

**A Study of Mobile Learning Trends
at the US Naval Academy and the Naval Postgraduate School**

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1.0 Introduction

The use of mobile electronic devices such as smartphones, e-readers, and tablet computers is exploding and students today are more connected than ever. StatCounter reports “Global internet usage through mobile devices, not including tablets, has almost doubled to 8.5% in January 2012 from 4.3% last year” (StatCounter, 2012). The blog digitalbuzz predicts that “[b]y 2014, mobile Internet should overtake desktop Internet usage” (digitalbuzz, 2011). *The 2011 New Horizon Report*, sponsored by The New Media Consortium and the EDUCAUSE Learning Initiative, predicts that by 2015 people using mobile devices will make up 80% of those accessing the Internet. They also say that, “more important for education, Internet-capable mobile devices will outnumber computers within the next year” (Johnson, et al., 2011). In fact, some countries such as Korea, Japan, Sweden and Australia have already surpassed these milestones with more than 80 mobile broadband subscriptions per 100 inhabitants in 2011 (ITU, 2011). Furthermore, in Japan “over 75% of Internet users already use a mobile as their first choice for access” (Johnson, et al., 2011).

As described in *The 2011 New Horizon Report*, “People expect to be able to work, learn, and study whenever and wherever they want. ... Mobiles contribute to this trend, where increased availability of the Internet feeds the expectation of access. Feelings of frustration are common when it is not available” (Johnson, et al., 2011). This paradigm shift in how people, particularly younger people, connect and interact with the Internet is fueled by the development of an ever increasing variety of Internet-capable mobile devices, the expansion of networks that support connectivity, and web content providers increasing focus on creating flexible web content that is accessible via the mobile devices. Anyone who has been in the classroom recently has probably observed this trend firsthand, with increasing numbers of students using smartphones and PDAs in place of laptop and desktop computers.

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In this research, we assess these trends via a survey of graduate and undergraduate students at two United States military educational institutions: the U.S. Naval Academy (USNA) and the Naval Postgraduate School (NPS). While unique in some ways, these students are also quite similar in many ways to post-secondary and graduate students throughout the United States. Our primary goal is to better understand which mobile devices should be targeted for current and future instructional media development. Via our survey, we addressed the following questions:

- What are the trends in mobile device usage by today's students?
- What are future students likely to want?
- Which types of course content do current students prefer for their mobile devices and in what format?
- What will future university students expect schools to provide on their mobile electronic devices?

2.0 Background

The surveys were conducted on behalf of the NPS Center for Educational Design, Development, and Distribution (CED3). As its name describes, CED3 is responsible for the creation and delivery of university-level education products and is committed to ongoing excellence in its service. CED3 facilitates and encourages the use of new and existing technologies to improve education throughout the university.

CED3 made the presumption that current and future NPS students want to have information and educational products available on demand, anywhere, at any time, and CED3 made the further presumption that technology will be available to support the on demand nature of future education. To produce educational products that will engage students CED3 wanted to know what mobile devices NPS students, USNA students, students at other institutions, and the general public are using.

For the purposes of the surveys, we defined “mobile learning” as education that occurs when students are not at some fixed, predetermined location (e.g., classrooms, libraries, laboratories) and are taking advantage of learning opportunities offered via a hand-held electronic devices such as smartphones, personal digital assistants (PDAs), to include tablet-computers such as iPads, mp3 players, and e-book readers. We explicitly excluded desktop and laptop computers

from the survey because, while some may be portable, they are not generally small enough to be truly handheld in the sense of the previously listed devices.

2.1 The United States Naval Academy and the Naval Postgraduate School

The United States Naval Academy was founded in 1845. Today it is an accredited undergraduate institution with a student body of approximately 4,500 midshipmen. Located in Annapolis, Maryland, the Naval Academy offers a four-year undergraduate curriculum leading to a Bachelor of Science degree. In so doing, it blends required and elective courses similar to those offered at leading civilian colleges with professional subjects. As described on the USNA website (www.usna.edu/academics.htm), the curriculum is comprised of three basic elements:

- Core requirements in engineering, natural sciences, the humanities and social sciences, to assure that graduates are able to think critically, solve increasingly technical problems in a dynamic, global environment, and express conclusions clearly.
- Core academic courses and practical training to teach the leadership and professional skills required of Navy and Marine Corps officers.
- An academic major that permits a midshipman to explore a discipline in some depth and prepare for graduate level work.

The Naval Postgraduate School was originally established at Annapolis in the early 1900s as a postgraduate school of marine engineering with courses of study in ordnance and gunnery, electrical engineering, radiotelegraphy, naval construction, civil engineering, and marine engineering. In December 1951, the school was moved across country to its current campus in Monterey, California.

Today NPS is a postgraduate academic institution whose student body consists predominantly of officers from the five U.S. uniformed military services, military officers from approximately 30 other countries, and Department of Defense civilian employees. Of the 2,601 students – of which 1,831 are in residence and 770 participate in various distance learning curricula – most pursue a master's degree in programs that run year-round and take from 18 months to two years to complete.

The median age of a USNA undergraduate is approximately 20 years, the median age of an NPS resident student is about 30 years, and the median age of an NPS distance learning student is approximately 35 years. We do not know how representative USNA students are of the

general undergraduate student population in the United States, nor do we know how representative NPS graduate students are of the general graduate student population. Certainly they are clearly different in a number of dimensions, particularly the military environment in which they work and go to school, though it is not clear whether those differences are at all relevant to the survey topic of mobile learning. In any case, what is relevant to CED3 is that the current NPS students are precisely the constituency they currently serve and the USNA undergraduates are representative of future NPS students roughly five to 10 years in the future.

2.2 Related Literature

In a 2011 report, National Study of Undergraduate Students and Information Technology, the EDUCAUSE Center for Applied Research said, “More than one in three students (37 percent) have used an iPhone or another smartphone in one or more courses or academic activities in the past year. Forty-five percent of smartphone users have used these devices to look up information on the Internet in class” (Dahlstrom et al., 2011). This study included 3,000 college students from 1,179 colleges and universities. The report also shows smartphone users using their smartphone for the following academic purposes: “E-mailing professors 66%, Checking grades 62%, Texting other students about coursework 61%, Looking up information on Internet outside of class 59%, E-mailing other students about coursework 57%, Accessing course websites or syllabi 45%, Looking up information on Internet in class 45%, As a timer or time management device 42%, Listening to music while doing coursework 40%, Taking pictures 37%, Collecting data for classwork 28%, Accessing a social networking website 28%, Accessing library resources 24%, Registering for courses 22%, Conducting research for papers/presentations 22%, Texting professors 19%, Making textbook purchases 16%, As a source of additional help or tutoring 15%, Posting information or images on the Internet 14%, Writing papers or other classwork 12%, Making charts or other visual aids 5%.”

With regard to the devices students own, the 2010 Pew Research Center’s Internet & American Life Project report *College Students and Technology* shows undergraduate student cell phone ownership at 96%, mp3 player ownership at 84%, and 9% e-Book reader ownership. For graduate students, it shows cell phone ownership at 99%, mp3 player ownership at 86%, and 7% e-Book reader ownership (Smith, Rainie, and Zickuhr, 2012). In “January 23, 2012, Tablet and E-book reader Ownership Nearly Double Over the Holiday Gift-Giving Period” Pew reports that

between mid-December 2011 and early January 2012, the number of owners of tablet devices and e-reader devices both rose from 10% to 19%. Overall, 29% of adults own at least one of these devices (Rainie, 2012).

