

## STUDENTS' PERCEPTION OF TECHNOLOGY FACTORS AND ITS IMPACT ON BYOD-BASED LEARNING IN PRIVATE SECONDARY SCHOOLS IN DUBAI, UAE

Manoj Mechankara Varghese<sup>1,\*</sup>, Poonsri Vate-U-Lan<sup>2</sup>, and Varughese K. John<sup>3</sup>

### Abstract

This study aimed to investigate students' perception of technology factors and the impact of this perception on BYOD (Bring Your Own Device) based learning of ninth grade students. The target sample size of this study involved 1,800 ninth grade students from eight private secondary schools in Dubai, UAE, where 900 students belong to the schools where BYOD has been implemented, and 900 students belong to schools where BYOD has not been implemented. The scores of Science categorised by gender were collected as quantitative data for descriptive statistical and comparative analysis. The two major findings of this study were that students' perception of technology factors had a higher impact on students' achievements in the schools using BYOD for learning science than the schools not using BYOD, and that differences in achievement in relation to gender were higher in the BYOD schools. These research findings can be added to the BYOD body of knowledge, which can in turn help schools to implement BYOD programs effectively.

Keywords: BYOD, Digital Content, eLearning, Technology Integration, Technology Usage, Virtual Learning Environments

### INTRODUCTION

Bring Your Own Device (BYOD) is a concept which has been gaining popularity with a fast pace in many modern high schools and higher secondary schools at a global level. The term of BYOD-based learning refers to the use of tablets, laptops, smartphones or any other similar devices, in classrooms for academic purposes, by the students. The main idea of introducing BYOD to schools is to enrich the teaching and learning experience and thereby to improve student achievements by encouraging the younger generation through a higher

exposure, for life-long skills in using the digital devices in this era of digital revolution. Adequate teacher training, a proper framework and availability of relevant pedagogy based on digital content may lead such programs to success. Letting students bring their mobile technological devices to schools has given them more learning power and ease of learning. Giving more freedom to students regarding the way they like to learn is the best approach, teachers and instructors can focus more on managing the learning process rather than seeking for the source of information. Schools are using BYOD-based Learning tools such as Digital Curriculum

Corresponding author\* <sup>1</sup>Manoj Mechankara Varghese is a Ph.D. graduate in eLearning Methodology from Assumption University. Currently Manoj Mechankara Varghese is working as Senior Director of Connecta Education, London, United Kingdom. E-mail address: mvmanojdxb@gmail.com

<sup>2</sup>Dr. Poonsri Vate-U-Lan is working as an Assistant Program Director of Ph.D. in eLearning Methodology Program, Graduate School of eLearning at Assumption University of Thailand. She obtains Doctor of Education in Internet-based survey design in 2007, from School of Global Studies, Social Science & Planning, the Royal Melbourne Institute of Technology University, Victoria, Australia.

<sup>3</sup>Dr. Varughese K. John is a full-time faculty member at the Graduate School of eLearning, Assumption University, Thailand. He has 28 years teaching and research experience in higher education - Associate Professor (from 2010), Higher education administrative experience as Principal of a college (3 and a half years) and Industrial experience in the middle-east (5 years).

Content (DCC), and Virtual Learning Environments (VLE), expecting to improve the teaching & learning experience, student achievements, learning outcomes and student-teacher engagement. The main issue relating to BYOD is that it is not uniformly practised in schools where students are informally using these devices with or without the formal assent of the teachers in some schools. The reason is that there is no widely accepted BYOD framework for schools to practice it effectively. Therefore, the problem identified is whether BYOD practice in the teaching and learning process is more effective when used along with the traditional method of teaching and learning. Most of the BYOD initiatives in schools are driven by few teachers who have a personal interest in it, rather than as a collective organisational initiative. It can also be observed that teachers in different age groups respond differently to this self-initiative. Younger teachers show more interest than senior teachers in taking any technologically-based initiative. These teachers adopt a methodology convenient for allowing students to bring their own devices to school and to use them as complementary tools for learning. As such, there may be no uniform approach for the use of technology in learning, even between students in the same grade and school, but two different divisions. Use of eLearning tools in such an environment is primitive and ineffective. Success factor measurement of this type of initiative is highly difficult. This study has given insight into the impact of student's achievement in science while studying with BYOD and without BYOD.

