understanding of the importance of ICT in their studies.

Many studies have addressed the challenges that exist when integrating technologies into education. Some of the challenges are budgetary, and some are related to skills, attitude and experience. Summaka, et al. [2] has summarized a list of such challenges as lack of computers, lack of time, technical difficulties, poor funding, resistance to change, poor administrative support, low levels of computer literacy technology misaligned with the curriculum, lack of incentives, poor training opportunities, and lack of vision as to how to integrate technology into learning processes and, teacher related difficulties such as negative attitudes, beliefs and unwillingness towards technology. Other studies have confirmed these difficulties [5-13].

Many believe that success of technology integration and effective use of technology in education mostly depends on teachers’ willingness to adoption, and attitudes toward technology [14-18].

Parasuraman [1] developed the Technology Readiness Index (TRI) to measure consumers’ enduring propensities to embrace new technologies. He introduces four dimensions of technology belief that impact an individual’s level of techno-readiness. The four dimensions are optimism, innovativeness, discomfort, and insecurity. Both the optimism and innovativeness dimensions are referred to as being drivers of technology readiness, whereas discomfort and insecurity

as inhibitors. The construct can be viewed as an overall state of mind resulting from a gestalt of mental enablers and inhibitors that collectively determine a person’s tendency to use new technologies.

For teachers in a school, we may refer to “optimism” as a teacher who has a positive view of technology and a belief that it offers students and teachers increased control, flexibility, and efficiency in their lives in the school and at home; to “innovativeness” as a tendency to be a technology pioneer and thought teacher and leader in the classroom and outside; to “discomfort” as a perceived lack of control over technology and a feeling of being overwhelmed by it; and to “insecurity” as distrust of technology and skepticism about its ability to work properly in the class and outside.

Further, people can be segmented into distinct groups based on their patterns of scores on the four dimensions. Based on cluster analyses of TR scores on the four dimensions, Parasuraman, et al. [19] have identified five distinct customer segments, which they label as explorers (who are lead users most prone to adopt and experiment with new technologies), pioneers (in decreasing order of adoption propensity), skeptics, paranoids, and laggards.

In Abu Dhabi, the reform agenda that started in 2008 has focused on many strategic initiatives on educational technology. Some objectives regarding education system in the New School Plan (NSP) indicate strengthening ICT infrastructure in schools and developing methods for supporting to use ICT in classrooms with optimum integration in the various curriculums starting from cycle I (as Phase

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I). The Abu Dhabi Education Council (ADEC) has financed many projects to achieve technology integration in educational settings in Abu Dhabi. These initiatives included the infrastructure upgrading of all public schools in Abu Dhabi, the start of the iClass project, and the integration of technology in curriculum.

The importance of this study is based on many essential assumptions that are based on previous research. Yalcin, et al. [20] point out that teacher pedagogical belief is an important variable that influences teachers' use of technology in the classroom. Also teachers' attitudes and beliefs toward technology are of great importance in their decisions to adopt and frequently use technology in the classroom [14]. The (forthcoming) point out that perceived self-efficacy of teachers play an important role in many aspects related to school environment. The efficacy of teachers with regard to technology use and integration in class will enhance the effectiveness and self-belief of teachers in their teaching capabilities, especially in this environment where children are highly engaged with technology at home and outside the school. Changing teachers' use of technology requires changing their beliefs about technology [21]. Integration of technology into education, self-efficacy beliefs toward technology integration have been theorized to be a determining factor in how well a teacher is able to effectively use technology to improve teaching and learning [22]. The positive attitude of teachers will help teachers use more instructional technology tools and make learning more interesting and attractive for their students [20]. As they will be proficient in using different kinds of technological devices, their lessons will be more fun and students will be able to benefit more from the lessons [23]. The teachers, who have negative attitudes towards technology, are not expected to benefit well in this field and to insert efficiently the technology to education-teaching environment [24].

For ADEC, effectively segmenting and targeting teachers based on their likelihood to integrate the use of technology in their classes could help it better capitalize on their ICT investments in the schools by maximizing the effectiveness of teacher professional development programs. The results could help ADEC decision makers on designing best means of integrating technology into teacher preparation and preparing teachers to do the same in their classrooms. In addition, it helps in the efficient and effective utilizing of school resources.

This study explores the technological readiness of teachers. It has several major objectives:

- Test the validity of the TRI introduced by Lam, et al. [18] and explore the possibility of using a modified version of the TRI to find out technology readiness level of Abu Dhabi public school teachers.
- Further classify technology users (teachers) into five technology readiness segments, namely, explorers, pioneers, skeptics, paranoids, and laggards.
- Identify the relationship between teachers' technology readiness level and their demographic variables such as gender, age, nationality, education, years of experience, marital status, grade or cycle taught, number of students taught, school location, subject taught, specialization, and technology self-rating. In addition, the study will cluster the study sample into five segments of explorers, pioneers, skeptics, paranoids, and laggards.

