DIGITAL NATIVES AND DIGITAL IMMIGRANTS: A COMPARATIVE STUDY OF GREEN ICT-RELATED KNOWLEDGE AMONG MALAYSIAN TEACHERS'

Mohd Sukri Shafie, Rabiatul-Adawiah Ahmad Rashid
Universiti Sains Malaysia

Abstract

In line with the provision of ICT resources and infrastructures by the Ministry of Education (MOE) for the benefit of teaching and learning in schools, the idea of integrating Green ICT in the field of ICT management in schools has been inspired. Green ICT that has been outlined by the Ministry of Energy, Green Technology and Water (KeTTHA) is seen to be important to balance the implementation of ICT in schools where elements of environmental preservation from inefficiency use of technology can be applied from teachers to students at the early stage. The study examined the level of Green ICT-related knowledge among digital native teachers and digital immigrant teachers. The overall sample comprised 358 teachers. Descriptive statistics, independent sample T-test and Two-way ANOVA were used to analyse the data. Result revealed that a majority of teachers were lacked knowledge on Green ICT. However, digital native teachers displayed a better understanding on Green ICT characteristics compared to digital immigrant teachers, while digital immigrants teachers were more sensitive on current environmental issues compared to digital native teachers. The importance of knowledge gaps related to Green ICT was identified and discussed.

Keywords*:* digital natives and digital immigrant, green ICT, teacher's knowledge, sustainability

Introduction

ICT refers to Information and Communication Technology and it's already become the main agenda in the Ministry of Education (MOE) Malaysia. They are focusing on the need to enhance the knowledge dissemination, integration and to create the culture using technology in schools (MoE, 2012).

Through this objective, policies and strategic plans for school was created in order to support and monitor the implementation of ICT by teachers in schools including the ICT management. The ICT management also covered the ICT infrastructure, application of ICT, ICT technical and the reporting from time to time to the Ministry of Education (MOE, 2009). It also includes step by step approaches to strengthen the ICT culture in schools that involved process of teaching and learning (MoE, 2008).

In this initiative, some of the experts believed that ICT is already becoming more fun and flexible when its can help teachers implement appropriate activities in their teaching sessions (Nur Qistina and Hazman, 2010). ICT is also said to be able to help and motivate students to develop a high level of thinking and also can increase the academic achievement in schools examination (Siti Fatimah et al., 2004).

Despite these fun and improvements, according to Nur Qistina and Hazman (2010) and Zaitun and Hamiyah (2011) there is a major barrier to ICT skills in which there is still a digital gap between generations of young teachers and generations of veteran teachers. Prensky (2001) describes the generation of young teachers or is called the digital natives generation is said to be friendlier with communication technology compared to the generation of veteran teachers so called the digital immigrants' generation.

At the same time, the Ministry of Energy, Green Technology and Water (KeTTHA) Malaysia also have realized that, the Green ICT also plays an important role in reducing carbon emissions that contribute to environmental issues related to global warming and climate change (KeTTHA, 2010). Green ICT is seen as a form of ICT management in terms of the procurement, use and disposal of equipment in efficient and effective ways with minimal impact or no impact to the environment (MAMPU, 2012). Moreover, Green ICT campaign through the Green ICT guideline produced my MAMPU has already been enforce to the public servant.

In this case, as the implementation of ICT in schools become important to strengthen the teaching and learning in schools, Green ICT is also important as an innovative way to stabilize the implementation of ICT that related to preservation and conservation of the environment and a sustainable future (Kavita and Sameer, 2014). Significantly, implementation of Green ICT in schools will enable awareness of Green ICT to be created among the schools teachers when ICT resources were used in the process of teaching and learning. Importantly when this awareness could be transferred to the students in the establishment of a sustainable culture for the future. Therefore, in order to initiate the implementation of Green ICT in schools, there is the need to study and explore the level of the existing knowledge of the teachers in Green ICT in schools. In addition, when there is no approached taken by MoE related to the important of Green ICT education in the schools level, its make no initiative taken by the schools involving teachers and students in addressing these issues even though the matter has been publicize by the government.

Teachers Generation of Digital Natives and Digital Immigrants

Digital natives and digital immigrants are the terms used to show the difference in generations born after and before the era of communication technology development that refers to the use of computers and the internet (Prensky, 2001). According to Prensky (2001), digital natives refers to the generation of teachers born after 1980 and digital immigrants referring to generations of teachers that were born before 1980.