In *An Investigation into Student Mobile Devices: Evaluating the Potential for Mobile Learning*, Lindsay, Sultany and Reader report the results of a 2010 survey of City University, London students. They found that "... amongst the 816 responses received there were 853 different mobile phones (with some students owning more than one type of mobile phone), and of these 597 were Smartphones (including Androids, Blackberries, iPhones and Nokia / Symbian devices." They go on to conclude: "Mobile learning projects that centre on students using their mobile devices for receiving and viewing information around teaching should be explored. Students seem happy to use their devices for teaching-related activities or delivery of learning content, but not for interacting in class" (Lindsay, Sultany and Reader, 2010).

The study *Examining Mobile Technology in Higher Education: Handheld Devices In and Out of the Classroom*, which focused only on the BlackBerry as a learning tool, found: "... as a learning tool, participants viewed the BlackBerry® in a marginally positive way, rating it as just somewhat effective and slightly more positively than negatively as an instructional tool. When participants used the BlackBerry® to learn, clearly, communication for the intent of organizing or sharing information with other students served as the key learning advantage associated with the devices. It was also the case that a small proportion of students did not find the technology useful which may be indicative of their perceptions of limitations in how the technology was used in their classrooms ..." (Mueller, et al., 2012).

Data show smartphone ownership in the general public is increasing. For example, Pew Research Center's Internet & American Life Project report that "Nearly half of American adults are smartphone owners" (Smith, 2012). The Pew data show adult ownership of cellphones at 87% with 46% of all adults owning smartphones. Additionally the report shows an increase in smartphone ownership across the demographics of gender, age, race, income level, education, and locality (urban, suburban, or rural) when compared to their 2011 report. Data in this report show in 2012 20% of cell owners now describe their phone as an Android device, 19% iPhone, 6% BlackBerry owners and it is noted BlackBerry percent of ownership is decreasing. From the same report, "Nearly every major demographic group—men and women, younger and middle-aged adults, urban and rural residents, the wealthy and the less well-off—experienced a notable

uptick in smartphone penetration over the last year, and overall adoption levels are at 60% or more within several cohorts, such as college graduates, 18-35 year olds, and those with an annual household income of \$75,000 or more.”

3.0 Methodology

A web-based survey was fielded to all NPS resident and distance learning graduate students during the 2010 summer quarter and to all USNA undergraduate students in the 2011 spring semester. The target population for the NPS survey was all 2,601 resident and distance learning graduate students enrolled in a degree program in the summer of 2010. The target population for the USNA survey was all 4,484 USNA undergraduate students enrolled at the time of the survey in 2011.

3.1 Instrument Description

The survey instrument was designed to obtain student feedback about their mobile device usage and their interest in using such devices for mobile learning. The final instrument consisted of 38 questions divided into the following four main sections.

- *Current Device Ownership.* Questions in this section asked students about the devices they currently own, including smartphones, PDAs (a category that was defined to include tablet-style computers), mp3 players, and e-book readers. If a student answered yes to owning any category of device they were asked a follow on questions about the specific device or devices owned.
- *Device Connectivity.* Questions in this section asked students about whether they paid for commercial wireless (“wi-fi”) capability for their device or devices and, if so, the type of data plan used. These questions are intended to gain insight into whether students would be limited by data plan constraints and/or incur additional costs to access educational materials on their mobile devices
- *Device Usage.* Questions in this section asked students for examples of how they were using their mobile devices and, in some cases, for the students to identify how often they use certain functions on their devices. These questions allowed the survey to identify applications or software tools students are most comfortable in using.

- *Future Interest.* Questions in this section asked students to identify educational tools and hand-held devices they would be interested in having access to or purchasing. This section thus differed from the rest of the survey, which was mainly focused on what students currently have and use, with questions about what they would like to have. The point of this section was to gain some insight into potential future trends in mobile learning.

3.2 Instrument Design and Pretesting

Following standard survey design principles (Dillman, 2006; Groves, et al., 2004), the questions and instrument were crafted in consultation with CED3. Upon completion of the initial design, the instrument underwent extensive pre-testing, again using standard methods (e.g., Fowler, 1995). Beginning with expert review by CED3, the survey was tested via three stages of cognitive interviewing designed to: (1) ensure consistent respondent comprehension of the questions, (2) the proper flow of the survey instrument, and (3) overall survey design, including the correct skip logic coding and proper software operation. Pre-testing was conducted on representative members of the NPS student body, including foreign military officers for whom English was not their first language. Survey pre-testing culminated in a mock fielding of the survey at NPS to ensure all aspects of the survey, from respondent e-mail notification through data collection and downloading, were fully operational. During the mock fielding it was determined that respondents took on average about 10 minutes to complete the survey.

3.3 Fielding Procedures

The surveys were conducted entirely electronically and they were fielded to the two student bodies via commercial software packages. For both, the fielding period was approximately a two-week period. Following good survey practice, potential respondents were first sent a pre-notification e-mail announcement. This was followed the next day by a second e-mail that invited the respondents to take the survey and included a URL link to the web survey. Non-respondents were then contacted up to three more times, roughly every two to three days, requesting that they take the survey. The notification and non-response e-mails were appropriately managed to ensure that, once students took the survey, they were removed from the non-respondent e-mail listing.

3.4 Response Rates

The NPS survey achieved a total response rate of 71.2 percent (1,851 out of 2,601 students). The resident students' response rate was 72.5 percent (1,328 out of 1,831 students) while the distance learning students' was 67.9 percent (523 out of 770 students). The USNA survey achieved a response rate of 24.8 percent (1,114 out of 4,484 students).

4.0 Results

Here we review and compare responses of both survey groups. A copy of the survey instrument (NPS variant) is available at <http://faculty.nps.edu/rdfricke/frickerpa.htm>. Survey responses rarely showed significant differences among class years (in the case of USNA respondents) or between resident or non-resident status (in the case of NPS respondents); therefore, aggregate results across these categories are reported here. Most differences between USNA and NPS students were statistically significant (using Pearson's chi-squared contingency table test, with continuity correction where appropriate); all tests were performed at the .05 significance level.

4.1 Smartphones

A majority of respondents (63% at USNA and 58% at NPS) owned smartphones; a substantial majority of these had unlimited data plans for these phones (87% at USNA and 83% at NPS). Among those who indicated smartphone ownership, Figure 1 shows type of smartphone owned. (Throughout, as applicable, table percentages do not necessarily add up to 100% due to rounding.) Nearly half of smartphone owners in both populations owned iPhones. USNA respondents owned more Androids and fewer BlackBerrys than their NPS counterparts; this may be due to the fact that BlackBerry devices are sometimes issued to active duty officers, which comprise the majority of the NPS resident student population, in the line of their duties.

Figure 1 about here.

The dominant smartphone activities for both populations, aside from conventional phone conversation, were browsing the Internet and checking e-mail. Figure 2 shows the percentages

of smartphone users who engaged in various activities at least weekly. USNA users engaged in most of the listed activities more frequently than NPS users.

Figure 2 about here.