## **RESEARCH OBJECTIVES**

The specific research objectives were:

To study the students' perceptions of technology usage and the impact of these perceptions on grade ninth students' achievement in science while studying with BYOD and without BYOD.

To compare the grade ninth students' achievement in science based on gender, while studying with and without BYOD.

## **Significance of the Research**

Outcomes of this study can provide information on what is appropriate for the implementation of BYOD in selected secondary schools, by providing information about the technology usage of students in connection to implementation of BYOD, and the achievement level of students as a result of the interventions of technology. The researcher emphasizes this strategy to enrich the educational experience with Mobile Learning (mLearning) solutions, engaging each new generation of students with the devices they have, know and prefer, and are able to use any time, in any place as a learning platform, allowing them to access all aspects of the digital learning experience. The knowledge base of the effectiveness of BYOD implementation can be enriched based on the findings of this research. The research study can also help schools to increase their level of consciousness regarding the possible impact on students' academic achievement and level of technological implementation due to their exposure to BYOD initiatives.

## **LITERATURE REVIEW**

### **BYOD in Education**

BYOD and mLearning initiatives give access to the power of the devices that students own, increasing student engagement and giving access of information to students anytime, anywhere (Peng, Su, Chou, & Tsai, 2009). BYOD already has some attraction in schools in the U.S., but this concept has yet to infiltrate the educational institutes within many developing and developed countries. Studies show that over recent years there has been an intense increase in the dominance of students bringing personal mobile devices to school, such as laptops, tablets, and smartphones, with better or more custom-made features, or higher competence than the ones issued by their school, for BYOD in

Australia and New Zealand schools (Sweeney, 2012).

### **Trends in Use of BYOD in Teaching**

Expert teachers have accepted the advancements in technology, and their integration in education, using mobile devices, gadgets and social media as a means to stay connected with their students, students' families, and other classrooms. A study on "BYOD in K-12 classroom", by Elena Dickerson, Teacher Education Dept., University Of Texas, has stated findings from various researchers that "the common mentality of the "I teach" curriculum may be another challenge in the development and implementation of the BYOD program in K-12 classrooms" (Norris & Soloway, 2011).

### **Trends in Use of BYOD in Learning**

The reasons for more popularity of BYOD was cited as student-centred and personalized learning (Alberta Education, 2012; Argueta et al., 2011). The important role played by mobile devices in shaping the learning trends was explored by mLearning Trends Infographic in 2015 (elearninginfographics.com, 2015). Learning through digital devices makes coordination and communication among each other easier and encourages student interactions and builds interest in learning. This kind of learning becomes phenomenal as the students get immediate feedback which helps in developing and managing their thinking and actions as well as quick feedback always help the students learn faster (Brown, 2005).

### **Digital Tools in Implementation of BYOD**

Two main digital tools highlighted are DCC and VLE since many researchers drive us through various learning and teaching concepts to give an insight into these digital tools apt for the millennial. DCC deployed on all the digital media mentioned above, and supported by many researchers, benefits each student in their learning process, making them more successful. Learning through digital media has opened up diverse opportunities to the student's learning process, like

visualization and exploration into more learning aids, concepts, applications and practice, and thus enhances learning.

### **Learning Theories and BYOD**

One learning theory is not sufficient to define BYOD. There are several theories that support the idea of BYOD and could have possibly been part of the foundation of the idea of BYOD. According to [mobl21.com](http://mobl21.com) currently, there is no widely accepted learning theory that can be suitable for mobile technologies based on effective learning, pedagogy, assessment and design of new applications ([mobl21.com](http://mobl21.com), 2012). As the foundation of BYOD, the below-listed theories are worth noting.

The BYOD initiative in "Social learning theory" or "Social Constructivism" states that "students carry their own understandings to the classroom and further through interactions and experiences in the class, develop new knowledge" (Clark, 2011). Social interactions that emphasize "critical thinking", "collaboration", "communication", and "learning by doing" as well as the "Constructivism" and "Connectivism" theories and "We All Learn" (WAL) framework model, assist and encourage the occurrence of the learning process through technological integration, thus making education more interesting and meaningful to students. Social constructivism is a sociological theory of knowledge according to which human development is socially situated and knowledge is constructed through interaction with others.