## Literature Review

Studies of Parasuraman's [1] technology readiness concept are widespread. The areas of application mostly include business marketing

domain where research focuses on identifying segments of the market that are likely to adopt new technologies such as mobile data services [25]. Other areas of application include consumer marketing [19,26] internet acceptance models [27]; accounting related consumers [28], human resources [29], distance education [30], healthcare, construction [31], hotel industry [32], small business [33], banks [34] and online insurance [35], among others. In most of the studies, the authors found the technology readiness model to be effective for studying respondents' propensity to adopt new technologies. Many have called for further validation and extension of the TRI to increase its generalizability [30,34,36,37].

Some studies examined the relationships between technology readiness and technology acceptance by using an aggregated measure of the four TR constructs [38]. These approaches may have limited value, because the four dimensions clearly have different meanings and relate to different psychological processes underlying technology acceptance [33,39].

Many TRI studies attempted to test the effect of other demographic or related variables on the dimensions of this instrument. Research on technology acceptance suggests that individual' personality, as well as demographics, may affect the acceptance ([1,33,39,40]. In the education context, the TR relates to how prepared teachers are for a new technology or integration of technology to be used in the classroom.

A significant effect was observed among respondents regarding gender and the various dimensions of TRI or overall TRI. In most cases and applications, males reported a significantly higher mean score than females (Summaka, et al. [2] - primary school teachers; [31] - healthcare students).

With regard to age, some studies found significant differences between younger and older respondents. Summaka, et al. [2] found no significant differences in terms of technology readiness across age of the teachers. Lee, et al. [41] also found no significant differences when applied to electronic business. Parasuraman, et al. [19] have found that skepticism about technology to be higher among older users of technology as they feel utilizing new technology to accomplish tasks does not necessarily yield a better outcome. Caison, et al. [33] found TR scores to go lower as age increases. They found beginning medical nursing students in Canada above 25 years old to have a negative technology readiness score while those under 25 had a positive technology readiness score.

Only limited number of studies looked at the effect of nationality (or race) on technology readiness. Ramayah, et al. [42-45] found no significant differences when applied in the small business environment. Colby, et al. [46] found a higher proportion of pioneers among African Americans, while Latinos had the highest percentage of skeptics. Interestingly though, the overall level of technology readiness was equal for all three groups.

With regard to highest education attained, studies in small business management found that managers with Master's level education tend to experience less insecurity compared to the lower educational group. The overall TRI score shows that managers with a degree-level education have a higher technology readiness as compared to lower education achievers [42]. Summaka, et al. [2] found no significant differences in terms of technology readiness across subject area of the teachers.

Based on our extensive search of the literature, there was no evidence of any exploring the effect of self-assessment, work location, number of

students, and marital status. Based on individual's technology readiness score and the TRI, Parasuraman, et al. [19] used cluster analysis to further classify technology users (customers) into five technology readiness segments, namely, explorers, pioneers, skeptics, paranoids, and laggards. They stated that "explorers" are highly optimistic and innovative; they score high in technology readiness; "pioneers" are relatively early adopters of new technology but are simultaneously held back by inherent discomfort and insecurity; "skeptics" are fairly techno-ready; they are lowly motivated and need to be convinced of the benefits of using the emerging technology; "paranoids" are the insecure who are later adopters of new technology; and "laggards" are the resistant ones, who are likely the last adopters of new technology [19,27].

Lee, et al. [41] used the TR Index to serve as an insight into a person's own motivations and inhibitions regarding the adoption of technology [18]. The TRI is calculated where the discomfort and insecurity item-scores are subtracted from the optimism and innovativeness item-scores. For the current study we are using a total of 35 items where 16 items are considered contributors, and 17 are considered inhibitors.

TRI applications to education systems, particular involving teachers have been limited. Summaka, et al. [2] used the TRI to assess the technology readiness of the primary school teachers in Gaziantep, Turkey. They also examined the demographics of the teachers to determine the effect of demographics on the technology readiness level. The TRI developed by Parasuraman was adopted to measure technology readiness of the teachers. Sample of study was 207 teachers in 11 different schools. The teachers' overall technology readiness level was moderate. Lai [31], based on the technology readiness index found that professional accounting students were neither highly techno-ready nor highly techno-resistant towards new technologies. Overall, the survey found that the respondents had moderate level of internet self-efficacy and computing experience.

Scholarly research focusing on technology readiness of teachers is scarce. Moreover, extensive studies focusing on the factors that affect TR of teachers is limited too. Therefore this study is important in providing more insights by providing an international understanding of technology readiness of teachers and creating a general awareness to the subject. It will test the applicability of the TRI for public school teachers in Abu Dhabi. The study will utilize the specification of the four diminutions of TRI to construct profile segmentation of teachers. The study further will explore the relationship between teachers' technology readiness level and their demographic variables.

