Kuwaiti undergraduate science students' perceptions towards using technology in education

Abstract

The use of technology in education has proven its potential to enhance and extend student learning. However, the actual use of technology in the classroom is still limited. The purpose of the current study is to explore science students' perceptions about their experience of the actual use of technology in the classroom, their perceptions about the preferred use of technology in the classroom, and the benefits of these technologies for their career. It also examines science students' perceptions toward digital distractions and other factors that affect the use of technology in learning. This study employed a mixed method approach using questionnaire and semi-structured interviews. The data of the questionnaire was collected from 140 science students, while the data of the interviews was collected from 25 science students. The results of the current study demonstrated that despite technology used in the classroom to enhance the science students learning (such as communication, doing presentations, uploading lectures, and searching for information); technology was not used to stimulate the science students' creative thinking or deepen their learning. The results of the study also found that there are many factors that affect the science students' use of technology, which are explained in detail within the study. In order to have a useful use of technology in the classroom, these factors have to be taken into account.

Keywords

Technology- undergraduate science students- e-learning

1. Introduction

Students attend university with the purpose of having a higher degree in a specific major. They expect to have the best education and learning experience that will prepare them for their future career. In order to provide the highest level of teaching and learning, research advocates that the university and its faculties should provide all the facilities and resources necessary to encourage and enhance students' learning and creative thinking(Laurillard, 2004; Singh, O'Donoghue, &Worton 2005). Instead, it is found that the classrooms lack the technologies and resources that are important for enhancing students learning (Al-

Doub, Goodwin, & Al-Hunaiyyan, 2008). The lack of these technologies and resources gives the students a limited learning experience, which also limits their enjoyment of learning. Students' enjoyment of learning increases their ability to absorb the information they are studying. Even when the technology and the resources are made available in the classroom, this does not mean that the actual use of the technology will be affective or successful (Keengwe, 2007).

The way students want to learn is extremely important, and the types of technology they prefer to use for learning play a major role in enhancing the learning and teaching process (Keengwe, 2007). Learners should not be considered as passive information consumers; rather, they are active co-producers of content" (Dabbaghn&Kitsantas, 2012, p.3).It is imperative to shed light upon the students' perspectives on the use of technology and which types of technology they prefer to use for learning (Dahlstrom& Bichsel, 2014).

It is important to understand the students' preferences from resources and technologies available to them. Students use resources and technologies in ways that benefit them and their studies only when they are competent enough to use them (Barczyk& Duncan, 2013; Venkatesh, Croteau, &Rabah, 2014;Westerman, Daniel, & Bowman, 2016). They can only integrate these resources into their learning when they know the proper usage of these tools and know how to personalize the usage of these tools in ways that help them find the proper information they are looking for (Venkatesh et al., 2014).

The use of technology to improve students' learning is not an easy matter for universities to approach due to the different needs of the students, different majors and modes of delivery (Selwyn, 2014). Therefore, it is important to understand students' actual use of technology in learning and the strategies that they employ to better understand the information taught in the classroom. Few studies have listened to students' voice regarding the use of technology in classroom (Zhou &Teo, 2017). Therefore, the current study proposes a study to understand students' perceptions towards using technology in the classroom, especially as they use technology in their everyday activities. This study contributes to the knowledge due to the limited studies that were conducted in Kuwait regarding undergraduate science students'

perceptions about integrating technology into classroom learning and teaching.

Undoubtedly, students show that they experience effective learning in the classroom when the instructor uses the technology that they prefer (Dahlstrom & Bichsel, 2014). University students compared to school students become aware of the benefits of using technology for their academic success and their future career (Edmunds, Thorpe, & Conole, 2012).

The objectives of the current study are to:

1- **Investigate science students' perceptions about their experience of the actual use of technology in the classroom.**
2- **Explore science students' perceptions about the actual use of technology for learning.**
3- **Explore science students' perceptions about the preferred use of technology in the classroom.**
4- **Investigate science students' perceptions toward the benefits of using technology in learning and for their future careers.**
5- **Explore science students' perceptions toward the digital distractions that distract students from learning.**
6- **Investigate science students' perceptions about the factors that affect their use of technology in learning.**

This study seeks to explore undergraduate science students' perceptions toward using technology in education. The study employs a mixed method approach using questionnaire and semi-structured interviews to collect the data form undergraduate science students studying at the College of Basic Education (CBE) that is supervised by the Public Authority for Applied education and Training (PAAET) in Kuwait.

2. Literature review

2.1 Technology and science education

Technology based learning environments are defined as the "interactions between the hardware, software, other resources, teachers and students" (Webb, 2005, p. 707). Using technology in science classrooms has a crucial role in transforming the classroom experience from simply studying information for assessment into a vibrant and enjoyable subject (Daniel, 2013). Technology-rich environments in science classrooms (such as simulations, microworlds, modelling and data-logging) enhance

students' learning experience (Cox et al., 2004; Webb, 2008). This in turn gives the students the motivation and interest to learn science (Bolstad & Hipkins, 2008); and provides opportunities for students to engage in technology integrated scientific investigation (Fensham, 2006).

There are many technologically based resources that can improve the learning and teaching process within science classrooms. Some of these resources consist of: 1) tools for data capture such as excel, 2) multimedia software for simulation of processes such as DVDs, 3) information systems such as the internet, 4) publishing and presentation tools such as PowerPoint, 5) computer projection technology such as data projector and screen, and 6) computer-controlled microscope, (Osborne & Hennessy, 2003)

For example, Williams et al. (2013) conducted a study in New Zealand to explore the effectiveness of e-networked approaches to support science students' scientific inquiry learning. The e-networked tools that Williams et al. (2013) used were: online search for information, YouTube, webquests, mobile devices to access ideas and resources, and presentation tools to communicate. The results of the study were that these tools helped students to exercise agency, share their own and others' input, and access sources of information. At the end of the study, the researchers suggested some factors that should be taken into account to have the optimal integration of technology in science classroom. These factors were: reliable access to technology, flexible curriculum and assessment structures, and teachers' developed understanding of how to use technology in learning/teaching science.

Despite the importance of using technology, teachers are still using traditional methods in the classroom (Barak, Ashkar, & Dori, 2011; Jimoyiannis, 2010). A study that investigated the way teachers use technology in the classroom among 22 countries found that science teachers' use of technology was low and highly variable across countries due to lack of equipment (Law, Pelgrum, &Plomp, 2008). However, despite the existence of obstacles that affect the integration of ICT, teachers' and students' attitudes and perceptions shape the integration of ICT in the classroom. As teachers' and students attitudes and perceptions can support or work against the use of ICT in teaching and learning (Barak, 2014; Brooks & Pomerantz, 2016).

