The Place of Motivation and Big Five Model in the Use of Technology in Consideration of Certain Elements of Rogers' Diffusion of Innovations Theory (DOI)

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ABSTRACT

This study seeks to explore the place of motivation and Big Five model in the use of technology in consideration of certain elements of Rogers' Diffusion of Innovations Theory (DOI). The objectives of this study are the following: (a) To what extent do certain elements of Rogers' (2003) Diffusion of Innovations Theory (DOI) explain students' ICT use, (b) To what extent do personality characteristics derived from the Big Five approach explain students' ICT use, and (c) To what extent does motivation explain students' ICT use. The research was conducted in Israel during the second semester of the academic year 2013-14, and included two groups of participants: a group of Educational Technology students (ET) and a group of Library and Information Science students (LIS). Findings add another dimension to the importance of Rogers' DOI theory in the fields of Educational Technology and Library and Information Science. Further, findings confirm that personality characteristics as well as motivation affect ICT use. If instructors would like to enhance students' ICT use, they should be aware of individual differences between students, and they should present to students the advantages and usefulness of ICT, thus increasing their motivation to use ICT, in the hopes that they will become innovators or early adopters.

KEYWORDS: Rogers' Diffusion of Innovations Theory, Big Five model, personality characteristics, motivation, use of technology

Introduction

Modern economies depend on ICT (Information and Communication Technology) use and development (Hine, 2011). According to the International Telecommunications Union (2014), by the end of 2014 there will be almost 3 billion Internet users, two thirds of them from the developing world. It seems that technologies are widely used in every-day life, as well as in workplace and academic settings. Therefore, it is very important that students be familiar with and master ICT in order to understand their learning environments, as well as their professional lives. The current re-search focuses on two kinds of populations: Educational Technology (ET) students and Library and Information Science (LIS) students. These two populations were specifically chosen, as ICT plays a major part in both their training and future work environments. This study seeks to explore what factors influence students' ICT use and web technology competence. The research may contribute to an understanding of the variables that influence their ICT use and may lead to further inquiry in this field. The current study uses Rogers' (2003) Diffusion of Innovations Theory, as well as the Big Five model (Costa &

McCrae, 1992), and motivation theory (Deci & Ryan, 1987) as theoretical bases from which we can predict factors that may influence students' ICT use. The remainder of the article is organized as follows. The next section introduces the theoretical foundations and hypotheses developed for the proposed study. Research methods are provided next, followed by findings and discussion. The last section provides theoretical and practical contributions, along with a discussion of some limitations of the findings.

Rogers' Diffusion of Innovations Theory

Rogers' (2003) Diffusion of Innovations Theory (DOI) is a widely used theoretical framework in the area of technology diffusion and adoption. The theory suggests that within a population group, innovations are not adopted at the same time by all individuals, as some people are more willing to try new ideas and technologies than others. The adoption of innovations depends on personal factors such as the following: gender, age, innovativeness, and ethnicity; social ones (e.g., education and income status); and on technological factors such as perceived usefulness and perceived benefits (Leung & Wei, 1999). Rogers proposes that innovation, communication channels, time, and social system are the main components of DOI theory. Rogers suggests (2003) that the innovation decision process is similar to an information seeking process, where the person would like to reduce the uncertainty about the advantages and disadvantages of the innovation. This process is built of five stages: knowledge, persuasion, decision, implementation, and confirmation. In the knowledge stage the person learns about the innovation and seeks information about it. In the second stage (persuasion), the individual forms an attitude after s/he knows about the innovation. According to Rogers (2003), the knowledge stage is more cognitive oriented, while the persuasion stage is more affective oriented. In the third stage, the decision, the person decides whether to adopt or reject the innovation. In the fourth stage, implementation, the innovation is put into practice and in the last stage the individual looks for support for his or her decision. Rogers (2003) suggests that the following attributes help decrease uncertainty about the innovation: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. Relative advantage is the extent to which people believe that the innovation is better than the traditional method. Compatibility refers to the extent to which people believe that the innovation is compatible with the traditional idea. Complexity addresses the extent to which people find the innovation difficult to use and understand. Trialability is the extent to which people believe that there are chances for the innovation to be experienced before deciding whether to adopt it or not, and observability addresses the extent to which results of the innovation are visible to others. The current study will focus on two of these five attributes: relative advantage and complexity. Rogers (2003) also presented classification categories of adopters: innovators, early adopters, early majority, late majority, and laggards. The Diffusion of Innovations Theory has been used as a theoretical framework to analyze the adoption of information technologies in both the education and library science environments. Various researchers have proposed that Rogers' theory is the most appropriate for exploring the adoption of technology in higher education (Borrego, Froyd, & Hall, 2010; Medlin, 2001; Parisot, 1997). A study that was carried out in Israel examined reasons for students' poor use of Web 2.0 technology (Goldstein et al., 2012). Bowers, Ragas, & Neely (2009) used Rogers' theory to investigate the value of Second Life as an educational tool among post-secondary instructors. Sahin (2006) suggested that Rogers' (2003) use of relative advantage, compatibility, and complexity attributes are related to the attitudes of individuals towards instructional computer use by college instructors. In addition, Tšoenyo and Wole (2012) proposed that relative

