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Technology Readiness of Early Career Nurse Trainees: Utilization of the Technology Readiness Index (TRI)

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Abstract. Health Information Technology (HIT) adoption by clinicians, including nurses, will lead to reduction in healthcare costs and clinical errors and improve health outcomes. Understanding the importance of technology adoption, the current study utilized the Technology Readiness Index to explore technology perceptions of nursing students. Our analysis identifies factors that may influence perceptions of technology, including decreased optimism for students with clinical experience and increased discomfort of US born students. Our study provides insight to inform training programs to further meet the increasing demands of skilled nursing staff.

Keywords. Technology Readiness, Health Information Technology, Nurse Trainees

1. Introduction

Technology readiness is the propensity of individuals to use new technologies in the accomplishment of goals [1]. It encompasses technology-related beliefs. These beliefs determine the predisposition of an individual to embrace and interact with new technology, independent of actual competence of technology use [1]. Electronic Health Records (EHRs) ensure access to relevant patient-level information. EHRs and other technologies in the healthcare setting, result in different modes [2] of practice amongst healthcare professionals. For optimal utilization of these and developing technologies, healthcare professionals must be receptive to their use. Understanding technology perceptions including the readiness of use by early career professionals in primary care fields such as nursing, is critical [1]. Such knowledge can enhance training and success in practice settings. This study seeks to assess the technology readiness of nurse trainees; guided by the Technology Readiness Index (TRI). Prior studies have found it to be effective for studying the propensity of technology adoption [1]. Studies have also proven the importance of considering perceptions to determine intervention such as technical support and training to ensure successful technology use [2].

2. Methods

A web-based version of the TRI survey was administered to a convenience sample of 43 urban nursing students. The design was cross-sectional, aimed at capturing a

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representative sample. The demographic portion of the survey comprised of questions evidenced to indicate the acceptance of technology [1, 3, 5]. Our study was approved by the Columbia University Medical Center Institutional Review Board.

2.1. Instruments

The Technology Readiness Index (TRI) is a 36 item tool to assess technology use readiness on a 5-point Likert scale of strongly disagree to strongly agree [1]. The TRI is based on four domains: two contributors (Optimism and Innovativeness) and two inhibitors (Discomfort and Insecurity). Optimism is the view of technology in a positive way and the belief that its use offers efficacy, flexibility and control. Innovativeness is the propensity for one to be a technological pioneer. Discomfort is the belief there is a lack of control over technology use and Insecurity is the disbelief and skepticism in the ability for technology to work correctly [1]. These personality dimensions affect the tendency of individuals to use and embrace new technologies.

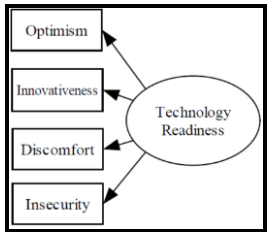

Figure 1. The Technology Readiness Index

2.2. Data Analysis

Mean scores were calculated for items that comprise the domains of Optimism, Innovativeness, Discomfort and Insecurity. Scores were reverse coded for the inhibitor domains. The appropriate weighting for domains with fewer items (i.e., Innovation and Insecurity) was conducted to allow for score equivalence. A mean total score for technology readiness was also computed. Internal reliability was calculated for each domain scale and for the overall TR score, Table 1. Pearson Product Moment Correlations (PPMCs) were calculated to determine the relationship between TRI domains and participant characteristics. Descriptive statistics were calculated for demographics. T-tests and analysis of variance assessed differences in continuous variables and chi square analyses assessed differences in categorical variables.

3. Results

The four TRI domains and overall TR total score demonstrate an acceptable level of internal consistency with Cronbach's Alpha scores of 0.80 (Optimism), and 0.7 (Innovation), 0.8 (Discomfort), 0.7 (Insecurity) and 0.9 (Overall TR), Table 1.

3.1. Descriptive statistics

Forty three students completed the survey. Participant mean age was 28.3 years (SD=4, range=23-39). Participants mean years of Nursing experience was less than a year with

the average healthcare experience in any capacity at 2.4 years (SD=2.3). The sample was predominantly White (N=35, 81.4%), followed by Black (N=4, 9.3%) and Other/Mixed Race (N=4, 9.3%). Participants who identified as Hispanic comprised 7% (N=3) of the sample. Most were born in the United States (N=31, 72.1%), Table 2.

Table 1. Internal Consistency for TRI domains and total score

TR Components	Cronbach's alpha
Optimism	0.8
Innovation	0.7
Discomfort	0.8
Insecurity	0.7
Overall Total Score	0.9

PPMCs in Table 3 pertains to the distribution of respondents' scores on the four domains and the overall TRI score. Results indicate that significant correlations exist between the two contributors (Optimism and Innovativeness) and two inhibitors (Discomfort and Insecurity). The overall TRI score significantly correlated with all four technology readiness domains.