While it is important to recognize how technology is used in science classrooms, it is more important to find out the perceptions of the students toward the use of technology in the classroom, so that reinforcement plans could be put in place. The following section reviews the literature that explains students' perceptions regarding the use of technology for learning and how satisfied students are from these uses.

2.2 Technology and students learning

Several research studies advocate the use of technology to enhance students learning (Davies, Dean, & Ball, 2013; Dündar & Akçayır, 2014;Venkatesh et al., 2014). Researchers conducted research studies to examine students' perceptions regarding the use of specific technologies and explore its effect on students learning. For example, Davies et al. (2013) conducted a research study in the USA to explore the use of technology in an introductory level course on spreadsheets to enhance university students' learning. Their main aim was to discover students' perceptions regarding the effect of using technological approaches to enhance their academic achievement and satisfaction. The results of the study were that using technology enhanced flipped classroom facilitated students learning and increased their academic achievement; also students had a positive attitude toward using technology in learning and displayed the desire to attend similar class in the future.

Similarly, in Canada Venkatesh et al. (2014) conducted a study to investigate university students' perceptions regarding the use of information and communication technology (ICT) and social media tools to effectively enhance students learning. The researchers employed a questionnaire survey to collect the data from 1, 4283 university students. The results of the study were that engaging lectures, individual study and group work using ICT tools have a positive and significant impact on students' perceptions of course effectiveness.

In contrast, a decade ago Keengwe (2006) conducted a study on US undergraduate students to explore the relationship between instructors and students' perceptions of the effectiveness of using computer technology to enhance students learning. The study collected the data from 800 students using a survey questionnaire. The results demonstrated that although students are accustomed to using technology for personal uses, they still

lack the experience and skills in computers and applications that are important to enhance their learning experience.

Also in the USA, a study was carried out by the EDUCAUSE association, which is a non-for-profit association that conducts research studies of undergraduate students. Dahlstrom and Bichsel (2014) conducted the study in the USA to investigate the technologies that matter most to the undergraduate students. The study employed a survey questionnaire to collect the data from 10,000 undergraduate university students. The results revealed that although students used technology in their every-day activities, their actual use of technology in the classroom occurred slightly only in a few of their courses for active involvement; otherwise it was used as a way of connection between students and faculty. Also, it was found that although technology was used widely, its use was very shallow. Students are only interested in using the few technologies they are accustomed to. It was also found that 59% of the students used their smartphones during class time for educational purposes; however these uses were more likely to occur when encouraged by the instructors.

In Australia, a study was conducted by Irwin, Desbrow, &Leveritt (2012) to investigate university students' perceptions regarding the integration of Facebook pages into the university courses. The study used a questionnaire survey to collect the data from the 253 university students. The study distributed the questionnaire before and after the launch of the Facebook integrated courses. The results demonstrated that although76.4% of the students recommended using Facebook integrated courses in the future; only half (51%) of the students found their use of Facebook pages during the integrated courses effective as a learning tool.

A recent study that was also conducted in Australia by Henderson, Selwyn, and Aston (2017) to explore university students' actual use of digital technology to improve their learning and to investigate the types of technology that the students use and find beneficial to their university studies. The study used a survey to collect the data from 1658 university students. The study identified"11 distinct digital 'benefits' – ranging from flexibilities of time and place; ease of organizing and managing study tasks through to the ability to replay and revisit teaching materials; and learn in more visual forms" (Henderson et al., p.1, 2017). The results of the study revealed that although students understand

the benefit of using digital technology in learning and use this technology in their studies, the teaching methods used in universities alongside these technologies is still the same as with traditional classroom teachings and was not transformed. At the end of the study, the researchers highlighted that educators should focus on and better understand the students' actual use of the technologies instead of focusing only on integrating the technology into the classroom without taking the students' abilities into account.

3. Methodology

The research methods that were used in the current study to collect the data are presented as follows. Section 3.1 describes the research design of the study. Section 3.2 provides an overview of the survey instrument. Section 3.3 presents an overview of the interviews. Finally, section 3.4 describes the research sample of the current study.

3.1 Research design

Many researchers advocate the use of mixed method approaches to confirm the results of all the methods that are employed in the study (Ryan & Bernard, 2000; Johnson & Christensen, 2008). Applying a mixed method approach by using qualitative and quantitative data provides a better understanding of the research problem (Creswell, 2009).Therefore, this study used a mixed method approach to collect the data from female and male undergraduate science students studying at the Collage of Basic Education (CBE) that is supervised by the Public Authority for Applied education and Training (PAAET) in Kuwait.

3.2 Survey instrument

This study adapted the questionnaire that was developed in 2017 by EDUCAUSE, an association of IT leaders committed to advancing higher education. The survey instrument was translated from English to Arabic because the participants of the current study are Arabic speakers. The survey was translated into Arabic by three Kuwaiti experts that worked at the Public Authority for Applied Education and Training who were aware of the nature of the study and were bilingual. Then, one of those experts back translated the Arabic survey into English. Finally, the experts compared both surveys (English and Arabic) to prepare the final version of the survey. In both pilot and main

study, statistical analysis was used to confirm the reliability of the questionnaire. The result of the Cronbach's alpha test (reliability test) of the questionnaire was 0.702. This result indicates that the measuring results of the questionnaire are consistent (Hair et al., 2006).

The questionnaire consisted of seven topics: 1) science students' experiences of technology in the classroom, 2) science students' technology preferences in the classroom, 3) science students' preferred learning environments, 4) science students' perceived benefits of technology, 5) science students' digital devices experiences in the classroom, 6) science students' personal use of digital devices in the classroom, and 7) digital distractions.

3.3 Interview instrument

The interview questions emerged from the survey. The themes that were addressed during the interviews were:

1) **Science students' views of the actual use of technology in learning.**
2) **Science students' views' of the digital distractions that distract students from learning.**
3) **Science students' views of the factors that affect their use of technology for learning.**

3.4 Research sample

The current study employed two methods to collect the data (questionnaire and interviews). The sample of the questionnaire consisted of 140 undergraduate science students (58 males and 82 females) who were selected randomly to answer the survey, while the sample of the interviews consisted of 25(10 males and 15 females) undergraduate science students who were selected from among the 140 science students who had completed the questionnaire.

