Green Information Technology Behavior of Young Generation

Ahmet Fatih Ozkul, Meltem Ozturan

Bogazici University, Turkey

Abstract: - As the role of information technology (IT) in the world has been tremendously increasing each day, its effects on the environment are becoming more crucial for our daily lives. Green IT has been investigated in the literature for almost 15 years since it was first mentioned. It focuses on IT's role in the environment in regard to sustainable practices for both organizations and individuals. This study aims to provide a comprehensive understanding on the precedent effects of green IT behavior of young generation.

In this study, a theoretical model is developed to understand the green IT behavior with several dependent variables. Moreover, a relevant questionnaire is developed for each variable and surveyed through university students in Turkey anonymously. Based on the data collected from 242 respondents, it is concluded that the higher environmentalist behavior and higher green IT awareness significantly lead to a higher statistical IT attitude among students. However, the general IT usage does not come out to have a similar relationship. Also no significant difference is found between the groups of mobile phone usage time and between the gender groups in IT attitude. On the other hand, green IT attitude is found to be positively, statistically and significantly associated with green IT behavior.

Keywords: Green IT Attitude, Green IT Behavior, Young Generation

I. Introduction

The adoption, penetration, and general usage of information technology (IT) have been increasing extremely over the last decade. At the same time, the problems of global climate change, carbon dioxide emissions, and environmental catastrophes have been becoming more crucial issues than ever. An early report indicates that the IT sector could be responsible for 20% of the global energy consumption by the end of 2025 as well as affecting 14% of global carbon emissions by 2040 (Vidal, 2017). To cope with these existential problems, IT's role has been investigated over the last 20 years.

In one of the related studies it was stated that green IT was firstly mentioned back in 2007 in a non-academic business report (Sedera et al., 2017). Green IT generally points out the financial as well as environmental implications of human efforts, with a focus on forms of decrease in energy waste, measures in cost-cutting, reduction in carbon emission, dealing with poor e-waste management, and contamination of environmental effects of hazardous IT devices (Linehan & Fisher, 2018; Przychodzen, Gómez Bezares, & Przychodzen, 2018).

In this manner, research questions for this study are stated as follows:

- What are the factors affecting the green IT behavior of individuals?
- What factors influence the overall green IT attitude?
- What is the general level of awareness of green IT?

Not only were there fewer green IT studies focused on individuals' green IT behavior but also green IT practices within universities have been less investigated in emerging countries (Hernandez, 2019). Hence, university students in Turkey were chosen as the appropriate population for this study.

In this study a survey is conducted to analyze the current factors that affect the green IT behavior of university students. It is hypothesized that high levels of green IT awareness, of general IT usage, of environmentalist behavior lead to a high level of green IT attitude which then eventually lead to a high level of green IT behavior among university students.

II. Literature Review

In this section, green IT studies that were mainly conducted in universities, are discussed.

Din, Haron, and Ahmad (2013) investigated Malaysian State University students' knowledge of green IT. The results indicated a general lack of knowledge on different perspectives of green computing, especially with respect to the policy of green technology of the Malaysian government, printer types and their power consumption, energy-efficient behaviors, and hazardous materials existing in computer hardware. Dalvi-Esfahani et al. (2020) studied assessing green IT behavior of students with theory of planned