### **Benefits of BYOD**

The benefits of BYOD in secondary schools, are referred to by various scholars. Allowing students to use their own personal devices is a cost-effective benefit. For teachers, BYOD offers a paperless classroom making it more cost effective. In addition to highlighting the benefits of BYOD, some drawbacks with regard to BYOD are also noted by a few researchers and are also considered in this study. One article written by Flanigan "BYOD Boundaries, a school in

Fairfax County, VA” briefed that, at the beginning of the school year in 2011 to 2012, when BYOD was implemented, he observed that during school hours, the number of discipline referrals on cell phone usage was significantly decreased (Flanigan, 2013).

### **BYOD and 4Cs**

The four Cs (Collaboration, Creativity, Critical Thinking and Communication) is a concept developed in the US for 21st-century learning, and is also called P21 (Partnership for 21st-century skills) (nea.org, 2017). The “4 C’s” — Critical thinking and problem solving, Creativity and innovation, and Communication and Collaboration — describe key skills for our students, especially in relation to the need for success in our increasingly complex, interconnected, information- and data-rich, and rapidly changing world. Many frameworks for teaching and learning, such as the Partnership for 21st Century Skills (P21) Framework, include the 4 C’s as primary components (nea.org, 2017). BYOD supports the 4 Cs of 21st Century Learning and other key capability areas. By using BYOD, students receive a cross-capability learning opportunity. Collaboration is increasingly mentioned as an important educational outcome, and most models of 21st-century education include collaboration as a key skill. Creativity is widely acknowledged to be a key 21st-century skill and included in the desired college and career ready outcomes for students of many countries. Although many aspects of human cognition are still a mystery, psychologists have begun to flesh out critical thinking, or the strategies that people use to think in organized ways to analyze and solve problems. Communication is one of the key components of 21st-century learning, yet it has not attracted the same level of research or attention as creativity, collaboration, or critical thinking.

### **BYOD and Gender**

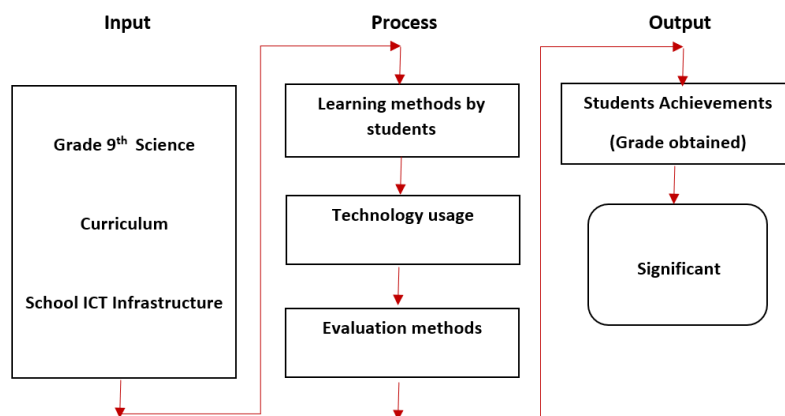
In an attempt to explore the gender differences influencing technology-based learning, Jung (2012) found a relationship between gender differences in the perceptions of dimensional impact on the quality of technology usage. The researcher indicated that females had perceived all quality domains and dimensions as being more important in evaluating the quality of technology-based learning than males. Keller et al. (2007) also found gender to influence acceptance, and in-line with Jung’s study (2012), females experienced more performance expectancy than males did.

### **BYOD Initiatives in UAE**

International private schools have been the first set of schools to adopt a BYOD program in Dubai, UAE, where this study was conducted. They announced a ‘Bring Your Own Device’ (BYOD) initiative in the UAE alongwith the establishment of a secure Wi-Fi facility to access the school’s internet and the network, therefore permitting students and teachers from these schools to use their own devices (laptops, tablets etc.) and use them for educational purposes within the classrooms. The BYOD specifications on hardware and software are outlined and made available in the schools’ websites for parents and students to adhere to, while purchasing devices for their wards.