4. Data analysis

This part describes and tests the survey and interview data collected from undergraduate science students. Section 4.1 examines the results of the survey data. Section 4.2 examines the results of the interview data.

4.1 descriptive statistics of survey data

Using SPSS 22 software two statistic indicators, skewness and kurtosis, tests were used to test the normality of the data distribution. Also, two statistics, mean and standard deviation, were used to describe the responses of science students regarding their experience with technology in classroom.

4.1.1 Normality tests

Skewness and kurtosis tests were used to examine the normality of the data distribution. The criteria +3 – 3 was used in the current study to identify if the data is distributed normally (Peat & Barton, 2005).Table 1 shows the skewness and kurtosis of each item of the questionnaire. The results of the tests determine that the data were distributed normally.

Table 1. Normality test (skewness and kurtosis)

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
…use technology adequately for course instruction	.375	.205	-.454-	.407
…use technology in face-to-face settings to engage you in the learning process	.923	.205	-.019-	.407
…use technology during class to make connections to the learning material or to enhance learning with additional materials	.707	.205	-.412-	.407
…encourage you to use your own technology devices during class to enhance learning	.475	.205	-.789-	.407
…encourage you to use online collaboration tools to communicate/collaborate with the instructor or other students in or outside class	.377	.205	-.996-	.407

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
...encourage you to use technology for innovation and creative or critical-thinking tasks	.579	.205	-.561-	.407
...have you use your tablet as a learning tool in class	.712	.205	-.482-	.407
...have you use your smartphone as a learning tool in class	.978	.205	-.199-	.407
...have you use your laptop as a learning tool in class	1.075	.205	.440	.407
Learning management system	-.588-	.205	-1.157-	.407
Online collaboration tools to communicate/collaborate	-1.297-	.205	.524	.407
E-books or e-textbooks	.370	.205	-1.257-	.407
Free, web-based content to supplement course-related materials	-.372-	.205	-1.336-	.407
Simulations or educational games	-.642-	.205	-.836-	.407
Student laptops as learning tools for course-related activities	-.543-	.205	-1.056-	.407
Lecture capture	-.877-	.205	-.883-	.407
Student tablets as learning tools for course-related activities	-.555-	.205	-1.065-	.407
Student smartphones as learning tools for course-related activities	-.433-	.205	-1.374-	.407
Social media as a teaching and learning tool	-1.282-	.205	.831	.407
Software to create videos or multimedia resources as a learning tool for course-related activities	-.847-	.205	-.441-	.407

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Search tools to find references or other information online for class work	-.880-	.205	-.282-	.407
Publisher electronic resources	-.767-	.205	-.670-	.407
Preferred learning environment	1.002	.205	1.008	.407
Technology will play an important role in my chosen career after college	-1.304-	.205	2.411	.407
Technology that I use in my courses now will prepare me adequately for my chosen career after college	-.777-	.205	.395	.407
Smartphone	1.195	.205	.424	.407
Tablet	.167	.205	-.847-	.407
Laptop	-.227-	.205	-.767-	.407
Smartphone	.313	.205	-1.520-	.407
Tablet	-1.113-	.205	.167	.407
Laptop	-.735-	.205	-.186-	.407
...use social media for non-educational purposes	-.268-	.205	-1.311-	.407
...text	.025	.205	-1.230-	.407
...read e-mail	.634	.205	-.815-	.407
...play games on a laptop or mobile device	.180	.205	-1.488-	.407
...access websites not related to class	-.294-	.205	-1.350-	.407

4.1.2 Descriptive statistics

Descriptive statistic is used to present the perceptions of the science students toward each item of the questionnaire. There were seven topics in the questionnaire: 1) science students' experiences of technology in the classroom, 2) science students' technology preferences in the classroom, 3) science students' preferred learning environments, 4) science students' perceived

benefits of technology, 5) science students' digital devices experiences in the classroom, 6) science students' personal use of digital devices in the classroom, and 7) digital distractions.

4.1.2.1 The technology experiences of science students in the classroom

The technology experiences of science students in the classroom were measured using nine items (see Table 2). A 6-point Likert scale was used to measure the perceptions of the science students: 1= "None", 2= "Very few", 3= "Some", 4= "Most", 5 = "Almost" and 6= "All". The descriptive statistics indicators are shown in table 2.

The means of this topic's items ranged between 2.34 (have you use your smartphone as a learning tool in class) and 3.29(encourage you to use online collaboration tools to communicate/collaborate with the instructor or other students in or outside class). The following paragraphs provide more details of the analysis, and focus on the highest three items and the lowest three items (see Table2).

Items with the highest meanamong the first section of the survey were as follows:

- **Item 5 (encourage you to use online collaboration tools to communicate/collaborate with the instructor or other students in or outside class), the total mean of this item was 3.29 and the Std. Deviation was 1.495. Thus, item 5 ranked the highest among the items of the first topic. This result indicates that the majority of science students perceive that most of the instructors use the technology to encourage them to use online collaboration tools to communicate/collaborate with the instructor or other students in or outside class.**
- **Item 1 (use technology adequately for course instruction), the total mean of this item was 3.14 and the Std. Deviation was 1.203. Thus, item1 ranked the second highest among the items of the first topic. This result indicates that the majority of the science students perceive that some of instructors use technology adequately for course instruction.**
- **Item 4(encourage you to use your own technology devices during class to enhance learning), the total mean of this**

item was 3.01and the Std. Deviation was 1.419. Thus, item4 ranked the third highest among the items of the first topic. This result indicates that the majority of the science students perceive that some of instructors encourage them to use their own technology devices during class to deepen learning.

While items with the lowest mean among the first topic of the survey were as follows:

- **Item 8 (have you use your smartphone as a learning tool in class), the mean of this item was 2.34 and the Std. Deviation was 1.473. This indicates that item 8 ranked the lowest among the items of the first topic of the survey. This result indicates that the majority of the science students perceive that very few instructors promote the use of smartphones by students as a learning tool.**
- **Item 9 (have you use your laptop as a learning tool in class), the mean of this item was 2.51 and the Std. Deviation was 1.422. This indicates that item 9 ranked penultimate among the items of the first topic of the survey. This result indicates that the majority of the science students perceive that very few instructors encourage students to use their laptop as a learning tool.**
- **Item 7 (have you use your tablet as a learning tool in class), the mean of this item was 2.64 and the Std. Deviation was 1.384. This indicates that item 7 ranked the second before the last among the items of the first section of the survey. This result indicates that the majority of the science students perceive that very few instructors allow students to use their laptop as a learning tool.**

