
AC 2012-3924: DIGITAL ENGINEERS: RESULTS OF A SURVEY STUDY DOCUMENTING DIGITAL MEDIA AND DEVICE USE AMONG FRESH- MEN ENGINEERING STUDENTS

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Digital Engineers: Results of a Survey Study Documenting Digital Media and Device Use Among Freshmen Engineering Students

Abstract

The current generation of college students has been dubbed Digital Natives, Generation Y and/or the Net Generation and seemingly possesses distinctive habits as well as perceptions about the use of digital media and device that set them apart from their predecessors. Despite the claim that these college students are avid consumers and users of media content and devices, there is limited understanding about the media use habits of engineering students belonging to this generation. To better understand the digital media and device habits of incoming engineering students, we conducted a survey-based study at a large university in the United States. We obtained 204 valid responses. Two surveys were designed to obtain self-reported information on the frequency of media device usage, participation in social networking, academic activities and information seeking tendencies. Through this survey study, not only are we able to document the significant use of digital media and devices among engineering students, we are able to provide specific findings related to the role of digital media and devices on socializing and learning activities of freshmen engineering students. Findings also indicated that female freshmen engineering students are more likely to use the cellphone for talking, texting as well as participation in Wikipedia platform when compared to the males.

Introduction

The need to innovate in engineering education has led to increased calls for integrating information technology with instruction and adoption of a wide variety of media and internet-based learning platforms to enhance learning³. Several studies have reported the success of leveraging technology in improving engineering learning and for instance, Rutz and his colleagues²⁸ investigated the use of instructional technologies such as streaming media and interactive videos to improve education in fundamental engineering science courses. They found that time spent on task and interest in content can be improved through when instructional technologies were leveraged. Rojas²⁷ investigated the use of web-centric tools in a graduate engineering course and reported that interactions were enhanced and collaboration efforts were improved. Chen, Whittinghill and Kadlowec⁵ used custom feedback system through PDAs in classes and reported that rapid feedback can positively improve the learning process. Similarly, Steif and Dollár³⁰ examined engineering students' interactions with the courseware and discovered that learning gains are increased when they made self-regulated efforts to use related courseware to complement their learning. On the other hand, Johri and Lohani¹⁵ found that the use of Tablet PCs in large classes combined with software such as DyKnow™ allow for the creation of a learning environment which is conducive to guided participation and can encourage a sense of community among students. In addition to studies that have examined the use of specific technologies, review of studies of technology will highlight the frequent changes in the range of devices and software available to students and illuminate the need to deepen our understanding of media and internet usage patterns of engineering students. It is important to frequently calibrate and gauge student use of technology so that educators can appropriately leverage new technologies in instruction and teaching. However, we need to first establish a

better understanding of media and internet use amongst our freshmen engineering respondents and this study attempts to do just this.

Literature Review

The use of technology for education is a centuries-old phenomenon which saw the use of pens and blackboards in classroom instruction in the past whereas the recent advancements in digital technology have dramatically changed the landscape. The infrastructure for education and learning has become significantly digitized as evident from use of devices such as electronic whiteboard, laptops, and mobile phones, and of web-based resources and activities such as the Internet, online gaming, and social networking. As Johri¹⁴ argues, the shift is not just in the infrastructure but also its use as technology has become a part of common educational activities such as managing content, facilitating interaction among students and teachers, grading, and conducting research. Given this extensive shift in the use of digital media and devices within education, a review of prior work on media habits of students will situate this study within the large body of research. We are primarily interested in the experiences of the “Net generation”, which is described as a generation of persons born between 1980 and the present^{31,32} who grew up with computer-based technology readily available and unrestricted access to the Internet. This group of youths is known to be extremely proficient with digital technology and is often dubbed as effective multi-taskers who are competent with the simultaneous use of more than one electronic and digital devices⁸. Tapscott and Williams³¹ have outlined several traits of the Net generation and according to them they “are not content to be passive consumers, and increasingly satisfy their desire for choice, convenience, customization, and control by designing, producing, and distributing products themselves” (p. 52). Their learning styles lean towards independence and autonomy, which then influence their behavior in school, from “what kind of education they buy” to “what, where, and how they learn”⁴. Since Net Generation students are able to utilize online tools to their advantage, researchers suggest that educators should not be restricted by the linearity of traditional communication media in planning or delivering instruction.