behavior (TPB) along with moderating variables through a survey given to university students. It was found that perceived behavioral control, attitude towards green IT, and personal norms greatly affected the intention to practice green IT behavior along with the following moderating variables: openness to experiences, conscientiousness, and agreeableness. Dezdar (2017) broadened TPB by applying the personality norms of openness and consideration of future outcomes to investigate the green IT practice behavior of students. It was reported that students' adoption of green IT behavior can be clearly defined by TPB and personality traits. Bulut, Kokalan, and Dogan (2017) studied the sustainable consumption behavior difference among several generations in Turkey. The results indicated that generation is linked with excessive consumption as an aspect of sustainable consumption adoption. Moreover, the Y generation has the highest level of awareness for energy-efficient equipment among the other concepts in terms of green IT (Dogan & Atasagun, 2016). In a university in United Arab Emirates (UAE), university students were given surveys to be evaluated on their green computing knowledge and assessment (Abugabah and Abubaker 2018). The findings indicated that students' level of knowledge of green computing is high whereas their daily behavior of green computing is not enough. Hernandez (2019) investigated the level of green IT awareness and green IT practices of university students in the Philippines. The results from the distributed survey showed that there is an average level of green IT awareness whereas lack of green IT practices among higher education students. On the other hand, Ojo`` and Downe (2019) and Esfahani et al. (2015) demonstrated in their studies that green IT attitude is an important and a direct factor that affects green IT behavior.

III. Theoretical Model and Hypothesis Development

Overview of the theoretical model

Having highlighted the importance of green IT adoption in the previous chapters, this study aims to investigate the factors that affect the green IT behavior of the young generation. A theoretical model is provided in Figure 1. Independent variables consist of environmental behavior, green IT awareness, general IT usage, and demographics that affect green IT attitude which in the end influences the dependent variable, green IT behavior.
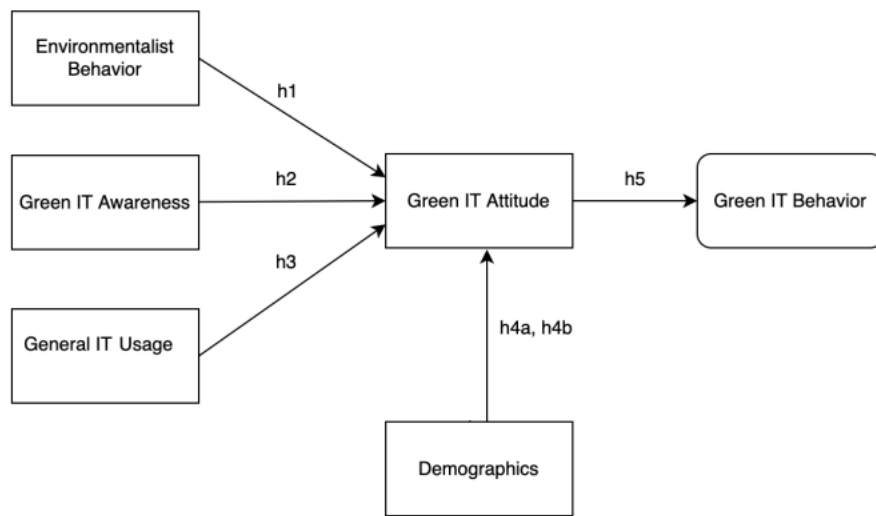

Figure 1. Research Model

Hypothesis development

Alongside the theoretical model illustrated in Figure 1, 6 hypotheses were developed to demonstrate how these variables affect each other. The existing literature performed as the basis for the expected results. The general IT usage, green IT awareness, environmentalist behavior and demographics were taken as the independent variables, green IT attitude was taken as the intermediary variable and the green IT behavior was taken as the dependent variable. It is expected to have positive correlation between all of these variables

H1: Environmentalist Behavior is positively associated with Green IT Attitude

There are not sufficient studies focused on the study of IT users' beliefs and behavior about green IT (Gholami et al., 2013; Tushi, Sedera & Recker, 2014). Because of the nature of green IT, it is assumed that the level of environmental responsibility will significantly affect the individual acceptance of green IT (Yoon, 2018). Moreover, it has been stated that the lack of environmental awareness results from cognitive limitations, which can be related to the pace of ecological problems in general (Kollmuss &

Agyeman, 2002). Thus, environmental knowledge can change a person's cognition and emotional state on sustainable practices (Ojo & Fauzi, 2020). Furthermore, it is seen that ecological knowledge is important in determining young consumers' green engagement and their purchase behaviors (Kanchanapibul et al., 2014). Therefore, the environmentalist behaviors of young generations should also be questioned in assessing green IT behavior. Moreover, it is seen that environmentalist individual practices of IT professionals along with green IT beliefs and attitudes significantly influence their green IT behavior (Molla, Abareshi & Cooper, 2014). Therefore, since environmentalist behavior is likely to affect attitudes toward green IT, it is put forward as an input variable along with others in the given research model Figure1.