### **CONCEPTUAL FRAMEWORK**

Based on the findings of the literature review, a preliminary conceptual framework for the development of a BYOD eLearning Framework was developed as shown in figure1.



**Figure 1. Conceptual Framework**

Examination scores of students for science in ninth grade in the BYOD implemented schools and the schools where BYOD was not implemented were used for descriptive statistical and comparative analysis. The independent variables were students' gender, students' learning method, students' level of technology usage and school ICT infrastructure. Students' achievement in science in grade nine was the dependent variable. The data collected was used to explore for any significant differences in student achievement in science subjects, while studying in the schools where BYOD is implemented, using tools and applications compared to those studying where BYOD is not implemented schools. The data was also analysed to understand the interaction between gender and instructional method regarding achievement in Science.

A paper-based questionnaire was employed to collect students' perceptions. The instrument was administered to grade nine students to define the students' level of technology usage. The results in relation to student achievement were tested using statistical analysis for the existence of a relationship.

## **RESEARCH METHODOLOGY**

### **Research Design**

This study consisted of seven distinct but interconnected stages where the output of each stage was suitably used to inform the

initiation and effective completion of the next stage. This study was based on the principles of quantitative research. This causal-comparative study was based on independent and dependent variables. In causal-comparative research, the study emphasises the connection between one or more categorical independent variables and one or more quantitative variables (Johnson & Christensen, 2008). Several studies have used causal-comparative design due to its advantage in terms of access to a large volume of data, large sample size and data collected from a larger population in a cost-effective manner, thereby adding it to the knowledge base of the design ("Encyclopaedia of Research Design," 2010).

### **The Target Population of The Study**

The target population of this study consisted of ninth grade students from eight private schools in Dubai, UAE. According to the official report, the number of schools in Dubai during the 2015-16 academic year totalled 173, housing a total of 265,299 students from 183 different nationalities (KHDA, 2015). A report shows Dubai private schools, currently have about 17,000 teachers. The sample of eight schools was chosen for this study from 32 international schools following the Indian curriculum in Dubai, such that about 20 per cent of the population was sampled, meeting the acceptable industry standard for acceptable sampling percentage for a finite population.

Researchers also used the infinite population-based sampling size method to validate the sample size of participating students, arriving at a value of 1,800 students using the sample size formula,  $Sample\ Size = \frac{(z^2 * (p(1-p)))}{ME^2}$ , where ME is the margin of error and z is the Z-score, a constant value which corresponds to the confidence level. The standard survey confidence level is 95 per cent, and for a confidence level of 95 per cent, the Z score is 1.96 (Smith, 2013). The standard margin of error (confidence interval) is less than 2.5 per cent, and 2.3 per cent was taken as the margin of error in this case. Applying the above formula here results in  $\frac{((1.96)^2 * .5(.5))}{(.023)^2} = \frac{(3.8416 * .25)}{0.000529} = \frac{0.9604}{0.000529} = 1,815$ . This number of students should be sampled across the eight chosen schools; the sample size was rounded to 1,800.

### **Sampling and Sampling Procedure**

Probability sampling was used as the sampling strategy for this research. Barreiro and Albandoz recommend using probability sampling in cases where choosing the appropriate technique will assure us that the sample will be representative and could estimate the errors for the sampling (Barreiro & Albandoz, 2001). The researcher got proper permission from the school authorities to obtain the achieved examination score data for science for all ninth-grade students. As mentioned earlier, approximately 1,800 students of grade nine from the selected schools were included in the study.

### **Data Collection**

Students' examination scores were collected from each of the schools. Students' examination scores and students' details from participating schools were coded and grouped for easy statistical analysis. Except for gender and exam scores, all other personal details were excluded. A briefing section with the teacher involved in the sample was arranged before sending the survey instrument to students through teachers explaining the details of this research. The level of usage of technology, by students included in the

sample and in teaching grade nine was determined using a survey instrument.

### **Research Instruments**

The data collecting instrument was a survey questionnaire for students. The questionnaire was developed based on the research objectives and refined in consultation with subject matter experts. It was tested for validity and reliability with 30 students who represented the population of the study, followed by modification of the questionnaire according to the pilot result. The validity result was 0.91 which is higher than the acceptable validity mark of 0.7 and the reliability was higher than the acceptable reliability mark of 0.21.