Green ICT and Education Requirements

Tomayess et al. (2014) argues that Green ICT is an approach that should be implemented in educational institutions in this century. This is because the present generation of ICT native need to be strengthen their knowledge so that inefficient use of ICT can be avoided. At the same time, educational institutions globally have started to build awareness among their communities in order to address environmental issues through Green ICT approach (Kavita and Sameer, 2014). One of factor that Green ICT initiative started from the school is due to the awareness of environmental issues is growing worldwide and schools would be the best platform to implement it.

According to Susaporn Chai and Keiichi (2011), United Kingdom is the first country to focus in implementation of Green ICT in the higher education institutions and the changes in government policy. The initiatives taken by the United Kingdom is seen as the best step to educate the younger generation with the targets that have been placed to reduce emissions of carbon gas in the country by 26% by 2020. From the observation, Green ICT initiative also has been given attention to be implemented in higher education institutions by countries such as the Netherlands, India and Australia (Albert, 2013; Kavita and Sameer, 2014).

Although the Green ICT in the education system of Malaysia has not been emphasized by the government yet, Green ICT initiative has been given attention by the government especially for the public servant (MAMPU, 2010). Indirectly, this initiative can provide early exposure to the society that are concerned to environmental issues, which is actually in line with the requirements of the Green ICT education in the present.

Methodology

Population and Sample

This study adopted a quantitative research design. The study population is national type secondary school teachers from a chosen state in Malaysia. The total number of the study population is 5197 teachers. In general, teachers from national type secondary schools were frequently involved in environmental related programmes and activities organized by the State Education Department.

Based on Krejcie and Morgan (1970), table of sampling, the study identified 357 teachers as respondents of the study. These respondents were teachers from 26 national type secondary schools. The sampling technique used in identifying these respondents is simple random sampling.

Instrumentation

As for the research instrument, an adapted questionnaire was used. The questionnaire was adapted from an instrument meant to investigate respondents' knowledge on renewable energy (RE) and Energy Efficiency (EE) by CETREE (2004). The instrument was divided into a section on respondents' demography and one constructs with 10 items. The construct of the instrument is a knowledge of Green ICT. The distribution structure of the questionnaire consists of Green ICT needs, Green ICT features (acquisition, use and disposal), application related to Green ICT management, source of carbon producers and existence of global warming and climate change.

Data Analysis Procedure

Descriptive and inferential analysis was carried out using Statistical Package for the Social Sciences (SPSS) software in this study. Feedback from respondents was encoded and values were given based on questionnaire questions. Here, the level of knowledge of secondary school teachers according to the aspects described in the questionnaire was measured. In the questionnaire, descriptive analysis methods were used with correct and incorrect answers were summed up in order to know the level of respondents' knowledge of Green ICT. T-test was used to see the difference in knowledge of respondents involving the birth year of the digital natives and digital immigrants. A two-way ANOVA was used to examine the difference in knowledge of respondents involving the birth year of the digital natives and digital immigrants, the teaching experience and the level of respondents' education.

Findings

The results from the descriptive analysis revealed that the mean score for teachers' knowledge of Green ICT was at a low level of 2.17. The findings also include some aspects of the identified teacher knowledge that are being studied and become the focus of the study as in the Table 1.

Table 1: Level of Teachers' Knowledge on Green ICT

Topic	Mean Score	Level
The Needs on Green ICT	1.00	Low
Characteristics of Green ICT - procurement, usage and disposal	1.40	Low
Applications on Green ICT	1.70	Low
Source of carbon gas producer	3.00	Medium
Global warming and climate change	3.48	Medium
Overall Mean Score	2.17	Low

The following selected tables illustrates the details of the aspects studied based on the knowledge of secondary school teachers towards Green ICT.

Referring to Table 2, for Green ICT procurement characteristics, teachers have chosen the highest percentage of energy-efficient labelling and SIRIM certificates.

Table 2: Teachers' Knowledge on Green ICT Characteristics – Procurement

Green ICT Characteristics - Procurement Purchasing of Green ICT products that have Green features	Frequency (N=358)	Percentage (%)
Energy efficient labelling	248	69.3
Energy efficient rating	130	36.3
Low voltage	97	27.1
User manual	111	31.0
Certified by Energy Commission	118	33.0
Certified by SIRIM	172	48.0
Brand	36	10.1
Latest model	42	11.7
Product size	50	14.0
Recyclable components	143	39.9
Low components of toxic materials	115	32.1
High performance	88	24.6
Not to know	55	15.4

Referring to Table 3, focusing Green ICT usage characteristics, teachers have opted for the highest percentage, including turn off the switch after use, activate eco mode and activate standby mode.