H2: Green IT Awareness is positively associated with Green IT Attitude

Green IT attitude describes people's opinions on environmental sustainability with the effect of IT (Molla & Abareshi, 2011), which include awareness of IT's effect on ecological sustainability. Furthermore, green IT awareness leads to recognition of practical policies, acceptance of required regulations, and the total benefits and positive results stemming from green IT development. (Ansari et al., 2010; Chou & Chou, 2012). An early study by Hernandez (2019) indicates that higher education students demonstrated an average level of green IT awareness but have insufficient green IT behavior practices. It is important to put forward that green IT awareness might have a positive impact on green IT attitude.

H3: General IT Usage is positively associated with Green IT Attitude

Although Yoon (2018) states that "Green IT, an information technology for protecting the environment, does not have hedonic characteristics or require compulsory use of the technology", the general IT usage of students is important in assessing the green IT behavior. In this study, it is questioned whether there is a difference among students' green IT attitude concerning their general IT usage.

H4A: There is a statistical significant difference between age groups in affecting Green IT Attitude

H4B: There is a statistical significant difference between students' areas of study in affecting Green IT Attitude

Earlier studies not only addressed the role of external (institutional, geographical, etc.) and internal (e.g., attitudes, awareness) factors in regard to ecological sustainability but also pointed out the role of demographics played as well (Csutora, 2012). Therefore, demographics including age groups and areas of study of students are considered as an input in influencing green IT attitude.

H5: *Green IT Attitude is positively associated with Green IT Behavior*

Ojo and Fauzi (2020) investigated the factors of IT professionals' green IT beliefs and attitudes toward green IT practices for environmental performance with the belief action and outcome (BAO) groundwork of (Melville, 2010). It is seen that there is a significant effect of environmental consciousness in influencing IT professionals' attitudes towards green IT. In addition, their attitude was a crucial mediator in practicing green IT behavior. (Ojo & Fauzi, 2020). Moreover, earlier studies demonstrated that employees in the IT sector with positive green IT attitudes tend to realize green IT behaviors more than others. (Molla, Abaresji & Cooper, 2014; Ojo, Raman & Downe, 2019). Furthermore, people with more positive attitudes regarding green IT are more likely to embrace such behaviors and technologies (Sadaf, Newby & Ertmer., 2012). Therefore, green IT attitude is selected as an immediate antecedent variable before green IT behavior.

IV. Research Design

Aiming to test the hypotheses of the theoretical model, a digital questionnaire was developed using Google Forms. For each variable in the research model, except demographics, multi-item scales were constructed and illustrated in the survey with a 5-point Likert Scale which is ranged either between "Strongly Disagree" and "Strongly Agree" or "Never" and "Always". The questions in the questionnaire were not only inherited from the existing studies but also developed uniquely for this study. At first, all questions were written in English and then translated to Turkish. It is distributed in Turkish because the target audience of the study's native language is Turkish. Moreover, additional consultations regarding area-specific terminology usage were discussed with the related area academicians at Bogazici University.

To reach out to as many university students as possible in Turkey, convenience sampling was used. More than 10 universities' academicians were asked through email to distribute the questionnaire to their students. Moreover, the quick response (QR) code belonging to the questionnaire link was shared within university campuses. In addition, apart from email, the link was also shared digitally within university students' chat groups in a chatting mobile app, Whatsapp.

In total 252 students filled out the survey. 10 of them were deleted later because incomplete questions were detected in the answers. Hence, only the reliable correspondents (n=242) were left to proceed with the further analysis.