advantage, complexity, and observability were the most relevant attributes to faculty attitudes towards ICT. Addressing the library arena, Neo and Calvert (2012) found that compatibility and complexity were the most important factors to explain Facebook adoption in public libraries. Dorner and Revell (2012) used five attributes of Rogers' Diffusion of Innovations Theory as the basis for librarians' interviews while trying to explore their perceptions of promoting institutional repositories as an information resource for their clients. Rutherford (2008) classified librarians who used social software in libraries as falling into Rogers' (2003) categories of innovator and early adopter, while White (2001) examined diffusion of an innovation (Rogers, 1983) within digital reference services. In light of the above, the first research hypotheses will be: H_1: Intensity of ICT use will be positively associated with students' perceptions of relative ad-vantage. H_2: Intensity of ICT use will be negatively associated with students' perceptions of complexity.

The Big Five Model of Personality

The "Big Five" model of personality is one of the most famous measures of personality structure in recent years (Golbeck, Robles, & Turner, 2011), and it is considered a comprehensive model that includes five major factors representing personality traits: neuroticism, extraversion, agreeableness, openness to experience, and conscientiousness (Costa & McCrae, 1992). Various researchers have examined the model, finding validity and reliability across gender, age, and cultural lines (McCrae & John, 1992). Each factor in the model is bipolar and contains different aspects. According to Wang, Jackson, Zhang, and Su (2012), neuroticism is in contrast to emotional stability and is characterized by anxiety, sadness, irritability, moodiness, hostility, and nervous tension. Extraversion is associated with activity, energy, assertiveness, sociability, talkativeness, expressiveness, and positive emotions. Agreeableness consists of altruism, warmth, trust, modesty, cooperativeness, and tender-mindedness. Openness to experience addresses the complexity and depth of the person's mental and experiential life, and consists of curiosity, creativity, and preference for novelty. Conscientiousness refers to impulse control that contributes to task- and goal-directed behavior and is associated with discipline, reliability, responsibility, and organization. Other research has analyzed the association between the Big Five model and technology use. In the context of Computer Based Assessment (CBA), Terzis, Moridis, and Economides (2012) proposed that neuroticism has a significant negative effect on perceived usefulness and on goal expectancy. Agreeableness is related to social influence and perceived ease of use, while conscientiousness is associated with perceived ease of use. Extroversion and openness are connected with perceived importance. Various studies examined the connection between the Big Five model and Internet use (Amichai-Hamburger, 2002; Amichai-Hamburger & Ben-Artzi, 2003; Amichai-Hamburger, Wainapel, &Fox, 2002) showing that extraversion and neuroticism were significantly related to Internet use. Witt, Massman, and Jackson (2011) examined the influence of the Big Five on videogame playing, overall computer use, and communication technology use. Mark and Ganzach (2014) suggest that global Internet use is positively related to extraversion, neuroticism, and conscientiousness. Other studies focused on the relationship between the Big Five model and the use of social net-works sites, showing that all five factors were related to the use of social networks sites (Ross et al., 2009; Selfhout et al., 2010; Wehrli, 2008; Zywica & Danowski, 2008). Several studies pro-posed that extraversion was the most dominant factor concerning the use of social networks sites (Aharony, 2013; Gosling, Augustine, Vazire, Holtzman, & Gaddis, 2011; Wilson, Fornasier, & White, 2010, 2012; Zywica & Danowski, 2008). In a recent study (Deng, Liu, Li, & Hu, 2013),

researchers found that extroversion impacts perceived satisfaction, supplementary entertainment, as well as playfulness and SNS continuance intention. The current study will focus on three characteristics: extroversion, openness to experience, and neuroticism. Assuming that extroversion, openness to experience, and neuroticism may predict students' ICT use, the underlying assumptions of this study are:H_3: Extroversion and openness to experience will be positively associated with ICT use.H_4: Neuroticism will be negatively associated with ICT use.