The extensive use of technology by the Net generation is well established. There is no doubt that the ownership and use of devices, such as MP3 players, cell phones, laptops, gaming consoles has increased dramatically in the past 20 years. The most active users of these devices are young teenagers and young adults^{18,19}, who are described as digitally literate, always connected and desiring contact, social, visual, experiential and needing immediate responses²³. Two studies were conducted at the University of Massachusetts with the purpose of assessing students’ internet use and comparing the results²⁴. The study reported that 98% of the students in the more recent study owned a computer compared to 89% of students in the earlier sample. In addition, EDUCAUSE Center for Applied Research performed a study with the goal of measuring students’ internet use and abilities, and evaluating students’ needs for IT services, training and tools¹⁸. This web-based survey drew a sample of 18,039 students in 2004, as well as comments in the open-ended questions of the survey and in addition, 82 were interviewed. Results showed that most of the students had at least one computer and a cell phone. Over 61% of the respondents reported that they owned a personal desktop computer whereas over 55% owned a laptop computer and over 90% owned cell phones. They used these every day for socializing, studying and entertainment¹⁸. The study reported that they spent 11-15 hours per week using electronic devices, the most common activity being writing papers for coursework (3-5 hours per week),

instant messenger activities, i.e. texting or chatting (3-5 hours per week), e-mail activities (1-2 hours per week) and surfing the internet for pleasure (1-2 hours per week). Over 99% of the students participating in their study used email, over 98% used the internet for coursework and writing and over 94% used the internet for pleasure.

Jones and his colleagues have also replicated and extended their earlier study from 2002 on college students' media use and compared the results¹⁶. The research from 2002 had showed that about 77% of the students spent at least an hour online each day whereas the results from the second study, with data collection performed in 2005, showed a big increase in the use of the internet. 54% of the students reported being online at least three hours per day compared to less than a fourth of the general population. Regarding computer ownership, 76% of the students owned a desktop computer, 54% owned a laptop and over 35% owned both a desktop and a laptop¹⁶. In addition, students used multiple methods of communication to keep in touch with relatives and friends and 31% of the survey respondents sometimes used their cell phones to go online.

The use of the Internet has only increased in the subsequent years particularly with the popularity of social networking in recent times¹⁶. Hampton, Goulet, Rainie and Purcel⁹ surveyed some 2,255 American adults and found that 79% of the respondents used the internet. In addition, nearly half of the respondents (47%) or 59% of internet users reported that they used at least one of social networking sites. For the student population, more than one-third of the students reported logging on to Facebook daily and 21% admitted to logging on many times per day¹⁶. Furthermore, Schrock²⁹ surveyed 401 undergraduates in a large university and reported that MySpace members were more likely to be females. We turn to another social networking tool, Twitter, which is a popular short messaging or texting service available through the Internet browser, desktop or mobile software, has gained popularity in learning and education²⁰. In particular, Java and his colleagues¹² examined tweets from 76,177 users and discovered that the Twitter social networks have high degree correlation and reciprocity, indicating close mutual acquaintances among the users. Hargittai and Litt¹⁰ conducted a survey study of 505 students and found that less than 20 percent of the college students surveyed were using the website in 2010. In addition, they also found that 37 percent of black students were using Twitter in 2010 compared to 21 percent of white students.

Another trend that has gradually become an integral part of the Net Generation is multitasking^{22, 33}. Rideout, Foeur and Roberts¹⁷ found that students between the age of 8 and 18 reported using multiple media simultaneously, such as using computers and the Internet at the same time as video games, print media, music, and the phone. In this survey, 56% of their respondents reported that they use a computer, watch TV, play video games, text message, or listen to music while doing their homework some of the time or more frequently. In an attempt to examine the ill-effects of multi-tasking, Hembrooke and Gay¹¹ investigated the effects of multitasking in group of students who are using laptops in a lecture and reported that students who multitask perform significantly poorer in immediate measures of memory. Arriving at a similar conclusion, Levine, Waite and Bowman²¹ argued that if youths are repeatedly engaged in tasks that require frequent attention shifts (such as instant messaging), this may lead to a preference for frequent task switching over sustained attention during cognitive tasks and “quick, superficial multitasking rather than in-depth focus on one task” (p.565). These findings raise concerns about the multitasking habits of engineering students.