V. Results and Findings

In this section first, the descriptive statistics in regard with the data set are illustrated. Later, the multi-item scales are demonstrated. After that, several exploratory analyses are performed for the research questions before hypothesis testing. Lastly, the test results of the hypotheses are presented. Microsoft Excel and IBM SPSS Statistics Software are used to perform the analyses in the study.

Descriptive Statistics

Firstly, the respondents are grouped based on their area of study. It is worth mentioning that only 45 students out of 242 (18,6%) of the respondents were studying in IT-related areas such as Management Information Systems, Computer Engineering, and Computer Education Technology. The majority of the respondents (60) were from the arts and sciences areas whereas the minority (22) was from medicine. Distribution of the areas of the students can be seen in Table 1.

Table 1. Areas of the Study of Students of the Sample

Area of the Study	Number	Percentage
Information Technology	45	18.6%
Education Sciences	49	20.2%
Arts and Sciences	60	24.8%
Economics and Administrative Sciences	42	17.4%
Engineering	24	9.9%
Medicine	22	9.1%
Total	**242**	**100.0%**

When the students' academic degrees are considered, it can be seen from Table 2 that the majority was from Bachelor's (144) holding the share from the total as 59.5%. The minority was from Ph.D. students (6) accounting for 2.5% of the total. However, the graduate students (master's + doctoral) account for 22.2% making them the second majority (54) after Bachelor's because prep students (44) consisted only 18.2% of the total sample.

Table 2. Academic Degrees of the Students of the Sample

Academic Degree	Number	Percentage
Prep School	44	18.2%
Bachelor's	144	59.5%
Master's	48	19.8%
Doctoral	6	2.5%
Total	**242**	**100.0%**

Investigating the ages indicates that the majority of students were ranging from 20 to 22 (90) which was 37.2% of the total sample. Age group distribution can be seen in Table 3.

Table 3. Age Groups of the Students of the Sample

Age Groups	Number	Percentage
17 - 19	50	20.7%
20 - 22	90	37.2%
23 - 24	47	19.4%
> 24	55	22.7%
Total	**242**	**100.0%**

Furthermore, the average time spent on mobile phones during a day is examined. The majority with 161 people (66.5%) defined themselves as they use their phones more than 3 hours in a day regularly. Table 4 indicates that only 81 (34%) of the respondents engaged with their phones less than 3 hours in a day.

Table 4. Time Spent on Mobile Phones During a Day

Time spent on mobile phones during a day	Frequency	Percentage
Less than Hours	81	33.5%
More than 3 Hours	161	66.5%
Total	**242**	**100.0%**

It is seen from Table 5 that 55% of the respondents (134) are female, which constitutes the majority when compared to male respondents.

Table 5. Gender Statistics of the Sample

Gender	N	Percentage
Female	134	55.4%
Male	97	40.1%
Didn't specify	11	4.5%
Total	242	100.0%

Multi-item Scales and Reliability

After the illustration of descriptive statistics, reliability tests were performed for the multi-item scales for all the variables of the study, including both independent and dependent variables. Therefore, Cronbach's alpha values were analyzed for each variable in the questionnaire. It is known that if the Cronbach's alpha value is above the limit of 0.70, it can be put forward that the scale can be accepted as reliable. Table 6 illustrates Cronbach's Alpha Value for each variable.

Table 6. Cronbach's Alpha Values of Variables

Variable	Number of Items	Cronbach's Alpha Value
General IT Usage	12	0.830
Green IT Awareness	14	0.904
Environmentalist Behavior	10	0.861
Green IT Attitude	5	0.888
Green IT Behavior	20	0.921

Exploratory Analysis

Before proceeding with hypothesis testing, the characteristics of the respondents for enlightening the answers to the research questions is investigated. For this purpose it is analyzed to see if there is a significance difference between the groups related to phone usage time and to gender in green IT attitude. Independent samples t-tests are conducted for these analyses where the results can be seen in Table 7. As can be seen from Table 7, there is no statistical significant difference between the groups of mobile phone usage time and for gender (p values are greater than 0.05).