Figure 3 shows that about half to three-fourths of students used their smartphones to view files in Adobe, Word, Excel, or PowerPoint format; NPS students used smartphones for this purpose slightly more than USNA students.

Figure 3 about here.

Figure 4 suggests that the primary “educational use” of smartphones consisted of accessing school e-mail accounts: nearly three-fourths of USNA students and nearly two-thirds of NPS students used their phones for this purpose. Less than one-third of students used their phones for any other particular educational use.

Figure 4 about here.

4.2 Tablet PCs and PDAs

Less than a fourth of respondents (20% at USNA and 22% at NPS; difference not statistically significant) owned tablet PCs or PDAs. Figure 5 shows the most-used tablet PC or PDA by type. Most of those who owned a tablet PC or PDA primarily used the iPod Touch, and a strong majority primarily used either the iPod Touch or iPad. While less than one-fourth of respondents at both institutions reported primarily using iPads, we suspect that iPad ownership and usage percentages among the USNA and NPS demographics have grown since the time of this survey since the iPad only arrived on the market in the spring of 2010 (Apple, 2010). Similar to the case of smartphones, USNA respondents owned far fewer Palms than their NPS counterparts; this may be due to the fact that in some cases Palm devices are issued to active duty officers in the line of their duties.

Figure 5 about here.

As with smartphones, browsing the Internet and checking e-mail were the dominant tablet PC or PDA activities for both populations. Figure 6 shows percentages of smartphone users who engaged in various activities at least weekly. Usages were comparable between the two groups, although USNA users engaged in audio and video file activities more frequently than NPS users.

Figure 5 about here.

Approximately half or fewer of the students used their tablet PCs or PDAs to view files in Adobe, Word, Excel, or PowerPoint format. Figure 7 shows that, as in the case of smartphones, NPS students used tablet PCs or PDAs for this purpose slightly more than USNA students.

Figure 7 about here.

Interestingly, more than half of NPS students (57%) and nearly half of USNA students (43%) reported no tablet PC or PDA use for the educational options listed. Figure 8 shows that, as with smartphones, accessing school e-mail accounts was the primary “educational use” of tablet PCs or PDAs among respondents at both schools.

Figure 8 about here.

4.3 mp3 Players

Approximately three fourths of respondents (77% at USNA and 72% at NPS) owned mp3 players; most of these owned iPods (91% at USNA and 81% at NPS). Figure 9 shows that nearly all respondents used their players for listening activities and also that a majority of USNA students used their mp3 players for viewing activities as well. Fewer NPS students used their players for viewing. Figure 10 shows that, by a small margin, USNA students had more capable mp3 players than NPS students.

Figures 9 and 10 about here.

4.4 E-book Readers

Among the device types involved in this survey, e-book readers were owned least (18% ownership at USNA and 9% at NPS). Among those who owned e-books the majority owned Amazon Kindles (74% at USNA and 64% at NPS, see Figure 11).

Figure 11 about here.

Figures 12-14 suggest that respondents at both schools tended to employ their e-book readers for personal use much more than for use in support of their school curriculum. Indeed, most respondents did not use their e-book readers for any curriculum-related readings. About one-half read at least one curriculum-related newspaper or magazine. Meanwhile, over 90% in each group read a least one personal book per semester on their e-book reader. Furthermore, USNA students tended to download more books for personal use than their NPS counterparts.

Figures 12-14 about here.

4.4 General interest

The previous results of this section suggest that, in general, respondents to this survey tended to use their mobile devices more for personal use than for formal educational use. In fact, an overwhelming majority of respondents stated that they had not utilized mobile learning on their hand-held mobile device in the past (92% of USNA undergraduates and 87% of NPS graduate students). At the same time, solid majorities in both populations (74% at USNA and 61% at NPS) “agree” or “strongly agree” that they would use mobile learning on their hand-held devices if it were available in their curriculum (see Figure 15).

Figure 15 about here.

Figure 16 shows student interest in various types of educational materials that might be accessed via mobile devices. About half of respondents at both schools indicated interest in accessing course calendar syncing, textbooks, and applications (apps) in support of class work. At NPS, about half of respondents also expressed interest in mobile access to videos or podcasts of class lectures. USNA students seemed less interested in accessing lecture material (in any format) than their NPS counterparts.

Figure 16 about here.

Figure 17 shows that most USNA respondents would be interested to purchasing or upgrading to a smartphone or tablet PC or PDA for accessing educational tools, and nearly a half would purchase or upgrade to an e-book reader. Fewer NPS students expressed an interest in purchasing or upgrading, but many of those who said they would not spend any money already owned one or more mobile devices with an unlimited data plan. Figures 18 and 19 indicate how much money students would be willing to spend on devices or upgrades. USNA students, the younger of the two groups, indicated a greater inclination toward such spending.

Figures 17-19 about here.

5.0 Discussion & Conclusions

Consistent with prior research, our surveys show that a majority of our student populations say they would use mobile learning if it were made available: 55% of NPS distance learning graduate students, 60% of NPS resident graduate students, and more than 70% of USNA undergraduate students. Note the inverse relationship to median age, where the younger the student body the higher the fraction of students interested in mobile learning. This suggests that the interest in, and demand for, mobile learning is only going to continue to increase.

To those of us in the classroom, the trend is visibly apparent. Five years ago not all students had laptops; now virtually all of them do. Within the past five years it has become routine to see students using their laptops in class. Smartphones in the classroom are now at about the point laptops were five years ago, where even just a year or two ago it was a novelty for a student to use his or her smartphone to look up something and contribute it to the classroom discussion. Today that is becoming routine.

Comparing between the undergraduate and graduate students in our surveys, we can clearly see a shift from the dominance of the iPhone a few years ago to something of a parity between Android-based phones and the iPhone. That hardware-specific difference between the two populations aside, in general these results show that the undergraduate students use their smartphones and most other mobile devices to do more things with higher frequency. The USNA undergraduates also indicate that they are interested in purchasing hand-held devices for mobile learning in greater numbers.

About the only set of questions in which the NPS graduate students consistently showed higher percentages than the USNA undergraduates was in their desire to use smartphones and PDAs to view PDF, Word, Excel, and PowerPoint files. However, because type of student (undergraduate/graduate) is confounded with institution (USNA/NPS) in our surveys, these results may be due to differing institutional infrastructure and policies and not age.

What our survey results, and those of others, suggest is that investing resources in developing mobile learning tools is worthwhile, at least from the point of view of what students desire. For one thing, hand-held device use is ubiquitous among students, and although most of this use is personal a significant majority of students express an interest in using mobile learning on their hand-held devices. Furthermore, most students said they are willing to spend money to upgrade their mobile devices to access educational materials and, of those not interested in purchasing or upgrading, over half already own a smart phone. So, students are interested in mobile learning to the extent that they will invest their own money to take advantage of the technology.

From a media development point of view, our results seem to indicate that developers ought to be producing mobile materials that run on both Android and Apple devices. Such efforts for BlackBerry devices perhaps need not be a priority. It also appears that, for now, it is not necessary to develop materials specifically for e-book readers. However, trends regarding e-book reader usage should be watched, as it is unclear whether tablet PCs or PDAs, e-book readers, or other devices will emerge as the preferred tool for electronic reading.