Table 2. Descriptive indicators of the technology experiences of students in the classroom

Item	Mean	Std. Deviation
1…use technology adequately for course instruction	3.14	1.203
2…use technology in face-to-face settings to engage you in the learning process	2.95	1.294
3…use technology during class to make connections to the learning material or to enhance learning with additional materials	2.83	1.419
4…encourage you to use your own technology devices during class to enhance learning	3.01	1.505
5…encourage you to use online collaboration tools to communicate/collaborate with the instructor or other students in or outside class	3.29	1.495
6...encourage you to use technology for innovation and creative or critical-thinking tasks	2.94	1.415
7...have you use your tablet as a learning tool in class	2.64	1.384
8...have you use your smartphone as a learning tool in class	2.34	1.473
9...have you use your laptop as a learning tool in class	2.51	1.422

4.1.2.2 The technology preferences of science students in the classroom

The technology preferences of science students in the classroom were measured using thirteen items (see Table 3). A 5-point Likert scale was used to measure the perceptions of the students: 1 (Less), 2, 3, 4, and 5 (more). The descriptive statistics indicators are shown in table 3.

The means of this topic's items ranged between 2.65(E-books or e-textbooks) and 4.21 (online collaboration tools to communicate/collaborate). The following paragraphs provide more details of the analysis, and focus on the highest three items and the lowest three items (see Table3).

Items with the highest mean among the first topic of the survey were as follows:

- **Item 2(online collaboration tools to communicate/collaborate), the total mean of this item was 4.21 and the Std. Deviation was 1.166. Thus, item 2 ranked the highest among the items of the second topic of the survey. This result indicates that the majority of the science students prefer that the instructors allow more use of online collaboration tools to communicate/collaborate in the classroom.**
- **Item 10 (social media as a teaching and learning tool), the total mean of this item was 4.14 and the Std. Deviation was 1.127. Accordingly, item10 ranked the second highest among the items of the second topic of the survey. This result indicates that the majority of the science students prefer that the instructors allow more use of social media as a teaching and learning tool.**
- **Item 12 (search tools to find references or other information online for class work), the total mean of this item was 3.86 and the Std. Deviation was 1.259. Consequently, item 12 ranked the third highest among the items of the secondtopic. This result indicates that the majority of the science students prefer that the instructors allow more use search of tools to find references or other information online for class work.**

While items with the lowest mean among the second topic of the survey were as follows:

- **Item 3 (E-books or E-textbooks), the mean of this item was 2.65 and the Std. Deviation was 1.489. Accordingly, item 3 ranked the lowest among the items of the second topic of the survey. This result demonstrates that the majority of the science students prefer that the instructors allow less use of E-books or E-textbooks as learning tools.**
- **Item 4 (free, web-based content to supplement course-related materials), the mean of this item was 3.45 and the Std. Deviation was 1.490. Consequently, item 4 ranked penultimate among the items of the second topic of the survey. This result indicates that the majority of the science students prefer that the instructors allow a moderate useof free, web-based content to supplement course-related materials.**

- **Item 9 (student smartphones as learning tools for course-related activities), the mean of this item was 3.49 and the Std. Deviation was 1.529. Accordingly, item 9 ranked the second before the last among the items of the second topic of the survey. This result indicates that the majority of the science students prefer that the instructors allow a moderate use of smartphones as learning tools for course-related activities.**

Table 3. Descriptive indicators of the technology preferences of science students in the classroom

Item	Mean	Std. Deviation
1-Learning management system	3.64	1.518
2-Online collaboration tools to communicate/collaborate	4.21	1.166
3-E-books or e-textbooks	2.65	1.498
4-Free, web-based content to supplement course-related materials	3.45	1.490
5-Simulations or educational games	3.73	1.346
6-Student laptops as learning tools for course-related activities	3.57	1.430
7-Lecture capture	3.84	1.548
8-Student tablets as learning tools for course-related activities	3.63	1.401
9-Student smartphones as learning tools for course-related activities	3.49	1.529
10-Social media as a teaching and learning tool	4.14	1.127
11-Software to create videos or multimedia resources as a learning tool for course-related activities	3.83	1.325
12-Search tools to find references or other information online for class work	3.86	1.259
13-Publisher electronic resources	3.77	1.364

4.1.2.3 Science students' preferred learning environments

Science students' preferred learning environment was measured using one item (see Table 4). A 5-point Likert scale was used to measure the perceptions of the students: 1= "one with no online components", 2= "one with some online components", 3= "about half online and half face-to-face", 4= "one that is mostly but not completely online", 5 = "one that completely online", and 6= "no preference". The descriptive statistics indicators are shown in table 4. The following paragraph provides more details of the analysis.

The mean of the item (Preferred learning environment) was 3.09 and the Std. Deviation was 1.049.This result indicates that the majority of the science students preferred a learning environment that is about half online and half face-to-face.

Table 4. Descriptive indicators of science students' preferred learning environments

Item	Mean	Std.Deviation
Preferred learning environment	3.09	1.049

4.1.2.4 Benefits of technology towards science students' careers

Science students' perceived benefits of technology were measured using two items (see Table 5). A 5-point Likert scale was used to measure the perceptions of the students: 1= "strongly disagree", 2= "disagree", 3= "neutral", 4= "agree" and 5 = "strongly agree". The descriptive statistics indicators are shown in table 5. The following paragraphs provide more details of the analysis.

Item 1 (technology will play an important role in my career after college), the mean of this item was 4.23 and the Std. Deviation was .762. This result indicates that the majority of the science students agree that the technology will play an important role in their career after college.

Item 2 (technology that I use in my courses now will prepare me adequately for my career after college), the mean of this item was 3.69 and the Std. Deviation was .990. This result indicates that the majority of the science students agree that the technology that

they use in their courses will prepare them adequately for their career after college.

Table 5. Descriptive indicators of science students' perceived benefits of technology

Item	Mean	Std.Deviation
1-Technology will play an important role in my career after college	4.23	.762
2-Technology that I use in my courses now will prepare me adequately for my career after college	3.69	.990

4.1.2.5 Science students' experiences with digital devices in the classroom

Science students' experiences using their devices (smartphone/tablet/laptop) in the classroom were measured using three items (see Table 6). A 5-point Likert scale was used to measure the perceptions of the students: 1= "banned from using it in the classroom", 2= "discouraged from using it in class", 3= "about equally discouraged and encouraged", 4= "encouraged to use it in class", and 5 = "required to use it in class". The descriptive statistics indicators are shown in table 6. The following paragraphs provide more details of the analysis.