### **Students' Achievement**

The quantitative data required for this study was collected as examination scores of the participating grade nine students with a focus on science subjects. Science subjects are offered at all grades in the participating schools.

### **Students' Technology Usage & Implementation Questionnaire**

The survey questionnaire was used to collect usage of technology data for the BYOD implementation from participating students through a survey. This survey was conducted after meeting the responsible teachers in all participating schools' face to face and explaining to them the purpose of the study.

### **Data Analysis**

IBM SPSS software was used for the detailed analysis of science subject examination scores of ninth grade students from the contributing schools; the data analysis in this study was accomplished in two steps.

A comprehensive statistical analysis was carried out to study the connection between students' achievement in science and the students' level of technology usage.

Data related to the following areas was collected and analysed:

The difference of grade nine student achievement in science, between the students studying in BYOD implemented schools, versus those in schools where BYOD was not implemented, and also its interaction to the school ICT infrastructure, students' learning methods, students' technology usage, and evaluation methods.

The difference of grade nine student achievement in science of the students studying in BYOD implemented schools versus schools where BYOD was not implemented, and its interaction to school ICT infrastructure, students' learning methods, students' technology usage, and evaluation methods with respect to students' gender.

The students' scores in science was the dependent variable. An ANOVA analysis requires the dependent variables, in this case, student achievement, to meet certain parametric requirements. An ANOVA was used to examine whether levels of the independent variable, BYOD implementation, have on their own, or in a grouping with any other variable listed above, any effect on the dependent variable.

The difference in student achievement of students studying in schools where BYOD was implemented versus those without BYOD implementation was determined, with the independent samples t-test showing a mean difference. When performing the significance test on the data, covariance helped to define the correlation between the two measures. To test the difference between students' achievement in science while studying in schools with BYOD versus those without BYOD implementation, an ANOVA was used. Validity is the indication of the extent to which inferences can be correctly made, based on the students' scores in both learning environments. The assumption was that there might be a linear relationship within the dependent variable, science achievement.

The Levene Howard's test of similarity of the variance was used to test for equality of variance, as it tolerates violations of normality, and it was also scrutinized whether the amount of variance was respectively

represented within the independent variable (BYOD implementation) groups. The similarity of variance is that the variance of the scores in one type of school, would be equal to the inconsistency of scores in the second type school (Gastwirth, Gel, & Miao, 2009). To avoid the restriction of this statistical analysis, outliers were identified and removed before performing the ANOVA. Unequal sample sizes were adjusted using IBM SPSS Software to remove the unequal sample size that existed in the participating schools during data analysis. The level of usage was determined using the survey of students' technology implementation and usage. Findings specifying the different levels, together with the student achievement, were analyzed using IBM SPSS Software to establish the connection between students' level of technology usage and student achievements.

### **Reliability & Validity**

The data collection instrument was a survey, for students to understand their level of technology usage. The surveys were developed to achieve a high level of validity and reliability. Validity is the degree to which an instrument measures what it is purported to measure (Lunenburg & Irby, 2008). The degree to which an instrument consistently measures whatever it is measuring is its reliability (Lunenburg & Irby, 2008). Threats to the internal validity of this study were minimal since the testing involved a large sample of student examination scores.

### **Ethical Procedures**

The data collected from schools were kept confidential to protect the rights of the students in the participating sample. Separate codes were used for student data to protect confidentiality. To avoid any form of data leakage, all research data were stored in the laptop of the researcher, with password protection. After successful completion of this study, all research data related to samples was deleted.

### Summary of Research Methodology

The causal-comparative research design allowed the gathering of a large amount of data proportionate for this research study. The student examination scores were used to determine the level of student academic achievement and were linked to information on students' level of technology implementation and usage of BYOD.

A descriptive statistical analysis was used to detect the differences in the mean, the equality of variance, and relationship between the independent variable and dependent variable. The result of this analysis helped to establish the specified hypotheses. Suitable consideration was given to ethical processes by protecting the rights of participants, specifically in the examination of data regarding student scores.