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Figures

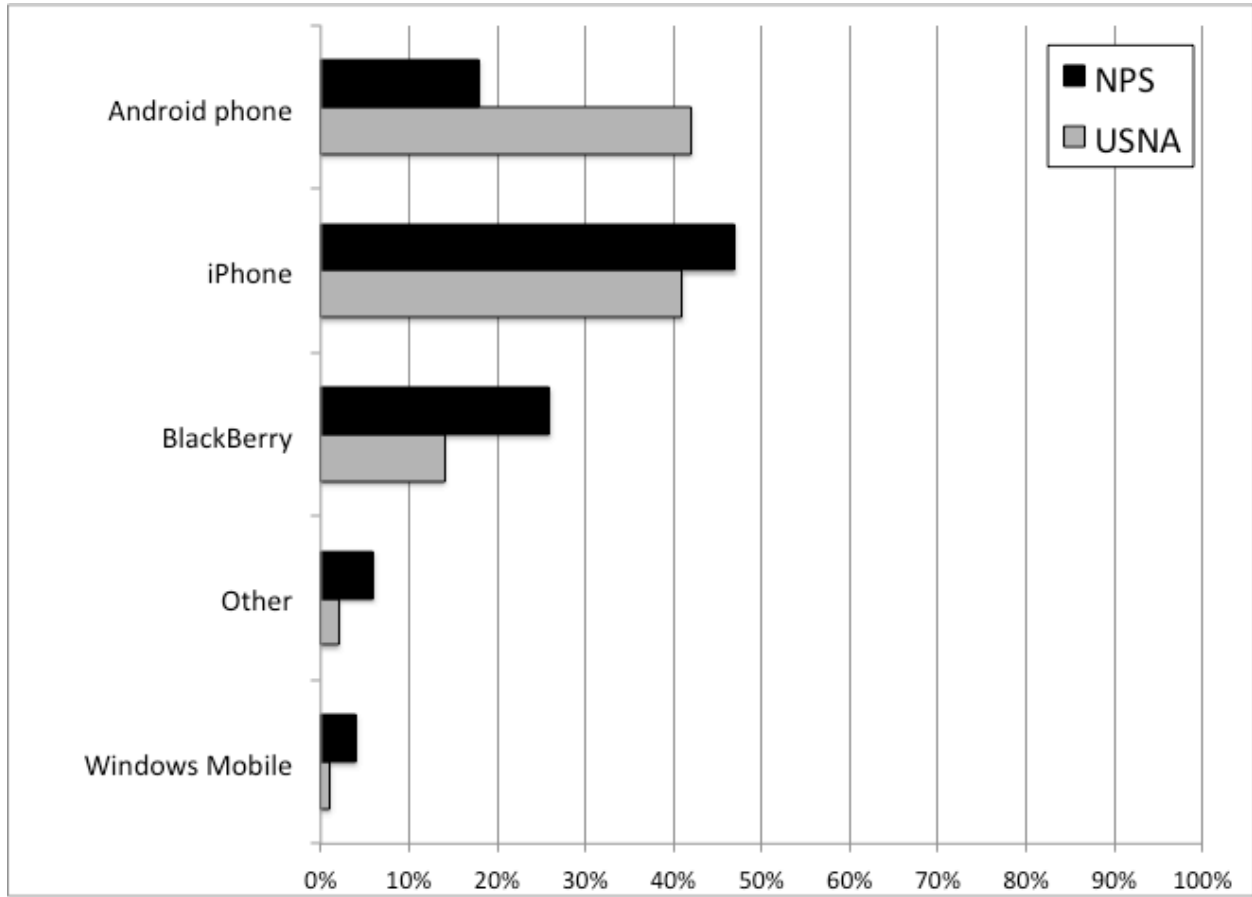


Figure 1: Of those who indicated owning a smartphone,
“Which type of smartphone do you own?”

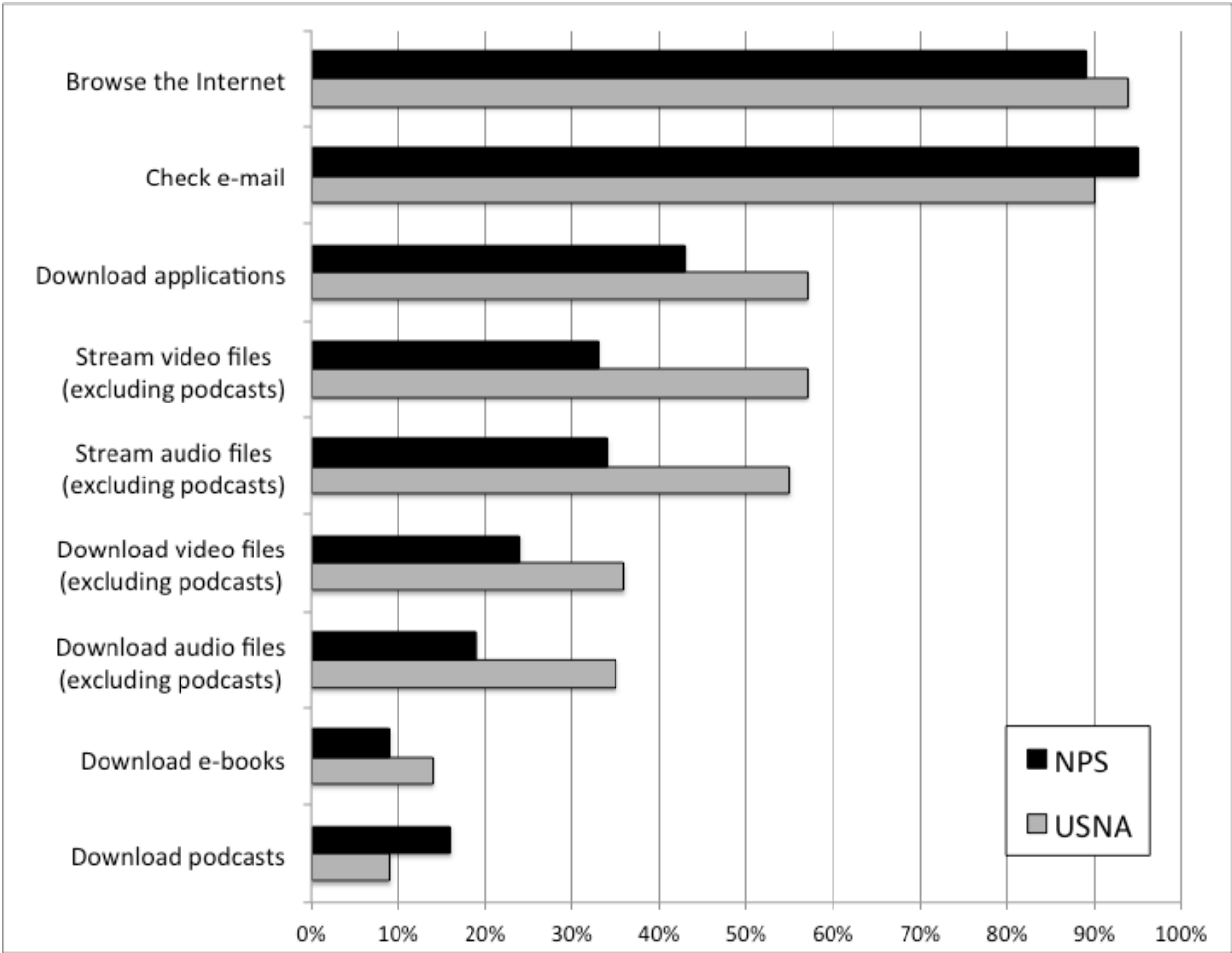


Figure 2: Percentages of smartphone users who engaged in these activities at least weekly.