Table 3: Teachers' Knowledge on Green ICT Characteristics – Usage

Green ICT Characteristics - Usage The practices of Green ICT in daily activities	Frequency (N=358)	Percentage (%)
Enable screen saver	127	35.5
Enable standby mode	156	43.6
Turn off the switch after use	208	58.1
Enable multi-display facilities	80	22.3

Use thin client	47	13.1
Activate high performance mode	38	10.6
Enable eco mode	163	45.5
1 computer for 1 printer	28	8.1
Use video conferencing	71	19.8
Increase use of wireless service	110	30.7
Increase use of email and messenger application	138	38.5
Increase use of online service	87	24.3
Not to know	59	16.5

In Table 4, for Green ICT disposal characteristics, teachers have opted for the highest percentage on follow the asset disposal procedure, recyclable and not pollute the environment.

Table 4: Teachers' Knowledge on Green ICT Characteristics – Disposal

Green ICT Characteristics - Disposal Disposal of ICT products with procedures that take into conservation of the environment	Frequency (N=358)	Percentage (%)
Plant	73	20.4
Burn	25	7.0
Throw in garbage	22	6.1
Follow the asset disposal procedure	205	57.3
Expired lifetime	85	23.7
Excess stock	18	5.0
Exceed needs	18	5.0
Can be resold	87	24.3
Can be recycle	191	53.4
Not pollute the environment	181	50.6
Broken products cannot be used	45	12.6
Auctions	38	10.6
Not to know	65	18.2

Referring to Table 5, most of the teachers have agreed with the high percentage of global warming and climate change in which "It has been proven to be a serious problem as it is urgently needed to address it".

Table 5: Teachers' Knowledge on Global Warming and Climate Change

The existence of Global Warming and Climate Change	Frequency (N=358)	Percentage (%)
Not sure	35	9.8
It has been proven to be a serious problem as it is urgently needed to address it	262	73.2
There is enough evidence therefore some action has to be taken	75	20.9
I do not know very much about this therefore research has to be done before I do something about it	34	9.5
The existence of such is a lies of scientists	3	0.8

Findings of the research also proved that there is a knowledge gap between two generation of teachers; digital native teachers and digital immigrant teachers. Further analysis indicate that digital natives teachers achieve higher mean score in the aspect of characteristics of Green ICT, but lower mean score in the aspect of global warming and climate change as compared to teachers from the digital immigrants generation. Since characteristics of Green ICT is a new knowledge as prescribed by KeTTHA (2009), it could be understood that digital natives generation (or new generation as named by Antonio et al. (2012)), might have an advantage in understanding and processing new information related to technology. However, the aspect of global warming and climate change, are more sensitively noted by digital immigrant teachers might be due to their life experience in dealing with nature and the environment.

Mean Score

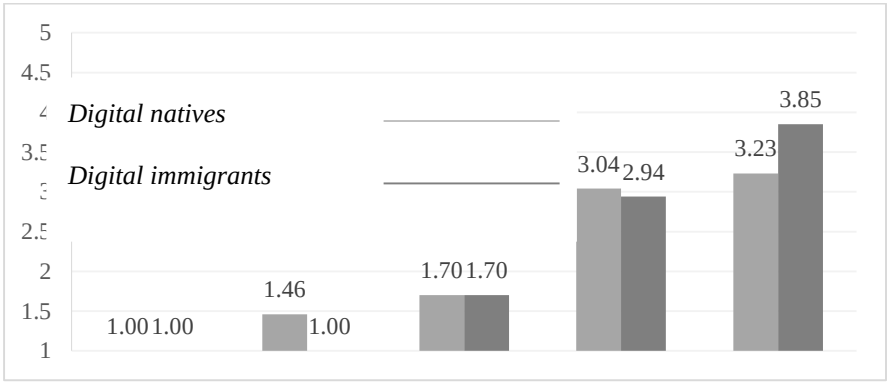

Figure 1: *The Achievement Profile of Teachers' Knowledge on Green ICT (Digital Natives and Digital Immigrants)*

The Needs of Green ICT	Characteristics of Green ICT - procurement, usage, disposal	Applications on Green ICT	Source of carbon emission	Global warming and climate change

In the inferential analysis, T-test and Two-way ANOVA were used. Normality test were also done before those parametric tests were used to analyse the data. Table 6 shows the results of differences in variables studied for knowledge of Green ICT that involved secondary school teachers.