Motivation

Another variable that may influence students' attitudes towards ICT is their motivation. Motivation is considered a key determinant of general behavior (Deci & Ryan, 1987), IT acceptance behavior (Davis, Bagozzi, & Warshaw, 1992; Moon & Kim, 2001; Teo, Lim, & Lai., 1999; Ven-katesh& Speier, 1999), and work-related behavior (George & Brief, 1996; Lu, 1999). Ryan and Deci (2000) have introduced Self-Determination Theory (SDT) and suggested that when individuals' needs are satisfied, they will present optimal motivation and well-being. Alternatively, when these needs are hindered, people will have low motivation and well-being. Pritchard and Ash-wood (2008) proposed that "motivation is the process used to allocate energy to maximize the satisfaction of needs". The reasons for selecting specific behaviors are different from one individual to another, and a person's motivation is related to his/her attitudes, needs and goals. Based on the literature review, H_5 is developed:H_5: The higher the motivation students have, the greater their ICT use. In light of the above, the objectives of this study are the following: (a) To what extent do certain elements of Rogers's (2003) Diffusion of Innovations Theory explain students' ICT use, (b) To what extent do personality characteristics derived from the Big Five approach explain students' ICT use, and (c) To what extent does motivation explain students' ICT use.

Methodology

The research was conducted in Israel during the second semester of the academic year 2013-14, and included two groups of participants: a group of Educational Technology students (ET) and a group of Library and Information Science students (LIS). The researchers obtained permission to investigate different graduate courses in two Israeli institutions. They gained access to two classes from the ET program at an Israeli college of education (Mobile technologies, and Social Net-works) and two LIS classes at an Israeli university in the department of Library and Information Science (Information retrieval, and Introduction to Information Science). The researchers handed out 120 questionnaires to the students and explained the study's purpose. Of these 110 responses

Aharony & Shonfeld (1995) were received back from these groups (91.6%), 50 responses were from college students and 60 from university students. The sample was made up of 28 (26%) men and 80 (73%) women. The average age was 38; the youngest was 23 and the oldest was 60. In terms of education, 57 (52%) were in their first year, 38 (36%) in their second year, and 12 (11%) in the third year of their graduate program. The survey covered five topics that were covered in five questionnaires: personal details, ICT use, attitudes to ICT, personality, and motivation. The personal details questionnaire had four parameters: age, gender, education, and institution. The ICT use questionnaire consisted of 14 statements rated on a five-point Likert scale (1=strongest disagreement; 5=strongest agreement). This questionnaire was previously used by the MOFET research group to measure students' ICT use in colleges of education

(Shonfeld & Goldstein, 2014). The value for the Cronbach's Alpha of this questionnaire was .82. The attitude to ICT questionnaire was based on Rogers' Theory, and modified for this study. It was previously used by Tsoenyo and Wole (2012). It consists of nine statements rated on a five-point Likert scale (1=strongest disagreement; 5=strongest agreement). The questionnaire encompasses two factors. The first is 'relative advanced' (meaning positive attitudes towards ICT be-cause of the advancement to the user). This section consists of items 1, 2, 3, 5, 9. The second is complexity (meaning adverse attitudes to ICT because of difficulties using it). This section is composed of items 4, 6, 7, 8. The values of Cronbach's Alpha were .72 for both factors. The personality questionnaire was based on the Big Five questionnaire (John, Donahue, & Kentle, 1991) and was modified for this study. It has 24 statements rated on a five-point Likert scale (1=strongest disagreement; 5=strongest agreement). The questionnaire includes three factors: extraversion (items 1, 4, 7, 10, 13, 16, 19, 22), neuroticism (items 2, 5, 8, 11, 14, 17, 20, 23), and openness to experience (items 3, 6, 9, 12, 15, 18, 21, 24). The values of Cronbach's Alpha were .82, .87, and .72 respectively. The motivation questionnaire included 6 statements rated on a 5 point Likert scale (1=strongest disagreement; 5=strongest agreement). Cronbach's Alpha was .92. The questionnaire developed for this study is based on a section of a questionnaire used by research at MOFET institute (Shonfeld & Goldstein, 2014). It was used for a previous study in 2007-2011 (Goldstein et al., 2012) findings. The aim of this study was to examine students' ICT use in the fields of Educational Technology and Library and Information Science in higher education institutions. Descriptive statistics from the questionnaire results indicate that these populations' use of ICT environments are at the level of M (Mean) = 3.31 and SD (Standard Deviation) = 0.68, where the mean was measured on a scale of 1-5. In order to examine whether there are differences between the ET students and LIS students, a one-way MANOVA was performed. The MANOVA revealed a significant difference between the two groups, $F(1.106.) = 18.39$, $p < .0.01$ $\eta^2 = .15$. Findings reveal that ET students use ICT more often: M = 3.61, SD =.59, than LIS students: M = 3.08, SD =.68. A similar analysis was performed to compare men with women, but no significant difference was found. In order to examine the relationship between attitudes, personality characteristics, motivation, and the dependent variable (ICT use), researchers performed Pearson correlations, which are presented in Table.