## Methods

### Study sample

The target population for this study was Abu Dhabi public school teachers during the school year 2012-2013. All public school teachers were invited to participate in the online survey that was posted on ADEC website for three weeks. The survey was available in both Arabic and English versions. All teachers in ADEC are registered in the ERP system. Teachers were contacted with emails and Short Mobile Messages (SMS). The school principals also were sent a letter from the ADEC Director General asking them to encourage their teachers to participate. The samples also included others that have other responsibilities besides teaching. They included cluster managers and Heads of Faculties.

A total of 796 teachers responded to the survey. Some teachers did not respond to some of the questions. As a result, the total responses for each question were different from the total responses. Percent of

male teachers was 42.1% with 57.9% female teachers. The average age of respondents was 37.6 years. About 78.2% of the teachers had college degrees, while 16.5% of them had master degrees. The rest had pre-college diplomas (2.9%) or doctorate degrees (2.4%). The teachers came from 10 different nationalities. About 43.7% were national UAE teachers, 38.1% other Arab nationals, and 11.9% Westerners. Teacher's experience ranged from 1 to 40 years, with a mean of 15.08 years. About 84.4% of the teachers were married. The teachers came from KG (15.49%), Cycle I (32.9%), Cycle II (35.2%), and Cycle III (16.4%). The teachers represented all three education zones in Abu Dhabi. About (34.2%) of the teachers came from Al Ain zone, (51%) from Abu Dhabi zone, and (14.7%) from the Gharbia zone. The teachers taught a range of 20 subjects.

### Study instrument

The 36-item TRI [1] was used in this study with written permission of A. Parasuraman and Rockbridge Associates, Inc., 1999. TRI was adapted into Arabic language-translation. Reverse translation was used to check for similarity and consistency. Discomfort and insecurity components' scores were reversely coded due to the negative meaning of their statements. The items on both dimensions are positively worded in favor of the human-element away from the technology-factor.

The Cronbach reliability alphas for the four dimensions (36-items) were (0.812) for optimism statements, (0.559) for innovative statements, (0.703) for insecure statements, and (0.720) for discomfort statements. It is obvious that the coefficient for innovative statement is below the acceptable level. However, when one item, "It seems your friends are learning more about the newest technologies than you" is removed from that dimension, the reliability jumps to (0.764). As a result, a modified version is used with 35-items only. The split half reliability for the 36-items was (0.802), and for the 35-items was (0.805).

Respondents were asked to rate their degree of agreement on a 5-point Likert scale for each item (i.e., 1 = strongly disagree, to 5 = strongly agree) and complete 12 demographic questions.

### Analysis Methods

The current study used a 35-item version with one item being removed from the second dimension. After appropriate reverse coding, a factor analysis is run with regard to each dimension separately to test if the dimension would split into more than one unique dimension.

Descriptive statistics (means and standard deviations) were obtained for all items and dimensions in the survey.

In this study we will use the segmentation suggested by Parasuraman, et al. [19] and Lee et al. [41] to find out the percent of respondents falling within each of the five segments. Cluster analysis will be used for that purpose.

An independent-samples t-test will be conducted to compare level of technology readiness of teachers in terms of gender, and marital status.

To test differences between groups (in terms of age, education level, nationality, subjects taught, years of experience, teaching cycle, work location, and TRI self rating), the Analysis Of Variance (ANOVA) test will be used.

Since optimism and innovation are considered by Parasuraman [1] to be contributors to technology readiness while discomfort and insecurity are inhibitors, it is possible to determine a total technology readiness score by designating the inhibitors as having negative values



while the contributors have positive values [23]. For the original TRI instrument without the reversing of items, by subtracting the inhibitors from the contributors, a mean total Technology Readiness (TR) score can be calculated. A positive TRI reflects a preponderance of teachers' attitudes and opinions suggestive of a "technology ready" orientation, while a negative mean TRI suggest a "non-technology ready" orientation. This method will be used to assign teachers as "technology ready" or "non-technology ready".

In addition, cluster analysis will be used to segment the responding teachers to the five categories of explorers, pioneers, skeptics, paranoids, and laggards as suggested by Parasuraman, et al. [19]. The segments will be categorized also with regard to the four dimensions of TRI.

After obtaining the results of the study, several focus group discussions were held with teachers of different backgrounds. Their comments will be added appropriately in the discussion suction.

## Results

Each hypothesized dimension was subject to a factor analysis to check if the dimension would form one dimension only. Factor Analysis (FA) of optimism with a Varimax rotation, yielded a unique factor with 62.33 percent of the variance explained. FA for innovativeness also yielded a unique factor with 60.41 percent of the variance explained. Meanwhile, FA for the discomfort dimension yielded a single factor with 59.59% of the variance explained. However, FA for the insecurity dimension yielded three different factors with 54.77% of the variance explained. This result indicated that future analysis might require splitting the dimension into three factors. However, it was decided to depend on the CFA result of the four dimension model (without splitting the insecurity dimension) to make the final decision on whether to split the dimension or not.