The future of education is heralded to be even more “digital” in nature. According to the latest Horizon Report¹³, an annual survey conducted by the New Media Consortium and Educause, identified six emerging technologies relevant to education: electronic books, mobiles, augmented reality, game-based learning, gesture-based computing, and learning analytics. The K-12 edition of the Horizon Report further lists cloud computing, open content, and personal learning environments, as areas of growth. In the current technology-infused environment, students and teachers alike are spending more time with and around digital devices and services. According to The Nielsen Company²⁶, time spent on social media worldwide has increased 82% over the previous year and users spend an average of over 5 hours on social media. In addition, WordPress³⁴, one of world’s premier blog hosting site, reported there are over 48 million blogs hosted through WordPress and almost 300 million people view the blogs each month. The popularity of electronic games continues to increase exponentially and according to Entertainment Software Association⁷, almost 70% of American households now play computer or video games.

Using the findings in the literature discussed above, we investigated freshmen engineering students’ use of digital media and devices. We used a self-reported survey instrument and typical of survey studies about goal was to establish the prevalence of specific media habits among the survey population. In the next section we discuss our research design and data collection.

Research Design and Data Collection

The survey instrument used for this study was designed based on prior studies of similar nature that had made their instruments publicly available^{9,17}. In addition, one of the authors of the paper has access to an instrument from a similar study by having worked as part of the research team that conducted that study². Given the advances in technology, only the overall design of the survey was replicated but the exact questions were changed to reflect newer technologies. Survey questions were based on a Likert Scale and coded so that positive outcomes were represented by higher response values. Two separate groups of students participated in the survey which was hosted on a commercial survey-hosting website which the host university maintains a license. The survey was administered on two separate occasions, once in April 2010 and then again in May 2010. In April 2010, a survey of 19 questions was administered to students of an engineering design class and the survey was conducted in presence of the researchers. Then in May 2010, another survey of 21 questions was administered to a separate portion of the freshmen engineering cohort and the students were notified through email. The two surveys were identical except for the last two questions, where the respondents were asked a question on their perceived ability to multi-task and the number of tasks they perceived themselves to be capable of performing simultaneously.

A total of 143 students responded for the first survey and 136 students responded for the second survey. Considering that this response rate was relatively high and the number of respondents was sufficient for conducting statistical tests, we did not send follow-up emails. We used list-wise deletion of missing data and the sample size after list-wise deletion is $n = 204$, compared with a total sample size of 279. List-wise deletion was used to remove the responses of 75 respondents with missing data, resulting in 204 students (73 percent) with complete data. Based on the demographics of our student respondents, descriptive statistics are shown in Table 1. As shown, a majority of the respondents are male (78.9% of total valid responses) and live on the

campus (85.8% of total valid responses), which is representative of the overall student population at the university.

Attributes		N	% of Total Responses
Gender	Female	43	21.1
	Male	161	78.9
Housing	Live on campus	175	85.8
	Live off campus	13	6.4
	On-campus learning community	29	14.2
	Others	1	0.01

Table 1: Freshmen Engineering Student Population

Data Analysis and Findings

We tabulated descriptive statistics, including mean and standard deviation, for several survey items and then conducted t-tests analyses to determine if statistically significant differences existed between groups. While the t-test is designed for the analysis of continuous data, it may also be used to estimate the p-value for discrete data by assuming that the responses are represented by a ratio scale. Therefore, the assumption is being made here that the Likert scale offered in response to each question reflects a ratio scale.

Participation in Online Activities

As shown in Figure 1, information related to fashion and relationships were not sought online by 62.3% and 64.2% of respondents respectively. Figure 2 reflects the respondents' reported use of the internet for various online activities. While 56% of the respondents reported that they listened to music online daily or more frequently, 48% of the respondents reported that they have never bought music online.