Table 6: Result of Inferential Analysis for Teachers' Knowledge on Green ICT

Variables for Teachers' Knowledge on Green ICT	Analysis	Result
The difference in Green ICT knowledge based on the year of birth (digital natives and digital immigrants)	T-test	Significant
Interaction effect of Green ICT knowledge interaction based on birth year (digital natives and digital immigrants) and teaching experience	Two-way ANOVA	Not significant
Interaction effect of Green ICT knowledge based on the birth year (digital natives and digital immigrants) and education level	Two-way ANOVA	Significant

Based on the result above for T-test, there was a significant difference in birth year variables involving digital natives and digital immigrants for teachers' knowledge of Green ICT ($t = 2.07$; $p < 0.05$). Therefore, teachers' knowledge of Green ICT for digital natives ($M = 40.65$, $S.P = 15.67$) is not the same as teachers' knowledge of Green ICT for digital immigrants ($M = 36.92$, $S.P = 16.04$).

Table 7: T-test Result for Teachers' Knowledge on Green ICT based on Birth Year

Year of Birth	Number	Mean (M)	Standard Deviation (S.D)	T-value	Significant (p)
1980 and above (digital natives)	215	40.65	15.67	2.07	0.04
1979 and below (digital immigrants)	143	36.92	16.04		

Two-way ANOVA analysis also found that there was significant mean difference for birth year variables involving digital natives and digital immigrants at a significant level of 0.05 ($F(1,349) = 4.43$; $p = 0.04$), but there was no significant mean difference for education level variable at a significant level of 0.05 ($F(3,349) = 1.59$; $p = 0.18$)

However, referring to Table 8, there is a significant interaction of the mean for birth year variables involving digital natives and digital immigrants and education level for teachers' knowledge towards Green ICT at a significant level of 0.05 ($F(3,349) = 3.15$; $p = 0.03$).

Table 8: Two-way ANOVA Result for Teachers' Knowledge on Green ICT based on Birth Year and Education Level

Variables	Sum of Squares	Degree of Freedom (df)	Mean Square	F Value	Significant (p)
Birth year	1080.06	1	1080.06	4.43	0.04
Education level	1549.33	4	387.33	1.59	0.18
Birth year * education level	2304.06	3	768.02	3.15	0.03
Error	85050.12	349	243.70		

Discussion

Based on the findings, the researchers believed that teachers are also not given thorough knowledge on issues related to environmental problems, including its cases and effects, the proper usage technological equipment and devices and so forth. Yet, they were only exposed to methods in environmental care; through recommended activities. Thus, it could be said that teachers' basic knowledge on environmental care is insufficient. Without having strong foundation on knowledge related to environmental care including in proper handling and usage of technological equipment's and devices, the researchers believed that any continuous and committed effort in practising Green ICT is not possible as suggested by Kollmuss and Agyeman (2002). Besides, as discussed by Zaini (2008), discussion and information given to teachers and students on environment are usually theoretical in nature; rather than practical.

Referring to knowledge gap on Green ICT among two group of teachers namely the digital natives and the digital immigrant, there are two main aspects of the knowledge that have a significant difference between these two generations which were knowledge aspect of the Green ICT characteristics involving the procurement, usage and disposal and aspects of global warming and climate change. Findings show that digital natives' teachers achieved a higher mean score of knowledge in the aspects of Green ICT characteristics but achieved a lower mean knowledge score in terms of the existence of global warming and climate change compared to digital immigrants' teachers. In this studies, it is undeniable that Green ICT characteristics are a new knowledge outlined by KeTTHA (2009). The digital natives or is known as a new generation by Antonio et al. (2012), has the advantage of this through thinking and using thoughts when it involves things for processing new technology-related information. In a reviewed on the aspect of global warming and climate change, researchers think teachers of digital immigrants are more aware of current environmental issues due to their age factor. This can be explained when the majority of teachers of this generation agreed that "there are evidence that global warming and climate change are a serious problem" compared to the teachers of the digital natives.