Next, confirmatory factor analysis was conducted to further test the factor structure of the modified TRI (TRI with one element missing from innovativeness). However, to get an acceptable CFA model, it was necessary to add a total of 12 correlated error covariance paths between the variables. The LISREL 8.83 solution provides an adequate fit with (Chi-square of 1381.86, with 569 degrees of freedom, RMSEA of 0.04, GFI of 0.95, and NFI of 0.94). As a result of the CFA, it was decided to do the t-test and ANOVA tests without splitting any TRI dimensions.

In Table 1, mean scores and standard deviations of each dimension of TRI are shown. Optimism was rated with the highest mean score of (4.1528). The next highest dimension was innovativeness (3.6116). These were drivers of TRI. It means that optimism and innovativeness dimensions positively affect TRI. In the mean time teachers' optimism level was found to be higher than their innovativeness. Insecurity and discomfort dimensions, inhibitors of TRI, provided mean values of (3.5778) and (2.9647) respectively. The ranking of the means of the TRI dimensions is consistent with other studies conducted in the education environment [35]. Mean of all dimensions of TRI, overall, was (3.5767) with a mean standard deviation of (0. 6001).

The correlation coefficients are also shown in Table 1. All

correlation coefficient is significant at the 0.05 level. The findings of correlation analysis showed that correlations between optimism and innovativeness is high (0.638), as well as between insecurity and discomfort (0.595).

Based on the method employed by Lee, et al. [41] this study used the TR Index to serve as an insight into a person's own motivations and inhibitions regarding the adoption of technology. When the discomfort and insecurity item-scores are subtracted from the optimism and innovativeness item-scores, a better sense of technology ready and non-ready could be better identified. Results show that 64.9% are technology ready, and 35.1% are non-technology ready.

When K-means (the simplest procedure) is run, the data did not cluster very well. When four percentile variables are created using the rank command, and then clustered again, it worked very well. Based on the TRI, and using clusters obtained, the responding teachers were categorized into five different segments, namely explorers, pioneers, skeptics, paranoids and laggards. For Abu Dhabi teachers, explorers make up 21.48% of the sample. They are the most techno-ready of all segment, this group has strong motivations to adopt technology, but with few inhibitions. They are more affluent, younger, and more likely to be male. Colby, et al. [19] asserted that explorers are an easy group to attract when a new technology is introduced; and they will comprise the first wave of customers.

About 15.45% of the sample teachers fall into the pioneer category. Pioneers are highly motivated to adopt technology but at the same time are inhibited by a high level of insecurity and discomfort. They are the most ethnically diverse of any segment. ADEC faces the challenge of helping them overcome their inhibitions to using technology through support, encouragement, training, friendly design, and reassurance. This category of teachers desires the benefits of the new technology in the class but was more practical about the difficulties and obstacles involved. Teacher pioneers need help in making the technology work for them and require some degree of assurance, and were usually the next group in line to try new technology.

Skeptics represent 22.49% of the sample. This group of teachers is not too far behind the pioneers; however, these teachers have few motivations but also few inhibitions to adopt technologies in the class. ADEC should take advantage and convince them of the underlying benefits of integrating technology in teaching and learning. This group did loathe technology, but once they were convinced of the benefits of the technology, adoption came readily because there were a few reasons to hold back.

The paranoid group covers 15. 45% of the teacher sample. This group believes in technology's benefits but is constrained by a high level of insecurity and discomfort. Analysis shows that they tend to be older, and more female. This was concerned about the risks, discomfort and insecurity.

The least techno-ready segment, laggards make up around 24.45% and have little motivation and a high level of resistance to using new technologies in the class. They are much older and more female.

Dimension	Mean	Standard deviation	Optimism	Innovativeness	Insecurity	Discomfort
Optimism	4.1528	.5705	1			
Innovativeness	3.6116	.5561	0.638**	1		
Insecurity	3.5778	.6672	0.122**	0.219**	1	
Discomfort	2.9647	.6085	0.019	0.020	0.595**	1
Overall TRI	3.5767	0.6001				

Table 1: Means, standard deviations and correlations.

ADEC may reach out to them by developing streamlined, easy-to-use educational resources and offerings. Some suggest that this group may never use new technology unless they were forced to do so.

Table 2 shows the percent of each segment, and the cross tabulation of the means of the four dimensions of TRI and the five teacher segments for Abu Dhabi. Further observations reveal that explorers are highly optimistic with mean of 3.89032, and innovative with mean of 3.66333, with low insecurity and discomfort. The skeptics are low on both optimism and innovativeness. The pioneers are high on optimism but with high insecurity. The paranoids experience high insecurity, but yet are highly optimistic. Finally, laggards are highly insecure and discomfort. Table 3, provides a better portrayal of the cross-section of these groups.