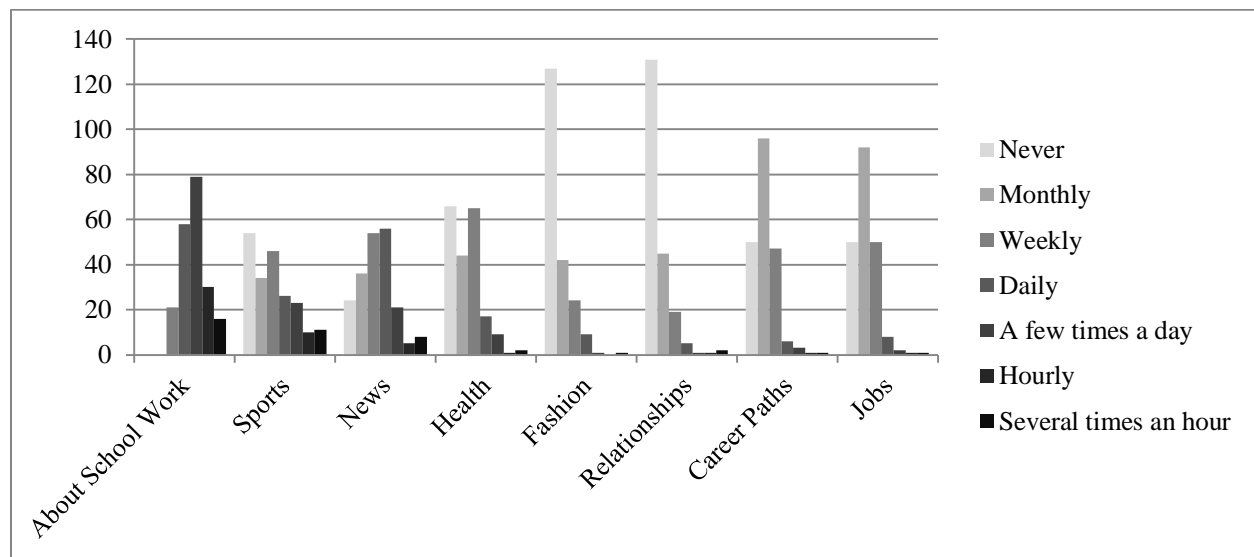


Figure 1: Information sought and read online

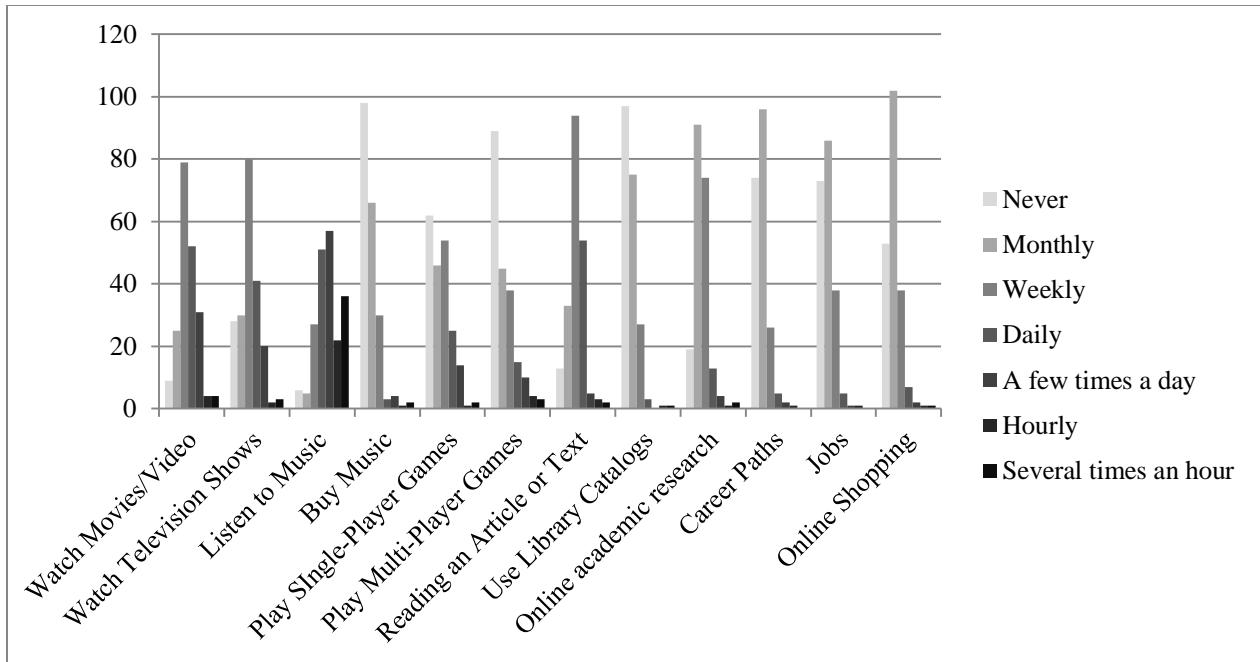


Figure 2: Frequency of participation in online activities

Collaborative Information Seeking

As shown in Figure 3, 67% of the survey respondents reported that they look at or search for information with other people every week or more frequently. This finding reflects the collaborative nature of freshmen engineering coursework.