Item 1 (science students' experiences with the smartphone in the classroom), the mean was 1.66 and the Std. Deviation was .903. This result reveals that the majority of the science students were discouraged from using the smartphone in the classroom.

Item 2 (science students' experiences with the tablet in the classroom), the mean was 2.77 and the Std. Deviation was 1.095. This result indicates that the majority of the science students were about equally discouraged and encouraged to use the tablet in the classroom.

Item 3 (science students' experiences with the laptop in the classroom), the mean was 3.14 and the Std. Deviation was 1.160. The result demonstrates that the majority of the science students were encouraged to use the laptop in the classroom

Table 6. Descriptive indicators of science students' experiences with digital devices in the classroom

Item	Mean	Std.Deviation
1-Smartphone	1.66	.903
2-Tablet	2.77	1.095
3-Laptop	3.14	1.160

4.1.2.6 Science students' actual use of digital devices in the classroom

Science students' actual use of their devices (smartphone/tablet/laptop) in the classroom was measured using three items (see Table 7). A 5-point Likert scale was used to measure the perceptions of the students: 1= "use to take notes", 2= "use to engage in non-class activities while in class", 3= "use to make other connections with the learning material while in class", 4= "use for instructor-directed in-class activities", and 5 = "do not typically use in class". The descriptive statistics indicators are shown in table 7. The following paragraphs provide more details of the analysis.

Item 1 (science students' actual use of the smartphone in the classroom), the mean was 2.69 and the Std.Deviation was 1.596. This result reveals that the majority of the science students used the smartphone to make connections with the learning material while in classroom (e.g., look up definitions of key terms; find more information on a topic).

Item 2(science students' actual use of the tablet in the classroom), the mean was 4.01 and the Std. Deviation was 1. 267. This result demonstrates that the majority of the science students used the tablet for the classroom activities that are directed by the instructor.

Item 3(students' actual use of the laptop in the classroom), the mean was 3.99 and the Std. Deviation was 1.011. This result shows that the majority of the science students used the laptop for the classroom activities that are directed by the instructor.

Table 7. Descriptive indicators of science students' personal use of digital devices in the classroom

Item	Mean	Std.Deviation
1-Smartphone	2.69	1.596
2-Tablet	4.01	1.267
3-Laptop	3.99	1.011

4.1.2.7 Digital distractions

Digital distractions that distract science students from learning were measured using two items (see Table 8). A 5-point Likert scale was used to measure the perceptions of the students: 1= "strongly disagree", 2= "disagree", 3= "neutral", 4= "agree", and 5 = "strongly agree". The descriptive statistics indicators are shown in table 8. The following paragraphs provide more details of the analysis.

- **Item 5 (access websites not related to course), the total mean of this item was 3.28 and the Std. Deviation was 1.435. Item 5 ranked the highest among the items of the digital distractions that may distract students form learning. This result indicates that the majority of the science students perceived that access to websites that were not related to the course distractedthe studentsaway from learning.**
- **Item 1 (use social media for non-educational purposes), the mean of this item was 3.26 and the Std. Deviation was 1.371. Item 1 ranked the second highest among the digital distraction items that distract students from learning. This result shows that the majority of the science students perceived that using the social media for non-educational purposes distracted the students away from learning.**
- **Item 2 (text), the mean of this item was 3.01 and the Std. Deviation was 1.322. Item 2 ranked the third highest among the digital distraction items that distract science students from learning. This result shows that the majority of the science students perceived that texting by using the digital devices distracted the students away from learning.**

- **Item 4 (play games on a laptop or mobile device), the mean of this item was 2.74 and the Std. Deviation was 1.150. Item 4 ranked the penultimate among the digital distraction items that distract students from learning. This result indicates that the majority of the science students perceived that playing games on a laptop or mobile device distracted the students away from learning.**
- **Item 3 (read e-mail), the mean of this item was 2.30 and the Std. Deviation was 1.318. Item 3 ranked the lowest among the digital distraction items that distract students from learning. This result indicates that the majority of the science students perceived that playing games on a laptop or mobile device did not distract the students from learning.**

Table 8. Descriptive indicators of digital distractions

Item	Mean	Std. Deviation
1-...use social media for non-educational purposes	3.26	1.371
2-...text	3.01	1.322
3-...read e-mail	2.30	1.318
4-...play games on a laptop or mobile device	2.74	1.510
5-...access websites not related to course	3.28	1.435

4.2Analyses of interview data

The interview questions emerged from the survey. The themes that were addressed during the interviews were:

1) **Science students' views of the actual use of technology in learning.**
2) **Science students' views' of the digital distractions that distract students from learning.**
3) **Science students' views of the factors that affect students' use of technology for learning.**

4.2.1Actual use of technology in learning

Three different categories of actual use of technology emerged during the interview analysis. These were: 1) types of devices

science students use for learning, 2) science students' experiences with technology the classroom, and 3) science students experience with technology outside the classroom.

4.2.1.1Types of devices science students use for learning

The science students mainly used their smartphones alongside with tablets, laptops and computers for learning. All the interviewees used the Smartphone to communicate with peers and instructors on WhatsApp, and search google for information, while 15/25 interviewees used the smartphones to take notes, record lectures, check emails, and do presentations. 18/25 interviewees used the laptop to search for information on Google, make presentations on PowerPoint, and write assignments using Word; whereas 7/25 interviewees used the computers that are available at the college to make presentations on PowerPoint, and write assignments using Word. 4/25 interviewees used the iPad to search google, check emails, and read lecture notes.

4.2.1.2 Science students experiences with technology in the classroom

The interviewees stated that the technology was used by the instructors in the classroom for: 1) presenting the lecture, 2) doing exams, 3) showing videos related to the subject, 4) sending course materials to students, 5) and providing blogs that have all the information of the course.Also, the interviewees stated that the main applications used were: 1) PowerPoint, 2) Moodle, 3) video, 4) MyU, 5) Blogs, 6)and excel.

"My instructors use PowerPoint to present the lecture"S10

"We do our exams on Moodle"S25

"My instructors show videos that are related to the lecture content"S1

"We communicate with the instructor using MyU, and the instructor sends lecture content and students grads on MyU"S2

"Theinstructor has a blog that includes the lecture material and questions' bank"S23

"The instructor takes students attendance using Excel"S8

4.2.1.3 Science students experiences with technology outside the classroom

The interviewees stated that the technology was mainly used outside the classroom for: 1) communication between students and their peers, and between students and the instructor, 2) finding information using Google, 3) uploading lecture notes, 4) preparing presentation projects, and 5) doing online tests. Also, the interviewees stated that the main applications used were: 1) MyU, 2) WhatsApp, 3) Twitter, 4) Emails, 5) Google, and 6) PowerPoint.