Doing further cross tabulation, most females are laggards, while most males are explorers. With regard to teacher's education, surprisingly, most college degree holders are laggards and skeptics. With regard to teacher self-assessment, we note that those who rated themselves as highest in technology readiness are mostly explorers or skeptics. With regard to experience of teachers, those from 1 to 10 years' experience are mostly explorers; those with 11 and more years' experience are mostly skeptics and laggards. For UAE national teachers, they are almost evenly divided between pioneers, skeptics and laggards. For teachers below 31 years of age, they are mostly explorers; for those above 31 and below 41, they are mostly explorers, skeptics and laggard; and for older teachers, they are mostly skeptics and laggards.

An independent-samples t-test was conducted to compare level of technology readiness of teachers in terms of gender and marital status. As seen in Table 4, there was significant difference in scores for female and male teachers for three dimensions of optimism, innovativeness, and insecurity. Males reported a significantly higher mean value for all three dimensions. Male teachers scored a mean of 4.281 for optimism, 3.709 for innovativeness, and 2.425 for insecurity. Female teachers scored a mean of 4.076 for optimism, 3.550 for innovativeness, and

2.346 for insecurity. There was no significant difference with regard to discomfort at the 0.05 level. Results confirm with other studies that female respondents show more technology readiness [2,42].

There were no significant differences observed with regard to marital status of teachers with regard to any of the dimensions or the overall readiness. Mean scores for the four dimensions of TRI are almost identical for married and not-married teachers. For Optimism (4.161 for married, and 4.124 for not married); for innovativeness (3.606 for married, and 3.636 for not married); for insecurity (2.383 for married, and 2.36 for not married); for discomfort (3.004 for married, and 2.929 for not married).

One-way ANOVA was used to explore relationships between the dimensions of technology readiness and variables of age, education level, nationality, subjects taught, years of experience, teaching cycle, work location, and TRI self-rating. The results are seen in Tables 5-7.

Teacher's age has a significant effect on the two dimensions of innovativeness and discomfort only. With regard to innovativeness, the younger the teacher is, the higher his mean score. The highest mean for teachers is observed with regard to those from 20-25 years of age (3.831). The lowest score is observed with teachers from 56-60 years old (3.042). With regard to discomfort, the older the teacher is, the lower his mean school becomes. The highest mean for teachers is observed with regard to those from 51-55 years of age (3.022). The lowest score is observed with teachers from 26-30 years old (2.878). Results are consistent with other studies that applied TR in other fields other than education [33,42].

With regard to subject taught, no significant relationship was found between the four dimensions of technology readiness and this variable. However, the dimension of innovativeness (with an F score of 1.536 which is significant at the 0.069 level) is slightly affected by the subject taught. For this dimension, teachers who teach subjects such as

	Number	Percent	Optimism	Innovativeness	Insecurity	Discomfort
Explorers	171	21.48	3.89032	3.663330	1.090430	1.133115
Pioneers	123	15.45	3.47002	3.022865	3.509825	1.776845
Skeptics	179	22.49	1.66303	1.456145	1.281300	1.858000
Paranoids	123	15.45	3.47002	3.022865	3.509825	1.776845
Laggards	197	24.75	1.18156	1.284595	3.417945	3.743160
Overall			2.73499	2.48996	2.561865	2.057593

Table 2: Mean distribution of the 4 dimensions and 5 segments of TRI.

	Optimism	Innovativeness	Insecurity	Discomfort
Explorers	High	High	Low	Low
Pioneers	High	High	High	Low
Skeptics	Low	Low	Low	Low
Paranoids	High	High	High	Low
Laggards	Low	Low	High	High

Table 3: Characteristics of the 5 segments with TRI.

Dimensions	Teacher gender		Marital status	
	t-value	Significance	t-value	Significance
Optimism	5.229	0.001	.668	.504
Innovativeness	4.135	0.001	-.571	.568
Discomfort	1.840	0.066	.631	.528
Insecurity	5.397	0.001	1.264	.207
Overall TRI	5.705	0.001	.715	.475

Table 4: Independent-Samples t- test (Gender and marital status).

Dimensions	Teacher age		Subject taught		Experience	
	F-value	Sig.	F-value	Sig.	F-value	Sig.
Optimism	.809	.580	1.041	.411	.790	.810
Innovativeness	7.695	.001	1.536	.069	1.921	.001
Discomfort	2.141	.037	1.045	.408	1.269	.135
Insecurity	1.201	.299	1.019	.437	.949	.557
<i>Overall TRI</i>	1.668	.114	1.173	.276	.822	.766

**Table 5:** One-way ANOVA (TRI and age, subject area, and experience).

Dimensions	Education level		Nationality		Cycle	
	F-value	Sig.	F-value	Sig.	F-value	Sig.
Optimism	1.289	.277	3.835	.001	.816	.486
Innovativeness	0.209	.890	6.735	.001	.842	.472
Discomfort	5.525	.001	3.590	.001	.404	.750
Insecurity	2.031	.108	4.292	.001	.808	.490
<i>Overall TRI</i>	3.044	.028	3.802	.001	.689	.559

**Table 6:** One-way ANOVA (TRI and education level, nationality, and Cycle).

Dimensions	School zone		No. of students		Self-rating TRI	
	F-value	Sig.	F-value	Sig.	F-value	Sig.
Optimism	1.206	.300	1.481	.001	20.435	.001
Innovativeness	1.066	.345	1.757	.001	58.649	.001
Discomfort	5.143	.006	1.627	.001	.716	.542
Insecurity	3.420	.033	1.921	.001	4.418	.004
<i>Overall TRI</i>	4.198	.015	1.959	.001	20.656	.001

**Table 7:** One-way ANOVA (TRI and school zone, no. of students and self-rating TRI).

math, physics, and English, score higher scores from those that teach humanity related subjects such as history, Arabic, or Islamic studies.