The finding from the studies also found that teachers of digital natives with the Master's Degree and Educational Diploma have a high knowledge gap compared to teachers of digital immigrants for similar qualifications. While it is assumed that the level of education provides differentiated knowledge based on intellectual input and experience, it can be seen that the factors of these two generations are born in different eras actually do not affect the level of education. As discussed earlier by Prensky (2001), teachers of digital immigrants have different approaches such as internet resources to become second sources of information while search agents and printed sources become the first source of information in order to gain the knowledge. This is different for digital natives who take the opposite action. Thus, the same approach is also practiced by both generations during the process of obtaining the educational qualifications which also has no effect on the nature of the digital natives and digital immigrants towards the technology.

Conclusion

Knowledge on Green ICT in schools is paramount in order to ensure the environmental education sustainable. This call for several approaches that can be proposed and discussed as the contents of the new guidelines that will strengthen the knowledge of Green ICT for teachers in schools. Teachers will require not only to acquire subject matter content, but also apply appropriate planning and method for knowledge dissemination strategies prepared by the government.

References

Albert Hankel. (2013). Green IT Practices in Dutch Higher Education. SURF net.

Antonio Calvani, Antonio Fini, Maria Rarieri and Patrizia Picci (2012). Are young generations in secondary school digitally competent? A study on Italian teenagers. *Computers & Education 58 (2012) 797–807.*

Kavita Suryawanshi and Sameer Narkhede. (2014). Green ICT at Higher Education Institution: Solution for Sustenance of ICT in Future. *International Journal of Computer Applications 107(14):35-38.*

KeTTHA (Ministry of Energy, Green Technology and Water). (2010). Green Practices KeTTHA. Electronic Document.

Kollmuss, A. and Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research 8(3): 239-260.*

Krejcie, R.V. and Morgan, D.W. (1970). Determining sample size for research. *Educational and Psychological Measurements, 30, 607-610.*

MAMPU (Malaysian Administrative Modernisation and Management Planning Unit). (2010). Guidelines on the Use of ICT towards Green ICT in Public Service. http://www.mampu.gov.my/documents/10228/12760/final+GP+GreenIT.pdf/13505223-7221-4fe8-9822-371ef0d68b82

MoE (Ministry of Education Malaysia). (2008). Implementation Guide (Smart School Qualification Standard): Best Practices for ICT Culture in Smart Schools. *Education Technology Division, Ministry of Education Malaysia*. ISBN 978-967-5100-09-3.

MoE (Ministry of Education Malaysia). (2009). MoE ICT Circular Number 2 Year 2009. ICT Steering Committee (JPICT), Ministry of Education Malaysia, KP.BTMK (S) 1/07/001/01 Vol 16 (34).

MoE (Ministry of Education Malaysia). (2012). Initial Report. Malaysia Education Blueprint 2013-2025.

Nur Qistina Abdullah and Hazman Ali. (2010). Use of Information and Communication Technology (ICT) Among the National School Teachers - UTM.http://eprints.utm.my/10521/1/Penggunaan_Teknologi_Maklumat_Dan_Komunikasi.pdf

Prensky, Marc. (2001). "Digital Natives, Digital Immigrants". *MCB University Press, On the Horizon 9 (5): 1–6.*

Siti Fatimah Mohd Yassin, Baharuddin Aris and Abd Hafidz Omar. (2004). Use of Analytical Rubrics for the Development of Student Creativity in Multimedia Product Development. *Presentation Papers at UPSI's First International Conference: Quality in Education. Kuala Lumpur*

Susaporn Chai-Arayalert and Keiichi Nakata. (2011). Evolution of Green ICT Practice: UK Higher Education Institutions Case Study. *2011 IEEE/ACM International Conference on Green Computing and Communications.*

Tomayess Issa, Theodora Issa and Vanessa Chang. (2014). Sustainability and green IT education: Practice for incorporating in the Australian higher education curriculum. *The International Journal of Sustainability Education. 9 (2): pp. 19-30.*

Zaini Ujang. (2008). *"Environmental Policy, Malaysia: The Way Forward"*. *Seminar Paper-Malaysian Islamic Academy of Sciences (ASASI).* http://www.kesturi.net/wp-content/uploads/2008/10/kertas-kerja-prof-dato dr-zaini-ujang_dasar-alam-sekitar-malaysia_the-way-forward.pdf

Zaitun Sidin and Hamiyah Mohd Lani. (2011). Use of School Access Centre's Among Teachers in Zon Tasek Utara Teacher Activity Centre, Johor Bahru. - UTM.

http://eprints.utm.my/11858/1/Penggunaan_Pusat_Akses_Sekolah_Dalam_Kalangan_Guru_Di_Pusat_Kegiatan_Guru_Zon_Tasek_Utara.pdf