"The instructor uses MyU to communicate with us and upload lecture notes"S21

"My instructors communicate with us using WhatsApp"S5

"I use WhatsApp to communicate with my classmates"S9

"The instructor updates us about lecture timing and cancelation of lectures and examination time using twitter"S3

"When I have some questions I email my instructor to explain for me"S18

"My instructor sends class lectures through email"S11

"I use Google to find information for my assignment"S22

"When I struggle with some subjects or don't understand some words I use Google to find the information"S20

"The instructor sends the lecture notes online and this is helpful, because sometimes I might miss something during the lecture or I might not be able to attend the lecture."S4

"All my peers contact me using WhatsApp; we enjoy sending entertaining videos and broadcasts"S15

"We create groups on WhatsApp for each subject and we discuss the content together and when we have question related to the subject we discuss it with each other."S14

Some of my courses require from me to do presentations, so I use PowerPoint for that" S12

"My instructor use online tests, so during the class the instructor asks us to open the exam online and complete it and submit it"S6

4.2.2 Digital distractions

Interviewees stated that the technology can distract them from learning. Mainly, science students depend on the smartphones to download social media applications for entertainment which makes it very easy to get distracted. Some of these applications include, but are not limited to: twitter, Snapchat, Instagram, and WhatsApp. The reason that these applications distract science students that there is always something new that attract the students to continue using the application.

"When I feel bored during the lecture I automatically reach out to my phone and check my notifications"S24

"Sometimes while searching for information I get a notification and forget about my search"S7

"Whilestudying at home I get bored and use social media for many hours without noticing speciallySnapchat and Instagram"S16

"My problem that I always want to know the updates and what is trending on Twitter, so I always forget about study"S13

"I frequently want to check celebrities' updates on Instagram"S19

"Every day I text my relatives and friends on WhatsApp more than three times a day"S17

4.2.3 Factors affect science students' use of technology for learning

Science students stated that there are some factors that may affect their use of technology in learning. These factors are: 1)extremely low wireless service at college, 2) instructors do not encourage students to search online and find extra learning resources, 3) lack of technology resources within the classroom, 4) no tutorial sessions to teach students how to use technology in learning, 5) no online lectures, 6) lack of using learning management systems such as Moodle, 7) and lack of time.

"We had an online examination and the wireless service was so bad that the page kept on refreshing and the exam was labeled as submitted although it was not completed"S25

"I have the hard copy of the curriculum and the booklet and the instructor depend mainly on them to teach us. So there is almost no need to search for extra information online."S9

"I wish that we have online lectures, but our college doesn't provide that kind of learning"S13

"The college does not provide smart boards in the classrooms and some classrooms do not have projectors and computers" S18

"The university provided us with Moodle however, instructors do not use it and we do not know how to use it"S2

"Nobody teaches us how to use applications or online websites to study"S21

"I do not have time to find extra information online; I have many subjects and many exams" S12

5. Discussion

The study provided evidence regarding science students' perceptions about their experience towards using technology in the classroom. The results demonstrated that most of the science students' instructors used the technology for communication with the students and for course instructions which was consistent with the result of Brooks and Pomerantz (2016). Moreover, some of the science students' instructors encouraged them to use their devices in the classroom to enhance their learning (such as finding information online and doing presentations); and they encouraged students to use their laptops to do these activities rather than using their Smartphones to ensure that the science students do not get distracted. However, few of the instructors used the devices of the science students (Smartphone, laptop, or tablet) as a learning tool in the classroom.

The results of the study also confirmed that almost all the science students relied on their Smartphone for communication and information seeking; while some of them use their Smartphone to record lectures, check emails, and do presentations. The results indicated that most of the science students relied on their laptops to make presentations and write their assignments. This result is consistent with Brooks and Pomerantz (2016) who found that the greater majority of students used their laptops for academic purposes. In addition, findings indicated that the way science students used technology for learning in the classroom did not differ from the way they used technology outside the classroom for learning.

The study's results also demonstrated that the majority of the science students used the Smartphone to connect with the learning

material while in classroom, even without the direction of the instructor. However, the results showed that the science students used their laptop and tablet only for the classroom activities that are directed by the instructor. This result is consistent with Margaryan et al. (2011) who found that the students did not really understand the importance of the technology to enhance the learning, instead they applied them for lecturer's instructions and only applied technologies and applications where needed.

Moreover, evidence found in the current study showed that the applications that the instructors asked the science students to use to communicate with them and with their peers (such as twitter, WhatsApp), became an important part of the science students' studies in those courses as they tend to use these applications to share information and discuss the course requirements with their peers. However, the applications that the science students use to be connected with friends (such as Instagram and snapchat) that were not suggested for educational purposes by the instructor tend to be used by the science students only for entertainment purposes. The reason for this is that the science students do not link between entertainment based applications and education based applications, as they like to have the two in separate categories (Harris, Warren, Leigh, & Ashleigh, 2013), unless otherwise told by their instructors.

Also, it was demonstrated that the use of technology for education is mainly for finding information on Google, uploading lecture notes, doing presentation, and communicating with peers and instructors. This result is consistent with Dahlstrom and Bichsel (2014) who found that although students widely use technology, its use in education is very shallow. In addition, this result is consistent with Keengwe (2007) who found that the instructors often used technology to do presentations, send emails, and manage students' learning, but rarely used technology-enhanced learning tools such as web publishing, content specific software, imaging devices, and discipline devices; they also infrequently taught in multimedia classrooms.

Based on the technology preferences of the science students in the classroom, the study provided evidence that the majority of the science students prefer that the instructors allow more use of online collaboration tools, social media, and search tools for learning and teaching process; and less use of E-books, free, web-based content, and Smartphones as learning tools for course-

related activities. Educational based tools (i.e. E-books and free, web-based content) and technologies that can be used for educational purposes were not chosen by the science students because they never experienced them in a learning environment. Even smartphones, something they use in their daily lives, was not selected as a learning tool as they are not accustomed to using it deeply in learning. This shows that the students only want a basic use of technology even when they were asked about their preference. Although the science students were asked what technologies and applications they prefer the instructor to use, they only selected the few applications and technologies they are already accustomed to and are already using in education. The reason of these preferences is that the students' expectations of learning appear to be affected by the approaches instructors use to teaching (Margaryan et al., 2011). The students, in addition, predominantly prefer the technology that works best for their academic work within their studies rather than using technology in a creative way for learning (Henderson et al., 2017).