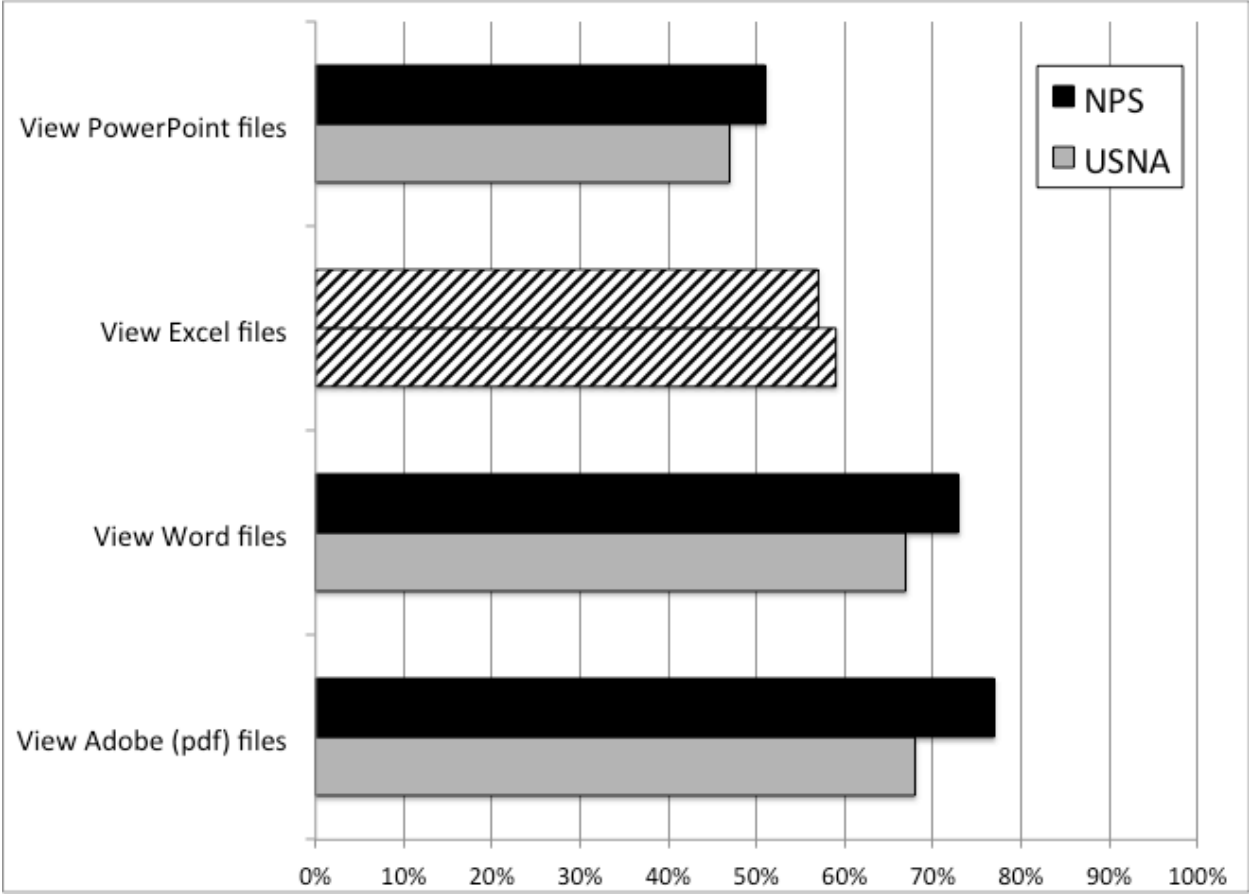


Figure 3: “Do you do the following using your smartphone?”
 Cross-hatching indicates the difference was not statistically significant.

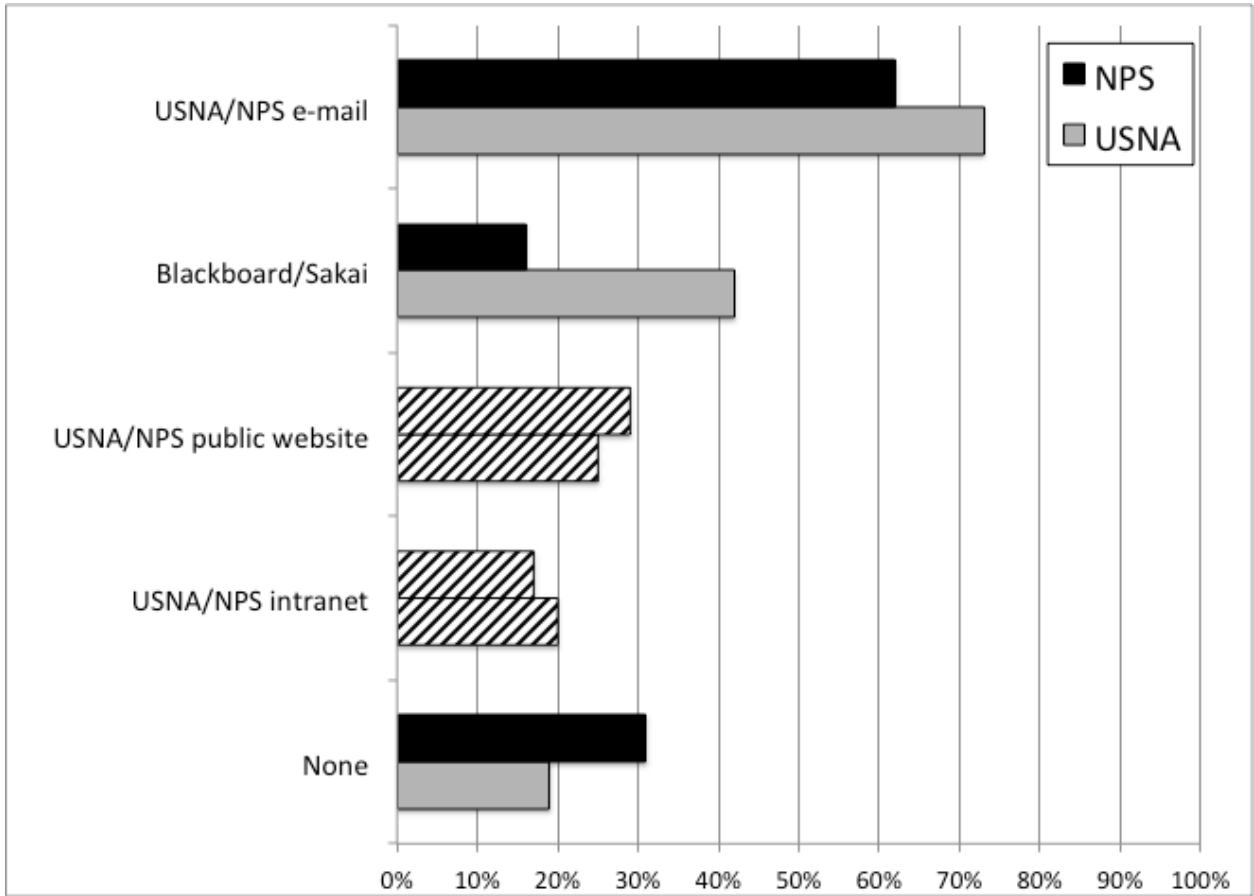


Figure 4: “Do you use your smartphone to access the following USNA/NPS educational tools?” Cross-hatching indicates differences are not statistically significant.