Results produced shows significant correlations between almost all research variables except neuroticism and the dependent variable (ICT use). Most of the correlations are positive; hence, the higher the level of extroversion, openness, motivation, and advanced, the greater the ICT use. Further, significant negative correlation was found between complexity and ICT use. In other words, the less students perceive ICT use as complex, the higher their ICT use will be. Regarding correlations between research variables, significant positive correlations were found between extraversion and openness to experience, and advanced. Therefore, the more extroverted students are, the higher their openness to experience and their attitudes towards ICT use. Significant, negative correlations were found between extraversion and neuroticism and complexity. Therefore, the less extroverted students are, the higher their level of neuroticism and their complexity attitudes. Significant negative correlations were found between neuroticism and advanced and motivation. The more neurotic students are, the less their advanced attitude towards ICT and motivation to use ICT. Significant positive correlations were found between openness and advanced and motivation. In other words, the more open to experience students are, the higher their attitude and motivation towards ICT use. A significant negative correlation was found between openness and complexity, meaning that the less students are open to

experience, the higher their level of complexity towards ICT use. A significant positive correlation was found between attitude and motivation; hence, the higher students' attitudes towards ICT use, the greater their motivation to use ICT. In addition, a significant negative correlation was found between complexity and motivation, meaning that the more students perceive ICT use as complex, the lower their motivation to use it.

Aharony & Shonfeld (1997) Pearson correlations were conducted between demographic variables (age and year of study) and ICT use. A significant positive correlation was found only between year of study and ICT use, $r = .23$, $p < .05$. In other words, the higher students' year of study, the greater their ICT use. Researchers also conducted a hierarchical regression analysis, in which the dependent variable was ICT use. The regression explained 32% of ICT use. The predictors were entered as five steps: (1) personal details (group and education); (2) personality characteristics (openness to experience, extraversion, and neuroticism); (3) attitudes towards ICT (advanced and complexity); (4) motivation; and (5) an interaction between the research variables. In the regressions analysis, the entry of the first four steps was forced, while that of the interaction was entered according to its contribution to the explained variance. Table 2 presents the standardized and unstandardized coefficients of the hierarchical regression of respondents' ICT use.

Based on the premises of Rogers' Diffusion of Innovations theory, the Big Five model, and motivation theory, the present research explored the extent to which Rogers' attributes of innovations, personality characteristics, and motivation explain students' ICT use. By addressing these questions, this article makes a number of theoretical and practical contributions: •The findings of this study add another dimension to the importance of Rogers' DOI theory in the fields of Educational Technology and Library and Information Science. •Findings confirm that personality characteristics as well as motivation affect ICT use. •Before dealing with research hypotheses, we would like to discuss the study population. Re-searchers assumed that because ET and LIS students deal a lot with technology, both in their learning environments and later in their professional life, participants would be classified as innovators who wish to experience new ideas and be gatekeepers in their organizations, or at least as early adopters who tend to spread the information about the innovation, decreasing others' uncertainty about it (Rogers, 2003). However, findings indicate that most students can be classified as early majority to whom the innovation decision takes more time than it takes for the innovators or the early adopters, or as late majority who will wait till most of their acquaintances adopt the innovation (Rogers, 2003).

Conclusions

These findings provide a more comprehensive picture, emphasizing the importance of combining elements derived from Rogers' theory and variables from the Big Five Model when trying to understand factors that may impact individuals considering adopting new technologies. In addition, these findings indicate again the fact that instructors in academic settings should be aware of individual differences, trying to make the ICT environment friendlier and less complex, thus in-creasing students' motivation to use ICT, and perhaps changing their predominant status from early majority and late majority to innovators and early adopters. Further, another intriguing finding is that the higher the year of education, the higher students' ICT use. We see that these students, who have already started their studies in technology-oriented programs, use more ICT as they progress in their program. We may infer that there is an effect of the program on the intensity of their ICT use.

Recommendations

The following recommendations were submitted:

1. In order to effectively enhance students' ICT use, instructors should consider individual differences between students and handle or teach them on such notation. As much as possible, hasty generalizations should be discouraged and checked by administrative heads to ensure effectiveness of motivation towards ICT use.
2. Students should also be presented with the advantages and usefulness of ICT, thus increasing their motivation to use ICT, in the hopes that they will become innovators or early adopters.
3. In light of the study, the "Big Five" model of personality traits which are: neuroticism, extraversion, agreeableness, openness to experience, and conscientiousness shows that personality traits are significantly related to Internet use. Therefore, instructors should take note of the traits while encouraging students to use ICT facilities as each individual expresses them differently.

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