Also, the results of the current study about science students' preferred learning environments revealed that despite the college does not provide online courses, the majority of the science students preferred a learning environment that is about half online and half face-to-face. This result is consistent with Brooks and Pomerantz (2016) who found that the students prefer blended courses online and face-to-face learning environments. Means et al. (2009) demonstrated that the use of blended learning environments enhanced and promoted students' learning than did face-to-face learning alone.

Moreover, the results of the current study about the benefits of technology on the science students' careers provided evidence that the majority of the science students agree that the technology will play an important role and will prepare them adequately for their career after college. This result is consistent with Anderson and Maninger (2007) who found that the students held positive beliefs about the benefits of using technology in their classroom in the future.

However, the current study demonstrated that the science students get distracted while studying due to the following digital activities that are not related to their courses: 1) websites, social media, texting, and playing games. The study found that the science students relied mainly on their Smartphone to install

applications that they use for entertainment. Some of these applications include, but are not limited to: Twitter, Snapchat, Instagram, and WhatsApp. The problem of these digital activities is that they are always updated with new information and other things that attract the students to continue using them endlessly. Similarly, Brooks and Pomerantz (2016) found that the use of Smartphone while studying was distracting. Brooks and Pomerantz (2016) suggested that taking away devices from students while studying will reduce the amount of distraction. To apply this in the classroom, instructors can control the time used for learning using the Smartphone so that the students are not distracted.

The results of the current study also revealed that the science students faced factors that affected their use of technology in learning. The first factor was science students' lack of skills to use technology in learning. Similarly, Keengwe (2007) found that students' lack of experience was one of the factors that affected the use of technology to improve students' learning. Also, Al-Ansari (2006) found that the instructors lacked the experience in using the Internet for searching and they wished to get training courses. It is obvious that when the instructors who are expected to have more experience in using technology see that they need training courses, without doubt students who do not have a real experience in using technology for learning also need guidance to use technology in meaningful ways (Dahlstrom and Bichsel, 2014).

The second factor was the unavailability of online learning. Similarly, Al-Doub, Goodwin, and Al-Huniayyan (2008) indicated that e-learning courses were not provided by the PAAET in Kuwait. Although that the college does not provide online courses, students of the current study showed interest in online learning and preferred to have blended learning environments.

Furthermore, the third factor that affected science students' use of technology in learning was the lack of technology resources within the classroom. Al-Doub, Goodwin and, Al-Huniayyan (2008) indicated that there were no e-learning recourses in the classroom at the PAAET. This shows that there has been some progress in providing technology on campus, as the current study demonstrated that there are still some e-learning resources that are unavailable.

In addition, the fourth factor that affected science students' use of technology in learning was that the instructors do not encourage science students to search online and find extra learning resources. This can be attributed to the low experience of the instructors in using technology (Pomerantz, Jeffrey, and Brooks, 2017). If the instructors are more comfortable and have self-efficacy in using technology this will be reflected on their courses and they will in turn encourage the students to use technology in the classroom.

Moreover, the fifth factor that affects science students' use of technology in learning was the extremely low wireless service at college which was similar to the finding of Al-Ansari (2006). Al-Ansari (2006) found that one of the factors that prevented the instructors to use the Internet at the college was the slow access speed. This problem is very prominent even after over a decade of Al-Ansari's study.

The sixth factor that affected science students' use of technology in learning was lack of using learning management systems (LMS). This result is consistent with Dahlstrom and Bichsel (2014) who found that despite that the students understand the importance of the LMS, the use of it is still limited. Also, the lack of use of LMS can be attributed to the instructor's lack of experience using LMS and their lack of integrating it into their teaching.

Finally, the seventh factor that affected science students' use of technology in learning was the lack of time. The results demonstrated that the students did not have time to use technology for learning and finding extra information. This can be attributed to the methods instructors use to teach students, which depend mostly on traditional teaching methods that focus on examining students on what is taught in textbooks, and the minor use of technology tools to deliver content (Margaryan et al., 2011). The instructors spend most of the class time in teaching the content of the textbook, leaving no time for students to experience a student-centered learning using technology.

Conclusion

This study explored undergraduate science students' perceptions about the actual use of technology in the classroom and their perceptions about the preferred use of technology in the classroom and the benefits of these technologies for their career. It also examined science students' perceptions toward the digital distractions and the factors that affect their use of technology in learning. The results lead to the conclusion that despite that technology is broadly used in teaching and learning; this use is not deep or creative. Science students appear to experience and use technology as a supportive tool for learning, and this use does not change the traditional teaching approaches of the college. On the other hand, the results revealed that one of the drawbacks of having a technology integrated education is the distractions that come along with it. Moreover, the results also show that the science students encounter other important factors that affect their use of technology in learning. Thus, educational institutions should take into account how to overcome the constraints that affect the use of technology in learning to have a useful and successful use of it. To transform the teaching approaches of the universities, more attention should be paid to the way of applying a technology-integrated curriculum that involves advanced student-centered learning procedures that engage students in the teaching and learning process, stimulate students' thinking, and use creative digital technologies.

At the end, the study recommends the following:

- **Provide courses for students to teach them how to integrate technology into the learning process.**
- **Provide courses for the instructors to teach them how to integrate technology into the teaching and learning process.**
- **Provide a technology-integrated curriculum to allow students to invent, innovate, and to have creative thinking.**
- **Supply classrooms with all the technology resources that are needed to fully integrate technology in the teaching and learning process.**
- **Provide e-learning courses for students to give them the chance to experience blended learning environments.**
- **Strengthen the wireless service on campus.**

References

Al-Ansari, H. (2006). Internet use by the faculty members of Kuwait University. *The electronic library*, *24*(6), 791-803.

Al-Doub, E., Goodwin, R., & Al-Hunaiyyan, A. (2008).Student's attitudes toward e-learning in Kuwait's higher education institutions. *Retrieved October*, *15*, 2010.

Anderson, S. E., &Maninger, R. M. (2007).Presevice teachers' attitudes, abilities, and intentions regarding technology integration.Journal of Educational Computing Research, 37(2), 151-172.

Barak, M. (2014).Closing the gap between attitudes and perceptions about ICT-enhanced learning among pre-service STEM teachers.*Journal of Science Education and Technology*, *23*(1), 1-14.