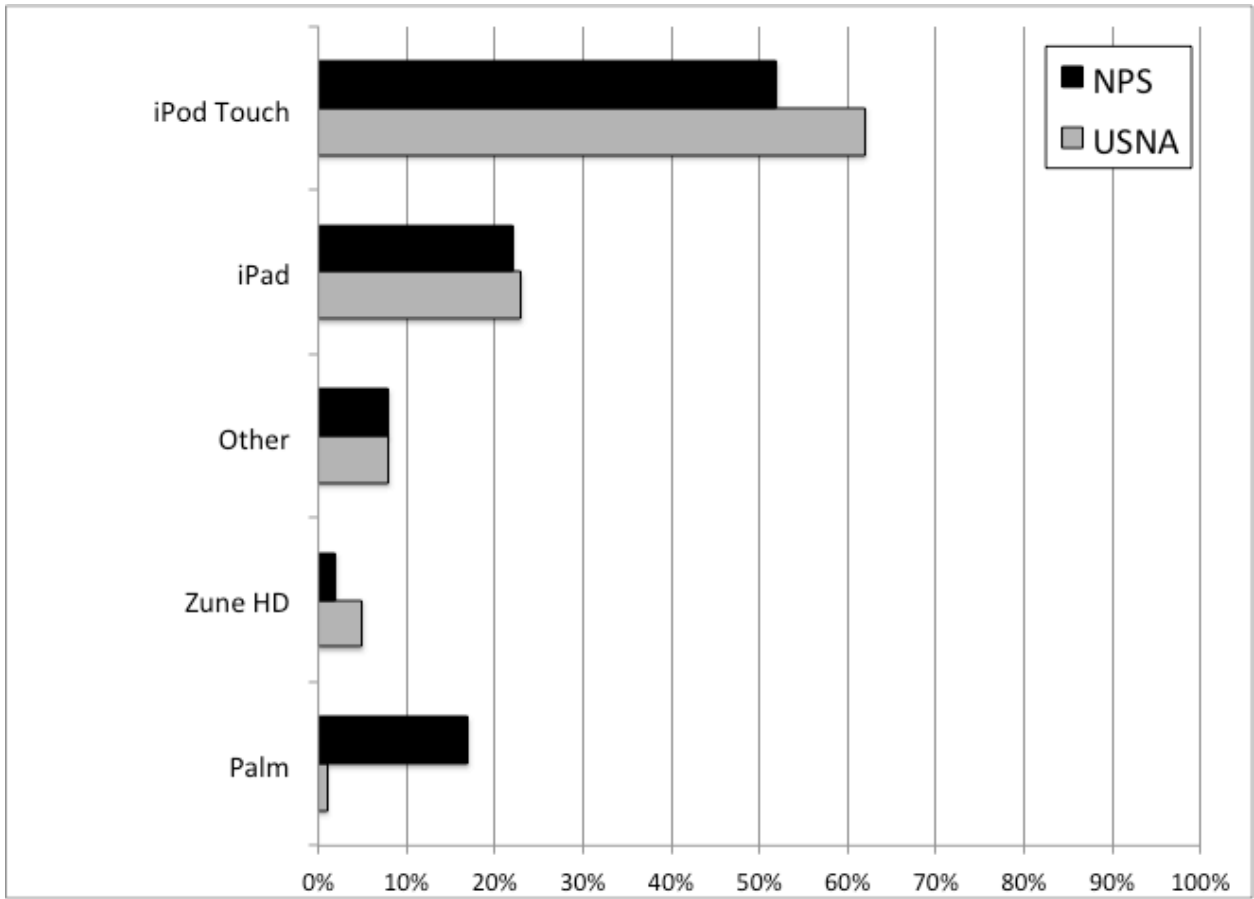


Figure 5: Of those who indicated owning a PDA, “Which type of PDA do you own?” The distribution NPS of students across all the categories was statistically different from that of USNA students.

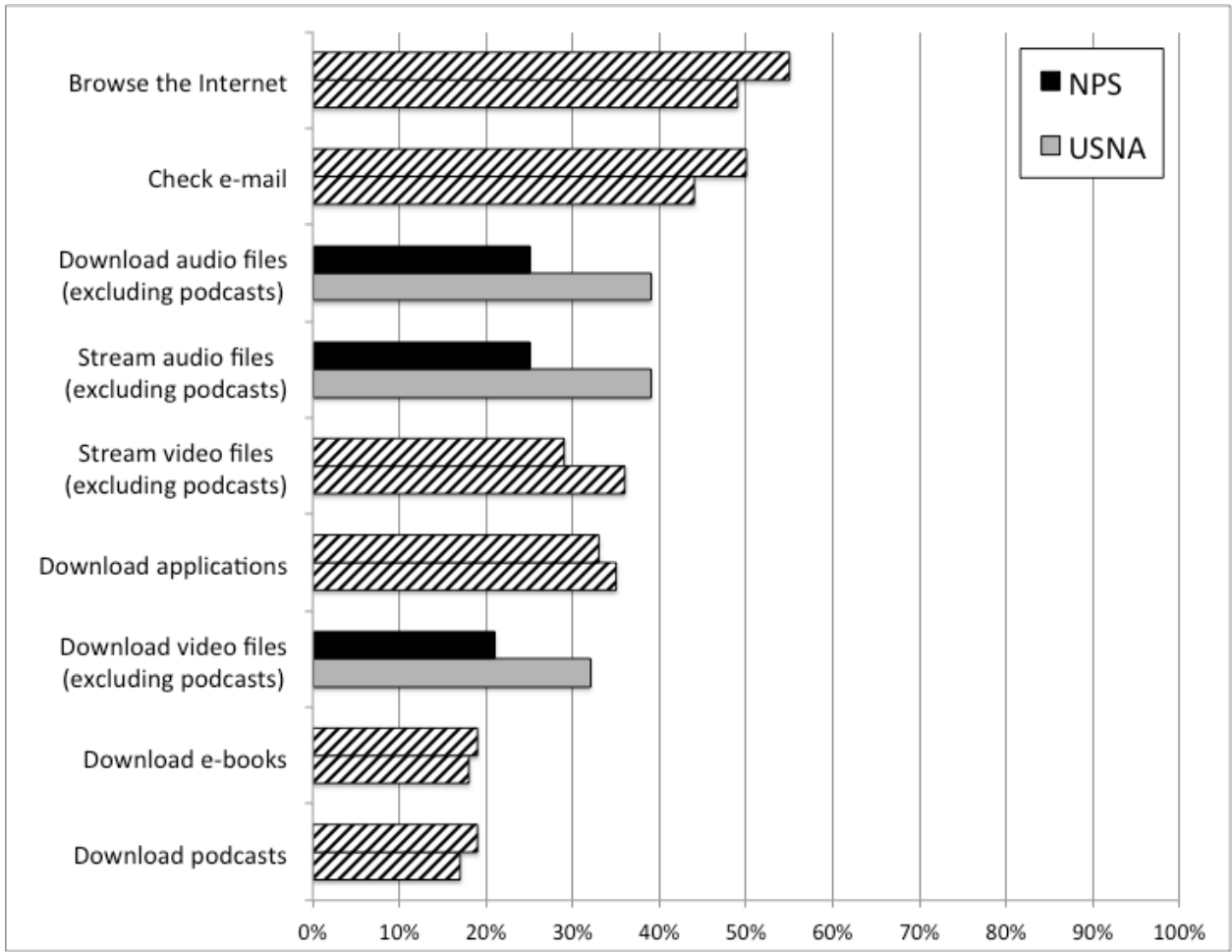


Figure 6: Percentages of PDA users who engaged in these activities at least weekly.
 Cross-hatching indicates the difference was not statistically significant.