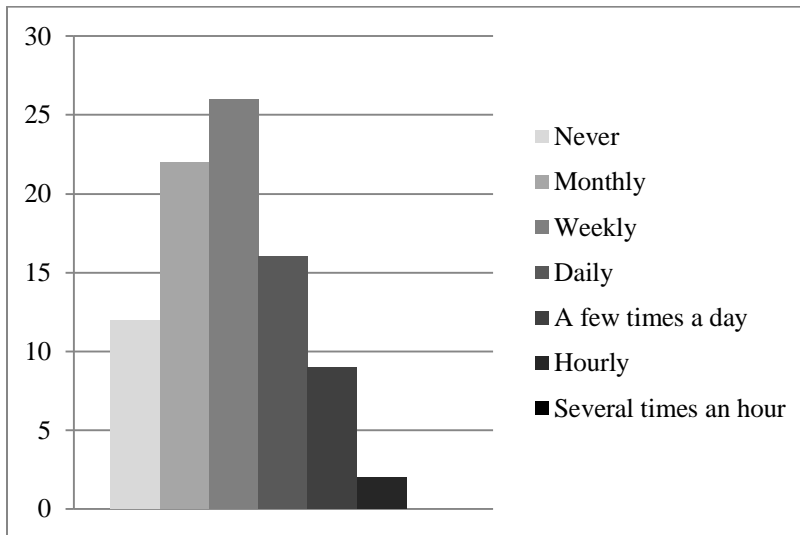


Figure 3: Frequency of looking at or searching for information with other people

Gender Differences

On a seven-point scale that ranged from 1 (never) to 7 (all the time), Table 2 and 3 summarizes t-test analyses conducted to determine if statistically significant differences existed between male and female students. There are three survey items with statistically significant differences, which include the use of cell phone, ownership of gaming consoles and participation in Wikipedia-related activities. The t-tests indicate that female freshmen engineering students were more likely to use the cellphone for talking and texting than the males who, on the other hand, are more likely to be owners of gaming console. What is more, female engineering students are more likely to participate in Wikipedia than males.

Digital Device	Gender	N	Mean	SD	t
Laptop	Male	161	6.540	0.783	0.868
	Female	43	6.651	0.573	
Gaming Console	Male	161	2.733	1.548	-4.933*
	Female	43	1.488	1.121	
Cell phone	Male	161	6.137	1.081	1.843*
	Female	43	6.465	0.855	
Desktop Computer	Male	161	1.689	1.574	-1.157
	Female	43	1.395	1.050	
Mp3 Player	Male	161	4.261	1.886	-0.732
	Female	43	4.023	1.908	

Table 2: Frequency of use of digital devices: gender comparison

Activity	Gender	N	Mean	SD	t
Social networking	Male	161	4.174	0.120	0.137
	Female	43	4.210	0.220	
Email	Male	161	4.093	1.145	0.620
	Female	43	4.209	0.861	
Texting	Male	161	4.516	1.437	1.892
	Female	43	4.977	1.354	
Chat	Male	161	3.919	0.151	0.320
	Female	43	4.023	0.273	
Blackboard/VT Scholar	Male	161	3.584	0.898	0.581
	Female	43	3.674	0.944	
Message Boards	Male	161	4.329	2.347	0.671
	Female	43	4.605	2.555	
Wikipedia	Male	161	2.503	1.304	1.633*
	Female	43	2.930	2.165	

Table 3: Frequency of participation in online and communication activities: gender comparison

* t-test between males and females significant at $p < 0.05$ (two-tailed).