Table 7. Results of Independent Samples t-Tests for Green IT Attitude

Green IT Attitude	t	p
Mobile Phone Usage Time (≤3 hours; >3 hours)	0.385	0.701
Gender (Male; Female)	0.594	0.553

Hypothesis Testing

In order to test the hypotheses mentioned before, multiple linear regression and ANOVA analyses are conducted.

At first, in order to analyze how much of the variance of the intermediary variable can be attributed to the model, multiple linear regression is conducted among Green IT Awareness, General IT Usage and Environmentalist Behavior. From Table 8, it is seen that multiple correlation coefficient R is 0.63, which indicates a good level of prediction. R Square, the coefficient of

determination, is however equal to 0.40 that it might have been expected to become much higher. By looking at the ANOVA section of Table 8, it is seen that F=52.342 and Significance F is below 0.05; therefore, it can be concluded that the overall regression model is a good fit for the data and that the independent variables statistically significantly predict the dependent variable, Green IT Attitude, in this case.

It is seen that H1: "Environmentalist Behavior is positively associated with Green IT Attitude" cannot be rejected since P-value is lower than 0.05. It is statistically significant and positively associated in predicting Green IT Attitude.

It is also seen that H2: "Green IT Awareness is positively associated with Green IT Attitude" cannot be rejected since P-value is lower than 0.05. It is statistically significant and positively associated in predicting Green IT Attitude.

However, H3: "General IT Usage is positively associated with Green IT Attitude" can be rejected since P-value (0.33) is much higher than the threshold (0.05).

Table 8. Multiple Linear Regression Analysis Results

Regression Statistics	
Multiple R	0.63
R Square	0.40
Adjusted R Square	**0.39**
Standard Error	0.63
Observations	242

ANOVA					
Model	df	SS	MS	F	Significance F
Regression	3	62.8	20.9	**52.342**	**0.000**
Residual	238	95.2	0.4		
Total	241	158.1			

Coefficients				
Predictors	Coefficients	Standard Error	t	P-Value
Constant	0.26	0.29	0.90	**0.370**
General IT Usage	0.06	0.07	0.97	**0.334**
Environmental Behavior	0.30	0.08	3.72	**0.000**
Green IT Awareness	0.46	0.08	5.76	**0.000**

To investigate the statistically significant differences between age groups in predicting Green IT Attitude, a one-way between-groups analysis of variance is performed. Students are divided into 4 age groups as indicated in Table 9. It is seen from Table 9 that the P-value between groups is much higher than 0.05, indicating that there is no statistically significant difference among age groups in predicting the Green IT Attitude. Hence, H4a: "There is a statistically significant difference between age groups in affecting Green IT Attitude" can be rejected.

Table 9. Age Groups' ANOVA Results

SUMMARY				
Groups	N	Sum	Average	Variance
17 – 19	50	177.8	3.556	0.619
20 – 22	90	316.4	3.516	0.827
23 – 24	47	166.6	3.545	0.483
>24	55	191	3.473	0.587

ANOVA						
Source of Variation	SS	df	MS	F	P-Value	F crit
Between Groups	0.218	3	0.073	0.110	0.954	2.643
Within Groups	157.867	238	0.663			
Total	158.085	241				

Similarly, in order to investigate the statistical significant differences between students' areas of study in predicting Green IT Attitude, a one-way between-groups analysis of variance was conducted. Students were grouped into 6 areas as seen in Table 10. It is seen from Table 10 that there is no statistically significant difference of students' areas of study in predicting Green IT Attitude because the P-value for between groups is much higher than the threshold of 0.05. Hence, H4b: "There is a statistical significant difference between students' areas of study in affecting Green IT Attitude" can be rejected.