### FINDINGS AND DISCUSSION

#### Respondents' Profiles

Table 1 below shows the student characteristics of ninth grade students who participated in the survey, including their genders. Table 1 shows that 846 (47.00%) of the students were females, while 954 (53.00%) were males. Regarding the type of school 900 (50.00%) students were from BYOD schools and 900 (50.00%) students from Non-BYOD Schools. In BYOD schools, 408 (45.30%) students were female, while 492 (54.70%) students were male. In the Non-BYOD schools, 438 (48.70%) students were female, and 462 (51.30%) were male.

*Table 1: Demographics of the Student Questionnaire Respondents*

Item	N	Percentage
<b>Students</b>		
Female	846	47.00
Male	954	53.00
<b>Total</b>	<b>1,800</b>	<b>100</b>
<b>Students - School Type</b>		
BYOD School Students	900	50.00
Non - BYOD School Students	900	50.00
<b>Total</b>	<b>1,800</b>	<b>100</b>
<b>Students - BYOD Schools</b>		
Female	408	45.30
Male	492	54.70
<b>Total</b>	<b>900</b>	<b>100</b>
<b>Students - Non-BYOD Schools</b>		
Female	438	48.70
Male	462	51.30
<b>Total</b>	<b>900</b>	<b>100</b>



### Ranking Data based on Students' Technology Factors

Interpretation of 5-point Likert scale data in the following ranking sections is based on the boundaries shown in table 2 below.

Table :2 Interpretation table - 5-point Likert scale data

Mean Range	Interpretation
1.00 – 1.69	Strongly Disagree
1.70 – 2.49	Disagree
2.50 – 3.29	Neutral
3.30 – 4.09	Agree
4.10 – 5.00	Strongly Agree

The data collected from students with respect to school ICT infrastructure, learning methods of students, students' technology usage, and evaluation methods are grouped and ranked in Table 3. The means, standard deviation and based on interpretation of the responses as indicated in table 2 are also shown below.

It is very clearly observed from Table 3 that all the technology factors in the BYOD schools are higher than in the Non-BYOD schools. The mean values of technology factors were found to be, 4.18 and 3.76 for school ICT infrastructure, 4.30 and 4.07 for the learning methods of students, 4.55 and 4.45 for evaluation methods, and 4.38 and 4.19 for evaluation methods, in BYOD schools and Non-BOYD schools respectively.

Table 3: Ranking based on Students Perception of Technology Factors

Technology Factors	School Type	N	Mean	S.D.	Interpretation
School ICT Infrastructure	BYOD	900	4.18	.676	Strongly Agree
	Non-BYOD	900	3.76	.900	Agree
Learning Methods of Students	BYOD	900	4.30	.510	Strongly Agree
	Non-BYOD	900	4.07	.648	Agree
Technology Usage	BYOD	900	4.55	.532	Strongly Agree
	Non-BYOD	900	4.45	.626	Strongly Agree
Evaluation Methods	BYOD	900	4.38	.722	Strongly Agree
	Non-BYOD	900	4.19	.813	Strongly Agree

Table 4 shows the Independent Samples t-test results for the difference between the students' achievement in science, of ninth grade students, in the schools where BYOD is implemented, versus schools where BYOD is not implemented, and its interaction with other factors, school ICT infrastructure, the learning methods of students, students' technology usage and evaluation methods.

Results of the Independent Samples t-test comparison of ninth grade students' achievement in science with technology factors in BYOD Schools vs Non-BYOD shows the mean difference between groups was significant. It is also observed from the t-test results that the mean score of BYOD schools (M=77.84, SD=12.34) with respect to the science subject is higher than in the Non-BYOD Schools (M=74.01, SD=13.20). As Table 4 shows, the t- statistic is t (6.348), with  $P < .05$ . Thus, a significant difference was found for the students achievement in science, and its interaction with school ICT infrastructure, the learning methods of students, students' technology usage and evaluation methods.

Table 5 shows the Independent Samples t-test results of the interaction between student's gender and its interaction to school ICT infrastructure, the learning methods of

students, students' technology usage and evaluation methods with regard to achievement in science.

Results of the Independent Samples t-test comparison of grade ninth students' achievement in science with respect to the technology factors, and interaction with their gender in BYOD schools shows the mean difference between groups was significant.