Use of Devices and Functions during Academic Activities

Table 4 provides a list of devices or activities turned on while the students worked on academic activities. Most of the survey respondents reported that they turned on their cellphones, use texting on their cell phone, email and use their web browser on either their computer or phone during academic activities. However, barely 38.7% of the respondents reported that they participate in online chatting while they work on academic activities, with Mean = 1.39 and Standard Deviation = 0.49.

Item	On	Off	Mean	SD
Cell Phone Call	162	42	1.79	0.41
Email	167	37	1.82	0.39
Web Browser (on computer or phone)	189	15	1.93	0.26
Chat	79	125	1.39	0.49
TXT/SMS	169	35	1.83	0.38

Table 4: Devices or functions active during academic activities

Disturbances to Academic Activities

Figure 4 summarizes the types of activities that students participate in when they are working on academic activities whereas Figure 5 provides data on the situations where students perceived disturbances to their academic work. As shown in Figure 5, approximately 47.5% of the respondents reported that they are occasionally or more frequently bothered when the internet access is on and 49.0% of the respondents reported that they are occasionally or more frequently bothered when music is playing. However, 65.7% reported that they are disturbed occasionally or more frequently when the TV is on and 81.4% reported that they are disturbed occasionally or more frequently when the people are talking around them.

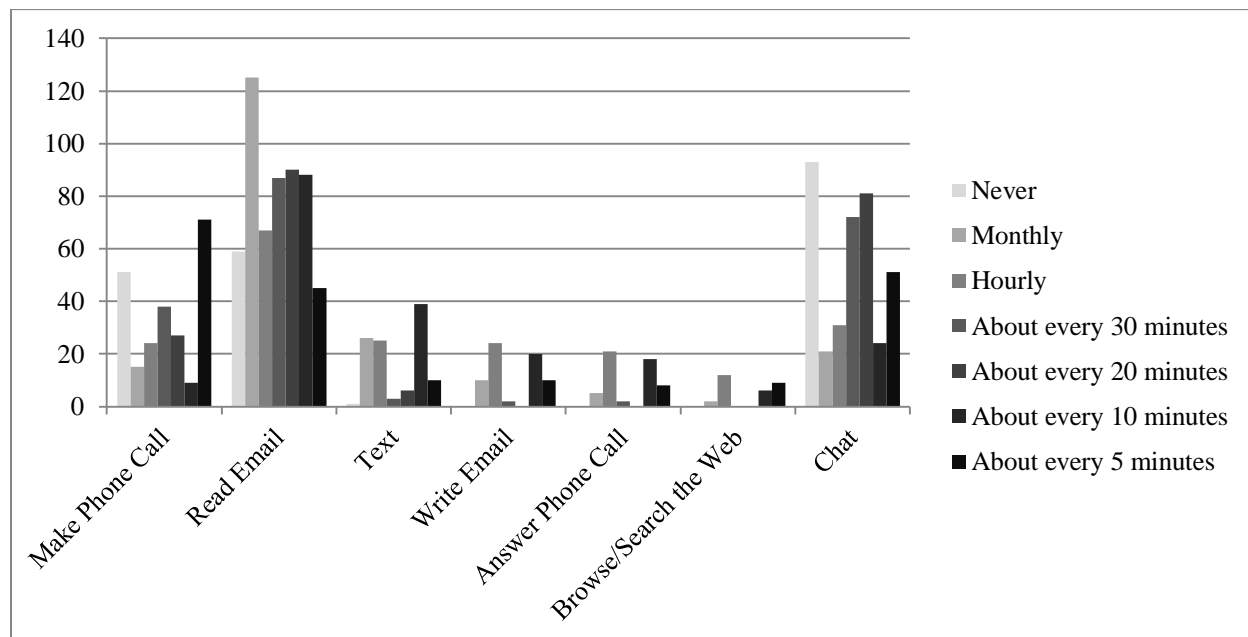


Figure 4: Participation in activities when working on academic activities

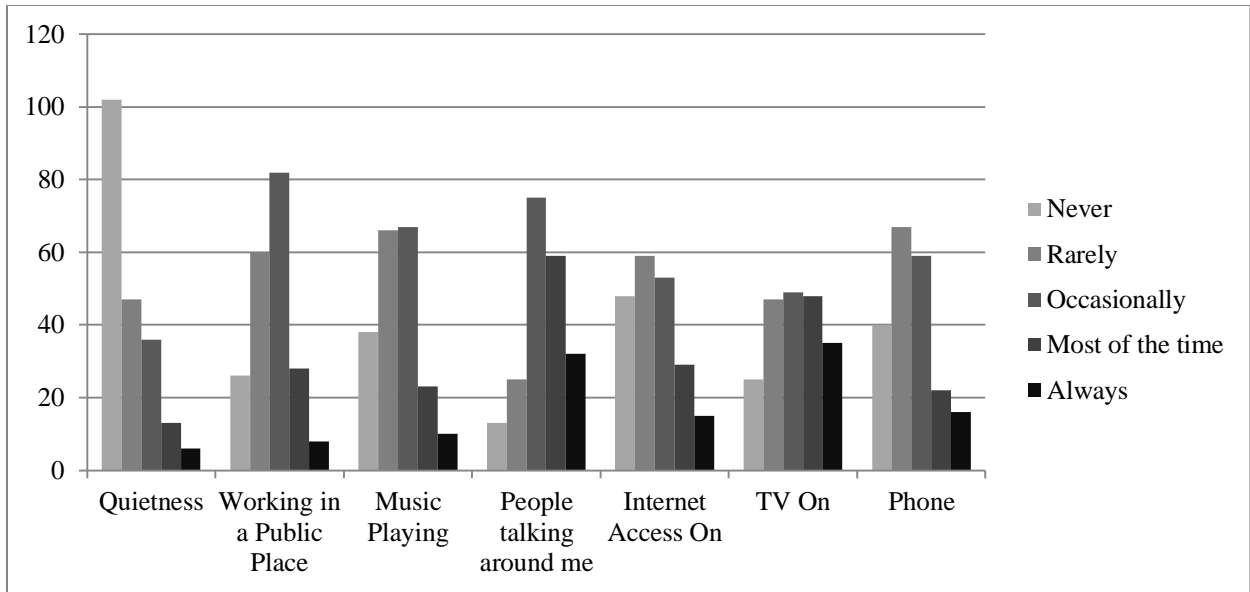


Figure 5: Situations where disturbance to academic activities is perceived

Multitasking

In our second survey a month later after the first survey, two additional questions were introduced to obtain students' perceptions of their ability to multitasking and the number of tasks perceived to be ably handled at the same time. The survey data are shown in Figure 6 and 7. As depicted in Figure 6, approximately 65.1% of the students perceived themselves to be capable of multitasking. As shown by Figure 7, more than 51.2% of students perceived themselves to be effective at simultaneously performing 2 tasks while 48.8% of students perceived themselves to be effective at simultaneously performing 3 or more tasks.