Table 10. Areas of Study's ANOVA Results

SUMMARY				
Groups	N	Sum	Average	Variance
IT Related	45	165.6	3.680	0.490
Educational Sciences	49	166.6	3.400	0.743
Arts & Sciences	60	208	3.467	0.523
Economics & Administrative Sciences	42	147.4	3.510	0.886
Engineering	24	85.2	3.550	0.627
Medicine Related	22	79	3.591	0.813
ANOVA						
Source of Variation	SS	df	MS	F	P-Value	F crit
Between Groups	2.165	5	0.433	0.655	0.658	2.252
Within Groups	155.920	236	0.661			
Total	158.085	241				

In order to investigate the positive association between the median independent variable, Green IT Attitude, and the dependent variable, Green IT Behavior, single linear regression is performed. By looking at Table 11, it is seen that Multiple R is 0.60 indicating a good level of prediction. In addition, R Square is 0.36 and as seen from ANOVA section that Significance F is lower than 0.05 and F is 136.750 which demonstrates that the overall model is a good fit in explaining statistically significant association of the dependent variable. Moreover, from Coefficients part of Table 11, it is also seen that Green IT Attitude has a P-value less than 0.05 indicating a proof of statistically significant association. Therefore, it can be concluded that Green IT Attitude is positively associated with Green IT Behavior, hence H5 can be accepted.

Table 11. Single Linear Regression Results Between Intermediary and Dependent Variable

Regression Statistics	
Multiple R	0.60
R Square	0.36
Adjusted R Square	**0.36**
Standard Error	0.59
Observations	242
ANOVA					
Model	df	SS	MS	F	Significance F
Regression	1	47.9	47.9	**136.750**	**0.000**
Residual	240	84.0	0.4		
Total	241	131.9			

Coefficients				
Predictors	Coefficients	Standard Error	t	P-Value
Intercept	1.72	0.17	10.15	**0.000**
Green IT Attitude	0.55	0.05	11.69	**0.000**

VI. Conclusion

This study was conducted to understand the precedents of green IT behavior of young generation. Since, each day IT's effect on the environment gets critical, it was considered important to investigate the young generation's environmentalist IT behavior. Students in Turkey, which is an emerging country, were selected as an appropriate sample to be surveyed because in the literature, there are less green IT behavior studies focused on emerging countries. In addition, there were less green IT research focused on young generation than the IT professionals and organizational level settings.

Looking at the results, it is demonstrated that General IT Usage was not whatsoever positively, statistically and significantly associated with the predictions of Green IT Attitude. In addition, students' areas of study also do not statistically and significantly differ from each other in Green IT Attitude. Therefore, whether a student studies in IT-related departments or has a quite high IT usage level does not necessarily make him/her a green IT adoption nor a person that has a high level of green IT attitude. Moreover, students' age groups are also not different from each other in affecting the green IT attitude.

Moreover, the gender do not differ corresponding to Green IT Attitude and also mobile phone usage time also does not make a difference as well. These also put forward that demographics do not have a statistically proven effect on determining their green IT attitude hence behavior.

It is also worth mentioning that Environmentalist Behavior and Green IT Awareness have indeed a positive association with the Green IT Attitude. In other words, if a student, generally speaking, has a much higher environmental attitude, it is seen that his/her attitude on IT could also be greener than the others despite the differences of areas of study and ages.

Lastly, it is seen that the Green IT Attitude has a positive effect on Green IT Behavior among students. Therefore, as also proved in early literature, it can be concluded that Green IT Attitude is a direct precedent of Green IT Behavior in this study.

The findings of the study demonstrate that there is a certain pattern among young generation to adopt green IT behaviors as discussed in previous studies like green IT behavior being solely and statistically related to their green IT attitude. However students' demographic features and IT usage do not make a difference in their green IT attitude as revealed in these studies. Based on these findings it can be suggested that, in universities academicians should focus on enriching the green IT attitude of students to have them adopt green IT practices by leading pro-environmentalist practices and enhancing green IT awareness in campuses.

Both for limitation and for further study, it should be considered that this study was only conducted in Turkey. Since there is a gap for emerging countries in dealing with green IT behavior of students, more comprehensive studies in several contexts such as studies among multiple emerging countries can be conducted.

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