It is also observed from the t-test results that the mean score of female students (M=79.08, SD=12.24) is higher than the mean score of male students (M=76.81, D=12.34). As Table 5 shows, the statistic is t (2.754), with  $P < .05$ . Thus, a significant difference was found in students science achievements with respect of technology factors and interaction with gender in the BYOD Schools. Similar trends were reported by other researchers, as included in the literature review.

Importantly, the results of the Independent Samples t-test comparison of ninth grade student achievement in science with respect of technology factors and interaction with gender in Non-BYOD schools shows that the mean difference between groups was not significant.

*Table 4. Results of Independent Samples t-test - Student achievement (BYOD Schools vs Non-BYOD Schools)*

Subject	School	N	Mean	SD	t	Df	Sig.
Science	BYOD	900	77.84	12.34	6.348	1790	.000*
	Non-BYOD	900	74.01	13.20			

\* The mean difference is significant at the 0.05 level.

*Table 5. Results of Independent Samples t-test - Student's achievements and interaction with their gender – BYOD Schools.*

Subject	Gender	N	Mean	SD	t	Df	Sig.
Science	Female	408	79.08	12.24	2.754	898	.006*
	Male	492	76.81	12.34			

\* The mean difference is significant at the 0.05 level.

## CONCLUSION AND RECOMMENDATION FOR FUTURE WORK

The main issue relating to BYOD is that it is not uniformly practised in schools where students are informally using these devices with or without the formal assent of the teachers in some schools. The reason is that there is a lack of availability of research-based BYOD body of knowledge for schools to refer to, to practice it effectively. Outcomes of this study provided information on what is appropriate for the purpose of BYOD implementation in secondary schools, technology usage level of students' and implementation, and achievement level of students as a result of the interventions of technology. Research findings of this work can be added to the BYOD body of knowledge for private secondary schools in Dubai, UAE for reference, and will help schools to implement BYOD programmes effectively.

Future studies based on this study with respect to other subjects, in particular mathematics, on a larger sample scale, or from different school types, could help to get more details to confirm the impact of technology factors on students' achievement in BYOD vs Non-BYOD schools. It would be desirable to investigate different aspects of the sample populations, such as cross-cultural, longitudinal, cross-gender and so on to confirm the impact technology factors on student achievement. The findings should be replicated in a different geographic region to understand the relationship between cultural and economic factors.

## REFERENCES

- Alberta Education. (2012). Digital Citizenship Policy Development Guide. Alberta Education. Retrieved from <https://education.alberta.ca/media/3227621/digital-citizenship-policy-development-guide.pdf>
- Argueta, R., Huff, J., Tingen, J., & Corn, J. (2011). Laptop Initiatives: Summary of Research Across SFWFO StBUes. Friday Institute for Educational Innovation North Carolina University. Retrieved from <https://www.fi.ncsu.edu/wpcontent/uploads/2013/05/laptop-initiatives-summary-of-research-across-seven-states.pdf>
- Barreiro, & Albandoz. (2001). Population and sample. Sampling techniques. Retrieved from [http://optimierung.mathematik.uni-kl.de/mamaesch/veroeffentlichungen/ver\\_texte/sampling\\_en.pdf](http://optimierung.mathematik.uni-kl.de/mamaesch/veroeffentlichungen/ver_texte/sampling_en.pdf)
- Brown, T. (2005). Towards a model for m-learning in Africa. ResearchGate. Retrieved from [https://www.researchgate.net/publication/255566978\\_Towards\\_a\\_model\\_for\\_m-learning\\_in\\_Africa](https://www.researchgate.net/publication/255566978_Towards_a_model_for_m-learning_in_Africa)
- Clark, T. (2011, May 11). BYOT Network. Retrieved from <https://byotnetwork.com/about/>
- Clifford, M. (2012). Bring Your Own Device (BYOD): 10 Reasons Why It's a Good Idea - InformED. Retrieved January 24, 2017, from <http://www.opencolleges.edu.au/informed/other/bring-your-own-device-byod-10-reasons-why-its-a-good-idea/#axzz2OWWT5Vjb>
- elearninginfographics.com. (2015). 2015 Mobile Learning Trends Infographic. Retrieved from <https://elearninginfographics.com/2015-mobile-learning-trends-infographic/>
- Encyclopaedia of Research Design. (2010). In N. Salkind, Encyclopaedia of Research Design. 2455 Teller Road, Thousand Oaks California 91320 United States: SAGE Publications, Inc. Retrieved from <http://methods.sagepub.com/reference/encyc-of-research-design/n42.xml>
- Flanigan, R. L. (2013, February 6). Schools Set Boundaries for Use of Students' Digital Devices - Education Week. Digital Directions. Retrieved from <http://www.edweek.org/dd/articles/2013/02/06/02byod.h06.html>
- Gastwirth, Gel, & Miao. (2009). The Impact of Levene's Test of Equality of Variances on Statistical Theory and