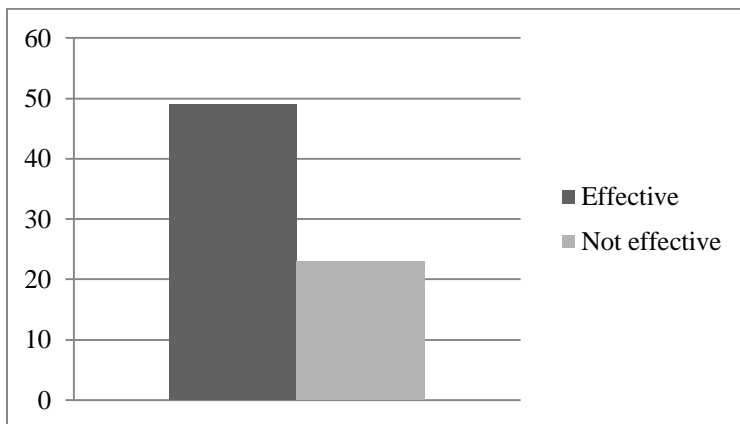


Figure 6: Perceived ability to multitask

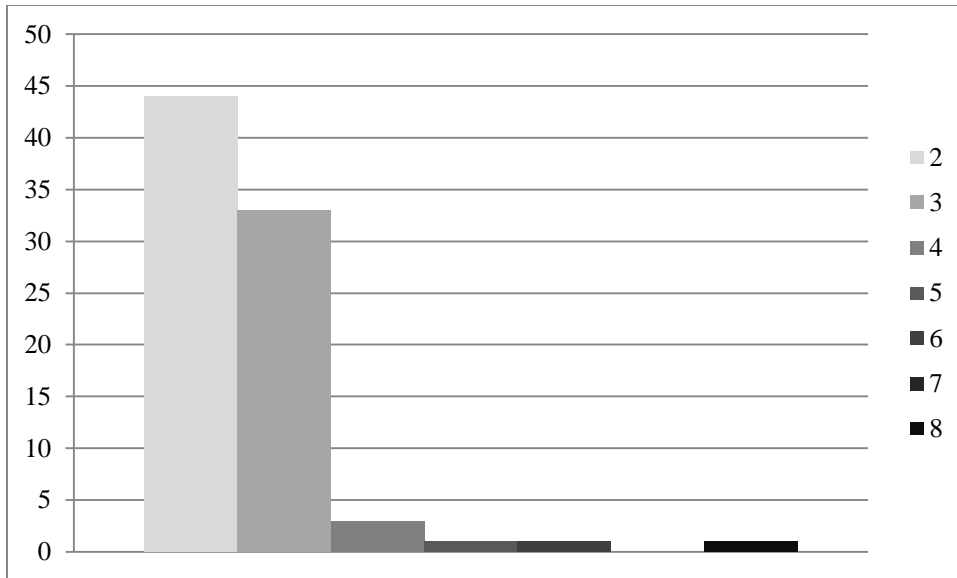


Figure 7: Number of simultaneous tasks perceived to be effectively performed when doing academic work

Twitter

As illustrated in Figure 8, almost 87.7% of respondents reported that they did not use twitter. This opposes the findings by Hargittai and Litt²⁵, who reported that Twitter is used by 17.8% of a sample population of 505 students in 2010.

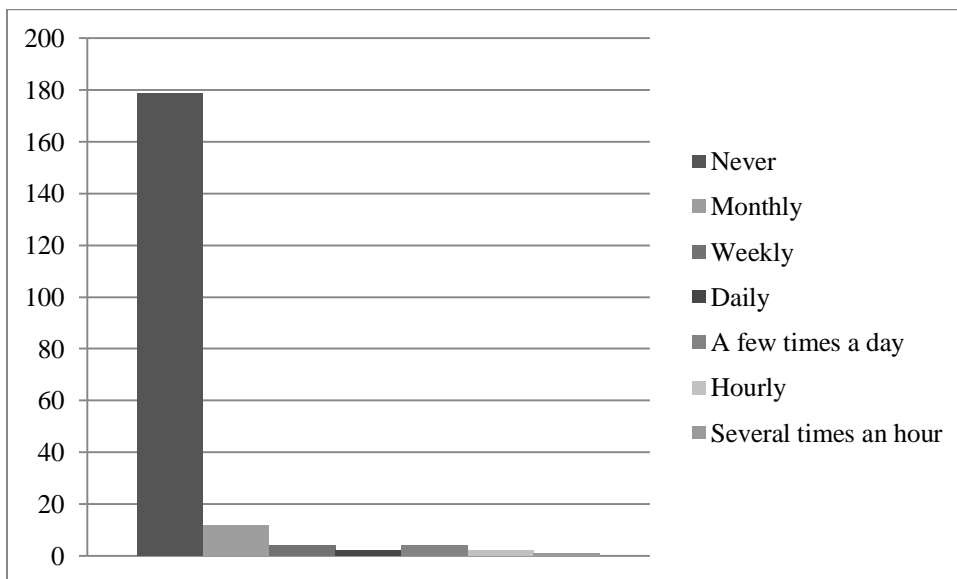


Figure 8: Frequency of use of Twitter

Conclusion

In this paper we present a study of the use of digital media and devices by freshmen engineering students. This paper describes the type of media, learning or social activities the students frequently participated in, as well as device ownership. While most of our findings match that of other related works, we found that only 12.3% of our respondents use Twitter, as opposed to the findings by Hargittai and Litt²⁵. In addition, t-test statistical analyses suggest that female freshmen engineering students are more likely to use the cellphone for talking, texting as well as participation in Wikipedia platform when compared to the males whereas male students were more likely to own a gaming console. While 68% of the students perceived themselves to be effective multitaskers, 92.8% reported they can effectively perform two or three simultaneous tasks while working on academic activities.

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