Barak, M., Ashkar, T., & Dori, Y. J. (2011).Learning science via animated movies: Its effect on students' thinking and motivation.*Computers& Education*, *56*(3), 839-846.

Barczyk, C. C., & Duncan, D. G. (2013). Facebook in higher education courses: An analysis of students attitudes, community of practice, and classroom community. nternational Business and Management, 6(1), 1-11.

Bolstad, R., &Hipkins, R. (2008).*Seeing yourself in science* (Report). Wellington, New Zealand: New Zealand Council For Educational Research.

Brooks, D. C., &Pomerantz, J. (2016). ECAR study of undergraduate students and information technology, *Research report. Louisville, CO: ECAR, October 2016*, 4 (3), 2- 48.

Cox, M., Webb, M., Abbott, C., Blakeley, B., Beauchamp, T., & Rhodes, V. (2004). An investigation of the research evidence relating to ICT pedagogy.

Creswell, J. W. (2009). *Research design qualitative, quantitative, and mixed methods approaches.* (3rd edn), Los Angeles: Sage Publications.

Dabbagh, N., &Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and higher education*, *15*(1), 3-8.

Dahlstrom, E., & Bichsel, J. (2014).*ECAR study of undergraduate students and information technology*.Research report. Louisville, CO: ECAR, October 2014. Available from http://www.educause.edu/ecar.

Daniel, E. G. (2013).Asia Pacific science education in a knowledge society.*Asia Pacific Journal of Education, 33(2),* 170-182.

Davies, R. S., Dean, D. L., & Ball, N. (2013).Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research and Development*, *61*(4), 563-580.

Dündar, H., &Akçayır, M. (2014). Implementing tablet PCs in schools: Students' attitudes and opinions. *Computers in Human Behavior*, *32*, 40-46.

Edmunds, R., Thorpe, M., &Conole, G. (2012). Student attitudes towards and use of ICT in course study, work and social activity: A technology acceptance model approach. *British journal of educational technology*, *43*(1), 71-84.

Fensham, P. J. (2006). Humanistic science education: Moves from within and challenges from without. In Ayob, Aminah (Ed.) *Proceedings of XII IOSTE Symposium*, International Organisation for Science and Technology Education (IOSTE), Penang Grand Plaza Parkroyal Beach Resort, Penang.

Hair, J.F, Black, W.C., Babin, B.J., Anderson, R.E., & Tatham, R.L. (2006).*Multivariatedata analysis* (6thed). New Jersey: Prentice-Hall International.

Harris, L., Warren, L., Leah, J., & Ashleigh, M. (2013). Small steps across the chasm: ideas for embedding a culture of open education in the university sector. *in education*, *16*(1).

Henderson, M., Selwyn, N., & Aston, R. (2017). What works and why? Student perceptions of 'useful'digital technology in university teaching and learning. *Studies in Higher Education*, *42*(8), 1567-1579.

Irwin, C., Ball, L., Desbrow, B., &Leveritt, M. (2012).Students' perceptions of using Facebook as an interactive learning resource at university. ***Australasian Journal of Educational Technology*****,** ***28*****(7).**

Jimoyiannis, A. (2010). Designing and implementing an integrated technological pedagogical science knowledge framework for science teachers' professional development. ***Computers & Education, 55,*** **1259-1269.**

Johnson, B., & Christensen, L. (2008).*Educational research: Quantitative, qualitative, and mixed approaches.* Los Angeles, CA: Sage Publications.

Keengwe, J. (2007). Faculty integration of technology into instruction and students' perceptions of computer technology to improve student learning. ***Journal of information technology education*****,** ***6*****.**

Laurillard, D. (2006). E-learning in higher education. ***Changing higher education: The development of learning and teaching*****, 71-84.**

Law, N., Pelgrum, W. J., &Plomp, T. (Eds.). (2008). Pedagogy and ICT use in schools around the world: Findings from the IEA SITES 2006 study. ***Springer,23*****, 1-34.**

Margaryan, A., Littlejohn, A., &Vojt, G. (2011). Are digital natives a myth or reality? University students' use of digital technologies. ***Computers & education*****,** ***56*****(2), 429-440.**

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. ***U.S. Department of Education Office of Planning, Evaluation, and Policy Development Policy and Program Studies Service*****, 1-55.**

Osborne, J., & Hennessy, S. (2003). Literature review in science education and the role of ICT: Promise, problems and future directions.

Peat, J., & Barton, B. (2005). Categorical variables: risk statistics. ***Medical Statistics: A guide to data analysis and critical appraisal*****, 241-266.**

Pomerantz, J., & Brooks, D. C. (2017). ECAR Study of Faculty and Information Technology, *Research report. Louisville, CO: ECAR, October 2017*,97(80), 3-43.

Ryan, G.W. & Bernard, H.R. (2000).*Data Management and Analysis Methods.*InDenzin, N. & Lincoln, Y., *Handbook of Qualitative Research*, (2nd edn.), (769-802). CA: Thousand Oaks, Sage Publications.

Selwyn, N. (2014). *Digital technology and the contemporary university: Degrees of digitization*. Routledge.

Singh, G., O'Donoghue, J., &Worton, H. (2005).A Study into the Effects of eLearning on Higher Education. *Journal of University Teaching and Learning Practice*, *2*(1), 3.

Venkatesh, V., Croteau, A. M., &Rabah, J. (2014, January).Perceptions of effectiveness of instructional uses of technology in higher education in an era of Web 2.0.In *System Sciences (HICSS), 2014 47th Hawaii International Conference on* (pp. 110-119).IEEE.

Webb, M. E. (2005). Affordances of ICT in science learning: implications for an integrated pedagogy. *International journal of science education*, *27*(6), 705-735.

Webb, M. E. (2008). Impact of IT on science education.InVoogt, J., &Knezek, G. *International handbook of information technology in primary and secondary education*, *Springer, 20*, 133-148.

Westerman, D., Daniel, E. S., & Bowman, N. D. (2016). Learned risks and experienced rewards: Exploring the potential sources of students' attitudes toward social media and face-to-face communication. The Internet and Higher Education, 31, 52-57.

Williams, J., Cowie, B., Khoo, E., Saunders, K., Taylor, S., &Otrel-Cass, K. (2013).*Networked inquiry learning in secondary science classrooms*.New Zealand Council of Educational Research.

Zhou, M., &Teo, T. (2017).Exploring student voice in teachers' motivation to use ICT in higher education: Qualitative evidence from a developing country. *International Journal of Educational Technology*, *4*(1), 26-33.