Teacher's work experience has a significant effect on the innovativeness dimension only. Experiences of teachers ranged from 1 to 40 years. If the sample is divided into four even segments according to years of experience (1-10, 11-20, 21-30, and 31-40 years), the following mean innovative score would be obtained: 3.691, 3.648, 3.161, and 3.054 respectively. In other words, the more experience the teacher is, the less his/her TRI innovativeness score. Other TR studies found no significant differences with regard to experience [41].

The highest level of education the teacher has attained has a significant effect on discomfort only. Teachers responded to five choices: pre-college diploma, college degree, master's degree, and doctorate degree. The mean scores for TRI for the four teachers' categories were 2.579, 2.333, 2.537, and 2.500. This means that teachers who portray most positive reaction with regard to discomfort are teachers who have pre-college diploma and those with master degrees. Teachers with college degrees are the most discomfort teachers. It should also be mentioned that the overall TRI score is also significant where the same pattern is observed. Lee, et al. [41] also found significant differences with regard to level of education.

The background of the teacher (nationality) has a significant effect on all four dimension of TRI. If we divide teacher's nationality into UAE nationals, other Arabs, and Westerners, we note the following mean scores for the four dimensions of TRI, 4.26, 4.123, and 4.117 for optimism. For innovativeness, we note the following mean scores for the three teacher categories: 3.697, 3.669, and 3.401 respectively. With respect to discomfort and insecurity, the results show that the Westerner teachers are most positive with both dimensions, while the Arab teachers are most negative on both dimensions.

With regard to class cycle (grade), no significant relationship was

found between the four dimensions of technology readiness and these two variables. In addition, the scores with regard to the overall TRY showed no significant differences. The cycle or grade level had no significant effect on TRI scores.

The location where a teacher is working (zone) has a significant effect on both discomfort and insecurity; but not on either optimism or innovativeness. With regard to all four dimensions, Al Gharbia teachers score the highest scores, while Al Ain zone teachers score the lowest scores. Al Gharbia could be characterized as more rural area, while Abu Dhabi and Al Ain as urban cities. Meanwhile, the number of students a teacher is in charge of teaching has a significant effect on all four TRI dimensions. As the number of students increase, the TRI scores tend to go down for all four dimensions.

The teacher's RTI self-rating has a significant effect on the three dimensions of optimism, innovativeness and insecurity. There is no significant effect with regard to discomfort. For all three dimensions of optimism, innovativeness, and insecurity, and in general, as the self-score goes up, the scores for the three dimensions go up to.

## Discussions

The Abu Dhabi Education Council (ADEC) has started an ambitious program of education reform where the Integration of ICT into all educational processes is a major component of its future education systems. In 2011 and 2012, ADEC spent more than 500 million Dollars on related initiatives. The professional development of teachers was the main focus for ADEC. Teachers' attitudes, beliefs, perceptions, and behaviors toward technology are extremely important for the success of such projects [2].

This research aims at measuring Abu Dhabi public school teachers' technology readiness by using TRI, a scale consisting of four dimensions of optimism, innovativeness, discomfort, and insecurity. Even though

the study utilized a previously validated scale of TRI, it was necessary to evaluate measurement validity using exploratory and confirmatory factor analysis since the environment of application changed. Based on those analyses, the study deleted one item under the innovativeness dimension. As a result, a 35-item instrument was used.

Explanatory factor analysis provided indications that the discomfort dimension might be split into three factors. However, confirmatory factor analysis provided clues to keep the structure of the modified TRI as is without splitting the discomfort dimension.

One contribution from the current study is that it offers more insight by identifying the effects of individual TRI constructs. The empirical findings suggest that each TRI dimension has a significantly different influence that should be identified.

For Abu Dhabi public schools, teachers' optimism level was higher than their innovativeness, and mean value of insecurity dimension was higher than discomfort. This result is also consistent with results obtained by others [2,47]. The TRI score in Summaka, et al. [2] for Turkish teachers was (2.96), while the TRI score for Abu Dhabi teachers was (3.28). TRI results from other empirical research but not related to education, provided results consistent with the current research with regard to the rank magnitude of TRI scores for each of the dimensions [25].