Table 2. Descriptive Statistics: Characteristics of Study Participants

Variable	Mean	N	%
Age	28.3±4.0	43	
Years of Nursing Experience	0.3±00.7	43	
Years of Healthcare Experience	2.4±20.3	43	
Country of Origin			
USA		31	72.1
Race			
White		35	81.4
Black		4	9.3
Other/Mixed Race		4	9.3
Ethnicity			
Hispanic		3	7.0

3.2. *Technology* readiness of participants

Results for the TR domains indicate that participants overall had positive outcomes of technology, indicating readiness. Many were optimistic about technology ($\bar{x}$=3.5) and are not insecure ($\bar{x}$=2.9) concerning technologies role. Participants also on average, did not show high levels of discomfort ($\bar{x}$=3.0). The overall TRI total score ($\bar{x}$=3.1) indicates an adequate level of technology readiness of participants. Although, the Insecurity score was higher than those found in the literature [1, 3, 5], scores align with a 2013 study of full-time nurses (N=878), assessed on acceptance of a mobile EHR [5].

3.3. *Technology* readiness by demographic variables

Independent samples t-tests were used to explore relationships between the TR domains and demographic characteristics of the study participants. Nursing students were asked to indicate the type of healthcare experience they obtained before enrolling in Nursing School. This would allow for us to assess participants who have actually used clinical based technologies including EHRs. Participants who indicated clinical care experience

were less optimistic about technology readiness than those who had no direct clinical experience, Table 4. TRI domain scores were categorized as low medium and high. Although low discomfort levels were the same for US born compared to non-US born participants, those born in the US, had significantly greater levels of Discomfort than non-US born participants, Table 5.

Table 3. Pearson Product Moment Correlations (PPMCs) for TRI domains and total score

			Correlation Coefficient			
TR Components	**Mean**	**SD**	**OPT**	**INN**	**DIS**	**INS**
Optimism (OPT)	3.5	0.5	1.0			
Innovation (INN)	3.1	0.5	0.5**	1.0		
Discomfort (DIS)	3.0	0.5	0.3	0.2	1.0	
Insecurity (INS)	2.9	0.6	0.1	0.1	0.4**	1.0
Overall Total Score	3.1	0.4	0.7**	0.7**	0.7**	0.6**

**p < 0.01, *p < 0.05

4. Discussion

Optimism and innovativeness drive an individual's readiness to use technology, with higher score indicating higher degrees of readiness [1]. Discomfort and insecurity are direct inhibitors of technology readiness, with higher scores indicating a reduction in overall readiness for technology use [1]. Results of our study indicate two major findings. First, people in actual clinical practice are less optimistic about technology use than those who have not used such tools in the clinic setting. Demographic study information indicated that healthcare experience in the clinical setting prior to attending nursing school, had an impact on Optimism scores, with significantly lower scores for those who worked with patients including Medical Assistants, Patient Care Technologists, and Physical Therapists. Our findings may shed insight into the actual use of technologies such as EHRs and difficulties experienced in clinic settings. Second, in spite of the young age of the sample ($\bar{x}$=28.3±4.0), there was significant discomfort levels, with US-born participants having greater discomfort. Other countries or origin include India and Portugal. Further exploration of the differences indicate no significant age difference between groups. Although not significant, non-US born reported more clinical experience (58.3%) than US born (48.4%). Computer self-efficacy can significantly influence a person's perception of new technology [4]. Clinical experience can also serve as an indicator of higher levels of discomfort resulting from in-experience with computer use in the clinical setting.

Several limitations exist. Our survey was a self-report instrument and limited by potential self-report bias. Future studies should consider additional measures that best captures technology readiness in addition to competencies and acceptance [2, 5]. Furthermore, due to its small sample size, our study is not generalizable.

Table 4. T-test for TRI domains and total score for healthcare experience

	Type of Healthcare Experience	
TR Components	**Patient Care**	**Other**
Optimism*	3.3±.50	3.7±.46
Innovation	3.0±.70	3.1±.47
Discomfort	2.9±.57	3.0±.45
Insecurity	2.8±.51	2.8±.53
Overall Total Score	3.0±.40	3.2±.30

**p < 0.01, *p < 0.05

Academic instruction can support increase optimism and decrease discomfort to improve technology readiness of new trainees. Efforts may include the direct use, of such technologies (i.e., EHRs) in the classroom setting, well before clinical training. Early and ongoing exposure will contribute to the reduction in discomfort, further preparing students for clinical training and future practice. Barrier and obstacles to technology use in the clinic setting must also be addressed in academic training. Courses should cover evidence-based practice including workflow analysis, barriers to EHR system use and identify effective approaches used to overcome such challenges.

Table 5. X^2 for TRI domains and total score for US born

	Optimism			**Innovation**		
Born in the US	Low	Medium	High	Low	Medium	High
No	12.5%	31.3%	45.5%	21.4%	31.3%	30.8%
Yes	87.5%	68.8%	54.5%	78.6%	68.8%	69.2%
	Discomfort**			**Insecurity**		
	Low	Medium	High	Low	Medium	High
No	50.0%	29.4%	41.7%	38.9%	30.8%	8.3%
Yes	50.0%	70.6%	38.7%	61.6%	69.2%	91.7%
	Overall TR					
	Low	Medium	High			
No	35.0%	18.0%	25.0%			
Yes	65.0%	82.0%	75.0%			

**p < 0.01, *p < 0.05

This study provides valuable insight into technology readiness of nursing trainees. Results can inform the teaching of technology related skills with optimal instructional methods to meet the needs of nursing students at all levels of technology acceptance.

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