- Practice. Retrieved from <https://arxiv.org/pdf/1010.0308.pdf>
- Johnson, B., & Christensen, L. (2008). *Educational Research: Quantitative, Qualitative, and Mixed Approaches*. SAGE.
- Jung, I. (2012). Asian learners' perception of quality in distance education and gender differences. *International Review of Research in Open and Distance Learning*, Vol. 13(2), pp.1-25.
- Keller, C., Hrastinski, S., and Carlsson, S. (2007). Students' acceptance of e-learning environments: A comparative study in Sweden and Lithuania. In Österle, S. J, (Ed.), *Proceedings of the Fifteenth European Conference on Information Systems* (pp. 395- 406). St. Gallen: University of St. Gallen. DOI: <http://urn.kb.se/resolve?urn=urn:nbn:se:hj:diva-3099>.
- KHDA. (2015). KHDA report, 2014-2015. Retrieved January 31, 2017, from [http://www.khda.gov.ae/CMS/WebParts/TextEditor/Documents/Final\\_035\\_KHDA-ENGLISH.pdf](http://www.khda.gov.ae/CMS/WebParts/TextEditor/Documents/Final_035_KHDA-ENGLISH.pdf)
- Lunenburg, F. C., & Irby, B. J. (2008). *Writing a Successful Thesis Or Dissertation: Tips and Strategies for Students in the Social and Behavioral Sciences*. Corwin Press.
- mobl21.com. (2012). *MOBILE LEARNING BASICS*. mobl21.com. Retrieved from [http://www.mobl21.com/Basics\\_Of\\_Mobile\\_Learning.pdf](http://www.mobl21.com/Basics_Of_Mobile_Learning.pdf)
- nea.org. (2017). *An Educator's Guide to the "Four Cs"*. Retrieved from <http://www.nea.org/assets/docs/A-Guide-to-Four-Cs.pdf>
- Neubert, S. (2010). Democracy and Education in the Twenty-First Century: Deweyan Pragmatism and the Question of Racism. *Educational Theory*, 60(4), 487–502. <https://doi.org/10.1111/j.1741-5446.2010.00372.x>
- Norris, C., & Soloway, E. (2011). *The 10 Barriers to Technology Adoption*. Retrieved January 30, 2017, from <https://www.districtadministration.com/article/10-barriers-technology-adoption>
- Peng, H., Su, Y.-J., Chou, C., & Tsai, C.-C. (2009). Ubiquitous knowledge construction: mobile learning re-defined and a conceptual framework. *Innovations in Education and Teaching International*, 46(2), 171–183. <https://doi.org/10.1080/14703290902843828>
- Sheninger, E. (2011, September 6). *Tool for Learning or Distraction?* Retrieved from [http://www.huffingtonpost.com/eric-sheninger/tool-for-learning-or-dist\\_b\\_947265.html](http://www.huffingtonpost.com/eric-sheninger/tool-for-learning-or-dist_b_947265.html)
- Smith. (2013, April 8). *Determining Sample Size: How to Ensure You Get the Correct Sample Size*. Retrieved January 31, 2017, from <https://www.qualtrics.com/blog/determining-sample-size/>
- Sweeney, J. (2012). *BYOD in Education - A report for Australia and New Zealand*. Retrieved January 30, 2017, from [http://1to1sustainmentdeecd.global2.vic.edu.au/files/2013/07/BYOD\\_DELL-2dtch9k.pdf](http://1to1sustainmentdeecd.global2.vic.edu.au/files/2013/07/BYOD_DELL-2dtch9k.pdf)