Optimism and innovativeness are drivers of TRI. The highest score related to teacher optimism. For teachers, optimism relates to a positive view about technology and a belief that technology offers teachers increased control, flexibility, and efficiency in life [1]. For ADEC, the controllability of new technologies is very important to optimistic teachers because convenience is the most frequently stated benefit of using new technologies. It is assumed that optimistic teachers might tend to use more active coping strategies because they are less likely to worry about a possible negative outcome and more likely to accept their situation. In addition, optimistic teachers are assumed to be more likely to focus on positive events than pessimists, and thus confront new technology more openly [2,47]. It is expected that a highly optimistic teacher will use new technologies more frequently.

The second highest score is related to innovativeness. In the educational context, we might refer to innovativeness as teacher's tendency to try out new things [18]. As a result, teachers with high innovativeness levels feel comfortable using technology [48,49] suggest that innovativeness positively influences usage variety, because being innovative means being experimental and having a tendency to try different things.

Insecurity and discomfort are inhibitors of TR. Both got the lowest scores. Insecurity involves the distrust of technology for security and privacy reasons. [1] Some suggest that technology anxiety entails negative comments on new technologies; attempts to reduce the amount of time spent using new technology and even avoid new technology [40]. The insecurity dimension focuses on specific aspects of technology based transactions, rather than on a lack of control over new technology in general [45]. In other words, teachers with a sense of insecurity are skeptical about new technologies, and would feel uncomfortable with them. As a result, such teachers become suspicious of new processes and functions and reduce trials to accept and use them.

Parasuraman [1] noted that discomfort consisted of a perception of lack of control over technology and a feeling of being overwhelmed by the technology. It represents the extent to which people have general fears of technology-based products and services, believing that

the products and services lead to learning costs and comprehension difficulty [50]. In the education context, these outcomes might mean that teachers who score high in discomfort perceive new technology in teaching as more complex and often causing reactions ranging from aggravation to disappointment and frustration [50]. In other words, such teachers might use technology-based products and services less frequently than originally intended.

Understanding the belonging of the teacher to which segment (explorers, pioneers, skeptics, paranoids, and laggards) is important. The results provide evidence upon which ADEC strategies can be developed to increase the rate of integration of new technologies into the curriculum and pedagogy. For example, we noted that while Explorers and Pioneers are optimistic and innovative, they also are slightly resistant to technology. Therefore it will be important to provide reassurance about the integration of new technology and ensure this segment of teachers that the practical benefits and instructions to use are clearly communicated. Providing help and assistance will assist these segments to adopt sooner. These findings contribute to our understanding of teachers' behavior patterns and can be beneficial when applying integration of new technologies.

With regard to teachers and TRI, and with regard to many other demographic variables, it was not possible to compare results of this study with previous research since not many researchers conducted related research with regard to education (or teachers). Lack of previous research was observed with education level of teachers, their nationality, the number of students they teach, and their experience as teachers. It also involves the cycle (or grade level) they teach, the subject they teach. However, some TRI studies conducted in other disciplines did investigate those variables [51,52].

Significant difference was found with regard to teacher's gender on their attitude to TRI. Male teachers demonstrated a higher overall technology readiness score than female teachers. Similarly, some studies indicated that male teacher's attitudes toward computer technology more positive than females [2,39] Dupagne and Krendi, [7] Some studies did not find any differences between genders [33]. In Abu Dhabi public schools, male and female teachers do not teach in the same school. Male teachers teach in only boy-schools, while female teachers might teach in KG and cycle I of boys school too. Most female teachers feel overwhelmed by home duties and feel that they might not have enough time to get involved in much professional development involving ICT.

In terms of age of teachers, there was a significant difference between technology readiness of teachers in terms of innovativeness and insecurity. Some studies reported that there is no significant difference between attitudes with regard to TRI and [34,54]. Many older teachers feel that the new technology does not provide enough encouragement to get involved. A large portion is "laggards", "skeptics", or "paranoids".

In terms of location, rural area teachers showed higher insecurity scores than urban teachers. For health professionals, Caison, et al. [33] observed that those in rural areas indicated significantly greater insecurity with technology than did their urban counterparts. Both Abu Dhabi and Al Ain are considered more urban than Gharbia. Usually, there are more chances in those two regions to get involved with technology.

Nationality of teachers showed a great impact on the TR ratings. Some studies conducted in business found no significant differences with regard to race [31]. Most probably, UAE national teachers with



their tenured contracts think long-term when it comes to working in Abu Dhabi schools. This might explain why they scored higher than other teachers. Many Arab and Western teachers (with 2 year contracts) might not exert themselves the extra efforts to improve their ICT skills further.

With regard to highest education attained, results are consistent with results of studies conducted in small businesses. These studies found that managers with degree-levels have a higher technology readiness as compared to lower education achievers [31]. In the current study, most high scoring teachers are the younger ones, and mostly fresh graduates from college. Younger college graduates might have had greater chances to learn newer teaching methods in college with more integration of technology in pedagogy and curriculum.

Number of students a teacher teaches is a significant factor in the TR scores. The score goes down as the number of students increases. In addition, there were significant differences with regard to teacher's self-rating on all four dimensions. A teacher with more students to teach might have greater responsibilities to manage students in the class.