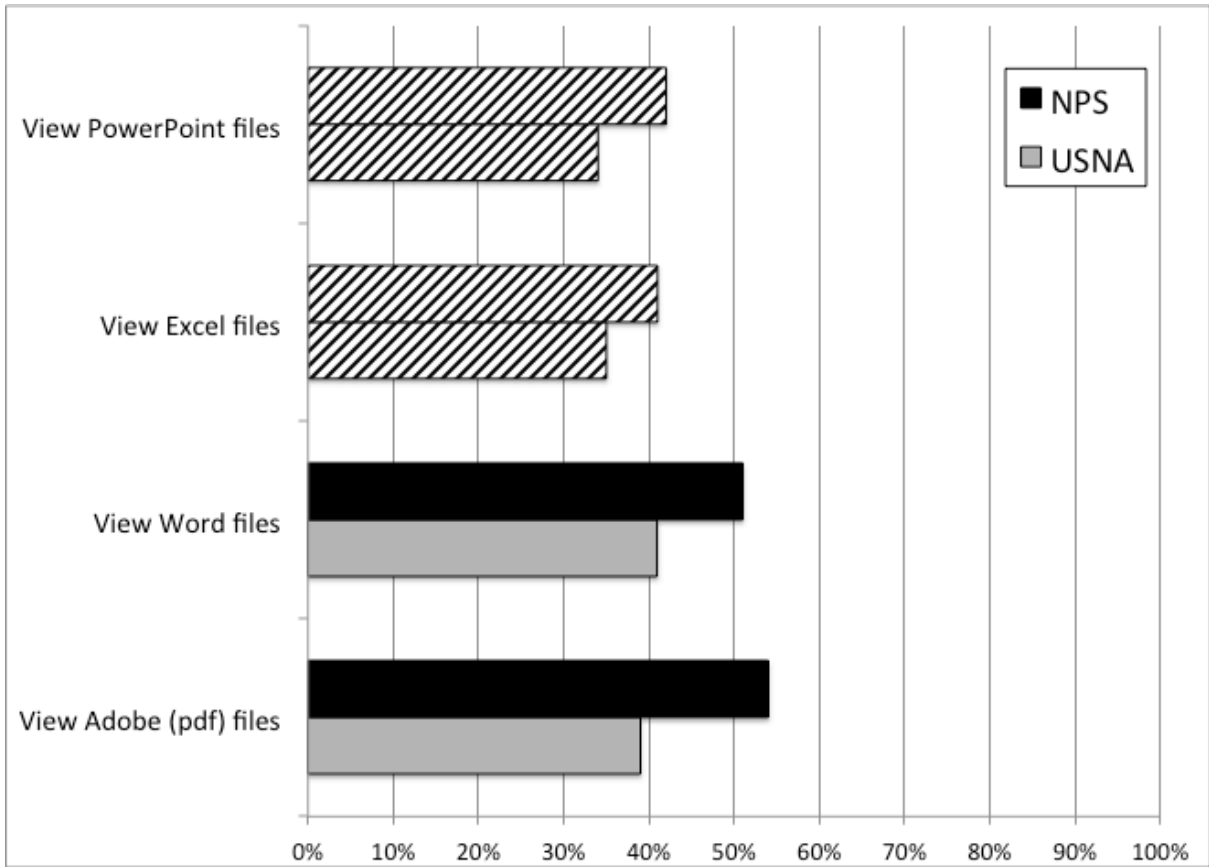


Figure 7: “Do you do the following using your PDA?”
 Cross-hatching indicates the difference was not statistically significant.