## Conclusions

This study replicated Parasuraman's [1] Technology Readiness Index (TRI) across the education contexts and in a different cultures which enhances its validity, applicability and generalizability. In an educational context, the positive drivers of TRI (optimism and innovativeness) encourage teachers to use technological products/services and hold positive attitudes toward technology. The negative drivers (discomfort and insecurity) inhibit teacher's adoption of technology.

For the Abu Dhabi Education Council, key to bolstering teachers' TRI is the positive experience teachers have with technology. Such experiences lead to more acceptance, comfort, and confidence, ultimately nurturing a positive attitude toward its integration into curricula and teaching. For the effective integration of technology, ADEC should educate/advocate teachers about the benefits of technology and promote a positive attitude toward technology within the school's teaching practices. Feedback should be collected for continuous improvement of technology integration. ADEC should also spend time and effort on designing more user-friendly interfaces. Continuous feedback on interface successes and failures is vital to continual improvement and the overcoming of TR inhibitors. Schools could provide more professional training and education that eases teachers into new technology integration.

ADEC strategists may be in a much better position to plan technology integration strategies to encourage the diffusion of technology-enhanced curriculum and pedagogy if they have a valid measurement and deep understanding of the four dimensions of technology readiness. Strategies could be targeted to whatever dimension is inhibiting or failing to contribute to technology readiness. This targeting would allow a much more efficient and effective use of strategic educational resources. Knowing which of the dimensions to target should be of critical importance to ADEC for effective technology integration [40].

As Abu Dhabi, among other nations, moves aggressively to adopt ICT in its education system to improve school practice and student outcomes, the success of these initiatives will increasingly depend on teachers to embrace these technologies. In this study of the technology readiness of public school teachers, teachers working in more rural areas were found to be significantly more insecure with new technology

than urban public school teachers. In addition, male teachers were found to be significantly more innovative than female teachers and older teachers were found to be less technology ready than younger ones. ADEC decision-makers would be well served before integrating technology into curricular to support the needs of teachers working in more rural areas, female teachers, and those teachers with long experience but relatively older than new comers to the profession of teaching. ADEC should also pay more attention to and serve the needs of those falling in the skeptics and paranoid segments. In addition, patterns such as those observed in this study highlight areas of professional development which should receive more focus.

Teacher segmentation according to the four dimensions of TRI show that the public school teachers sample is generally high in techno-readiness. This could be due to their education and age, which may be higher than the average person in the region. There is also the intriguing possibility that there is a cultural propensity toward innovation, which could have implications for economic development. It is interesting to note that Abu Dhabi (in a way) is akin to Iceland, Finland, Singapore, etc., small countries where there is potential for high tech. Many new capital projects in Abu Dhabi are of high tech nature.

In conclusion, this study showed that Abu Dhabi public school teachers' technology readiness level was relatively moderate. This result might cause challenges for ADEC with regard to its aggressiveness in the technology integration process, especially with regard to designing the appropriate professional development programs for teachers. ADEC strategists should note that those teachers who are high in the discomfort dimension should be approached with care.

## Study Limitations

Although we obtained samples from diverse groups of teachers, our samples may not be truly random across all categories of teachers. Future studies should encourage more participation of teachers from all backgrounds. It should extend its application to teachers in private schools too. Furthermore, this study offers a static view with cross-sectional surveys. Future studies should consider using longitudinal measures to track changes in teachers' technology readiness over time. Future study could be conducted on a larger sample of teachers in order to give a more understanding of the complete picture.

Even though, the insecure dimension was represented by a single factor only, FA revealed that it might be a composition of three different factors. Future studies should look into this outcome with more care by considering the significance of such splitting.

It is important to note that the TRI and the technology segments presented here are not indicators of technical competence. It is also important to note that each group is diverse, so other factors such as ethnicity, age, is not a sole determinant of techno-readiness. For example, 12% to 20% of each group is represented by the most tech-savvy segment, Explorers, the most tech-savvy segment, represents 12% to 20% of each group.

Future studies should also explore empirically the integration of TRI with other models such as the Fishbein and Ajzen's generic Theory of Reasoned Action (TRA) that could explain teacher's attitude towards technology in the schools. TRA argues that a person's behavior is predicted by his or her behavioral intention. This Technology Acceptance Model (TAM) has three key variables: Perceived Usefulness (PU), Perceived Ease of Use (PEU) and Behavioral Intention to Use (BIU). According to Wozney [54] the parsimony of TAM combined with its predictive power makes it easy to apply to different situations.



In the literature there are some studies to measure technology readiness and technology acceptance [24,29,55]. However (according to our search and knowledge), no study is reported in the area of education [56-60].

Future research might also consider showing how TRI might influence teacher post-adoption behavior. It should investigate the complete or entire process of how TRI affects teacher's behavioral outcomes such as teacher satisfaction and continued use intention through usage patterns after the adoption of technology.

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