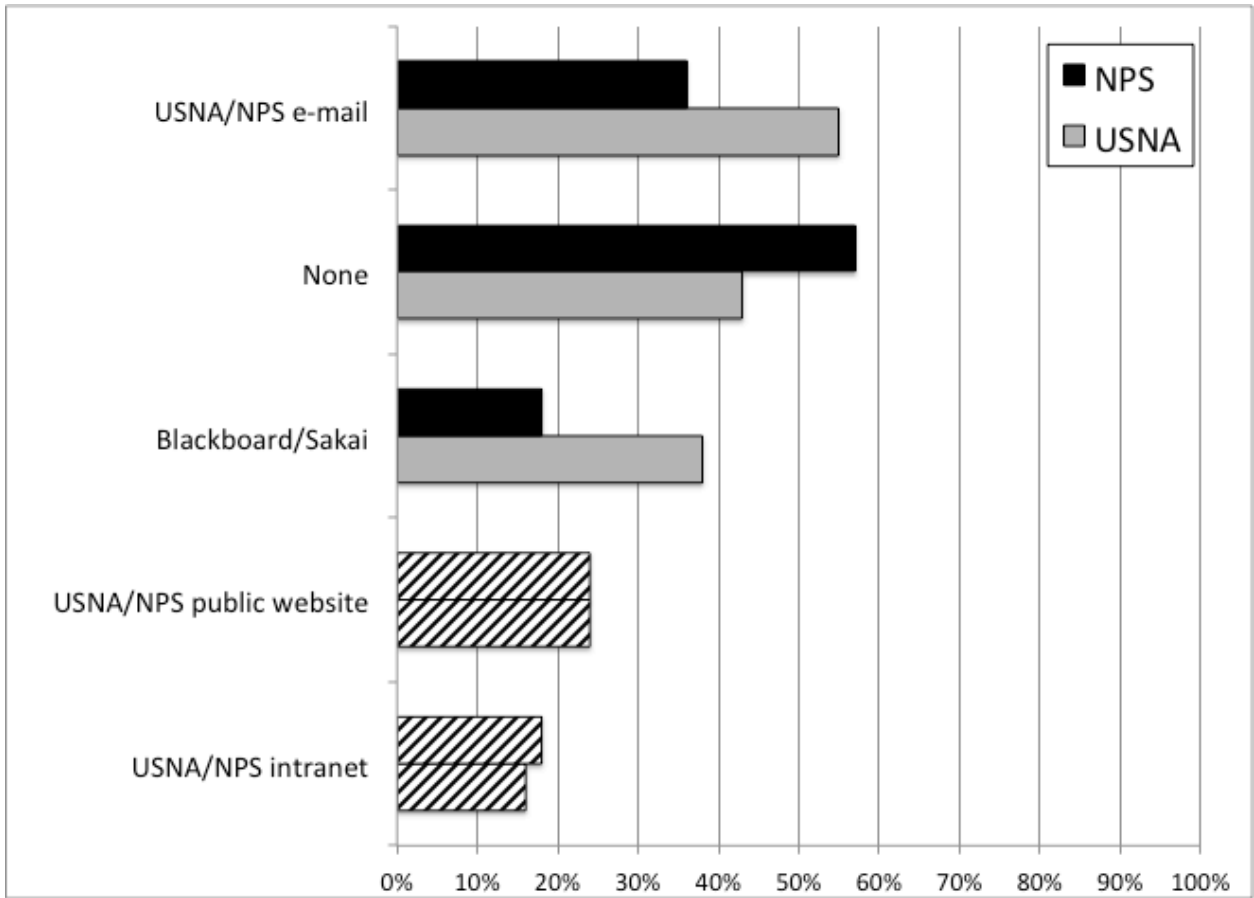


Figure 8: “Do you use your PDA to access the following USNA/NPS educational tools?”
 Cross-hatching indicates differences are not statistically significant.

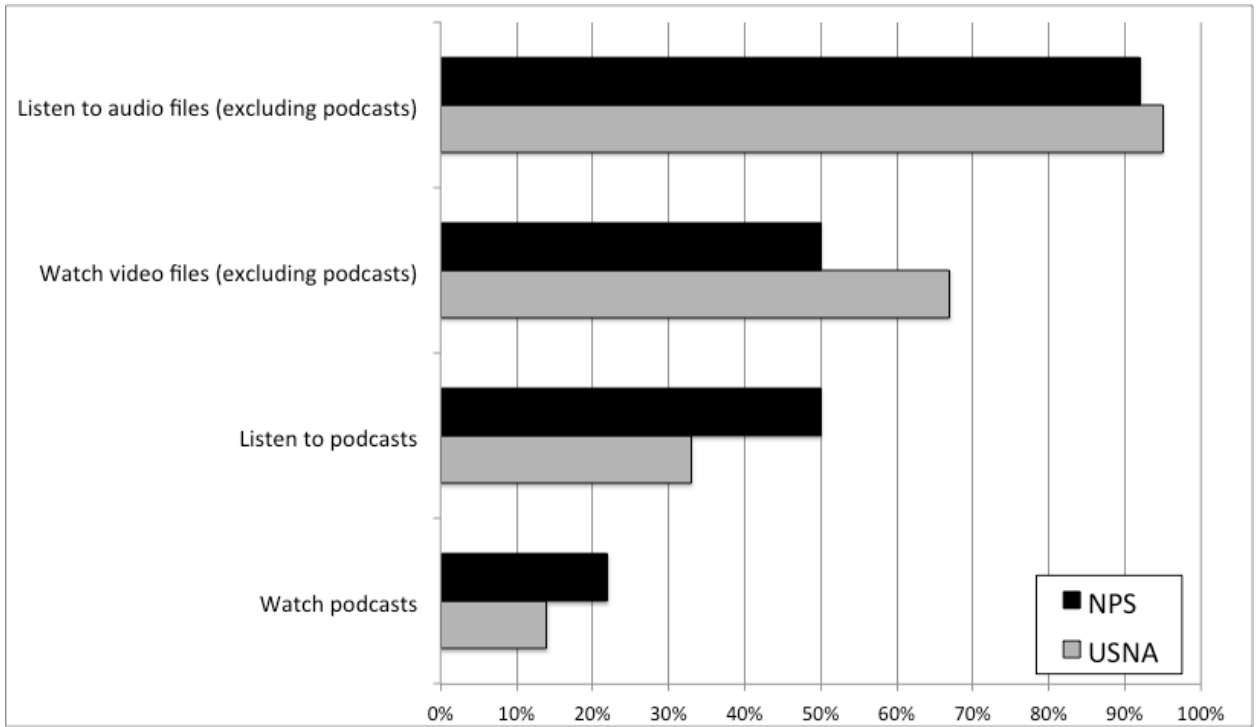


Figure 9: Percentages of mp3 users who engaged in these activities.

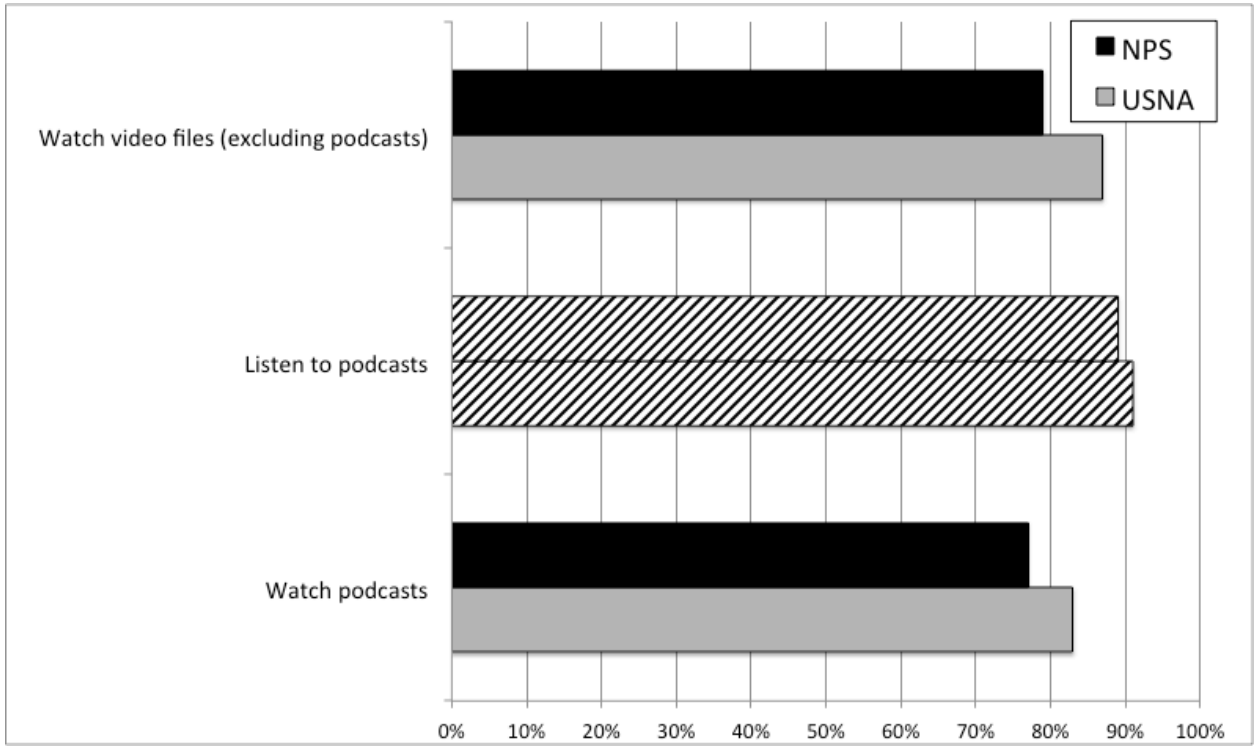


Figure 10: Percentages of mp3 users capable of performing the listed activities.
 Cross-hatching indicates the difference was not statistically significant.

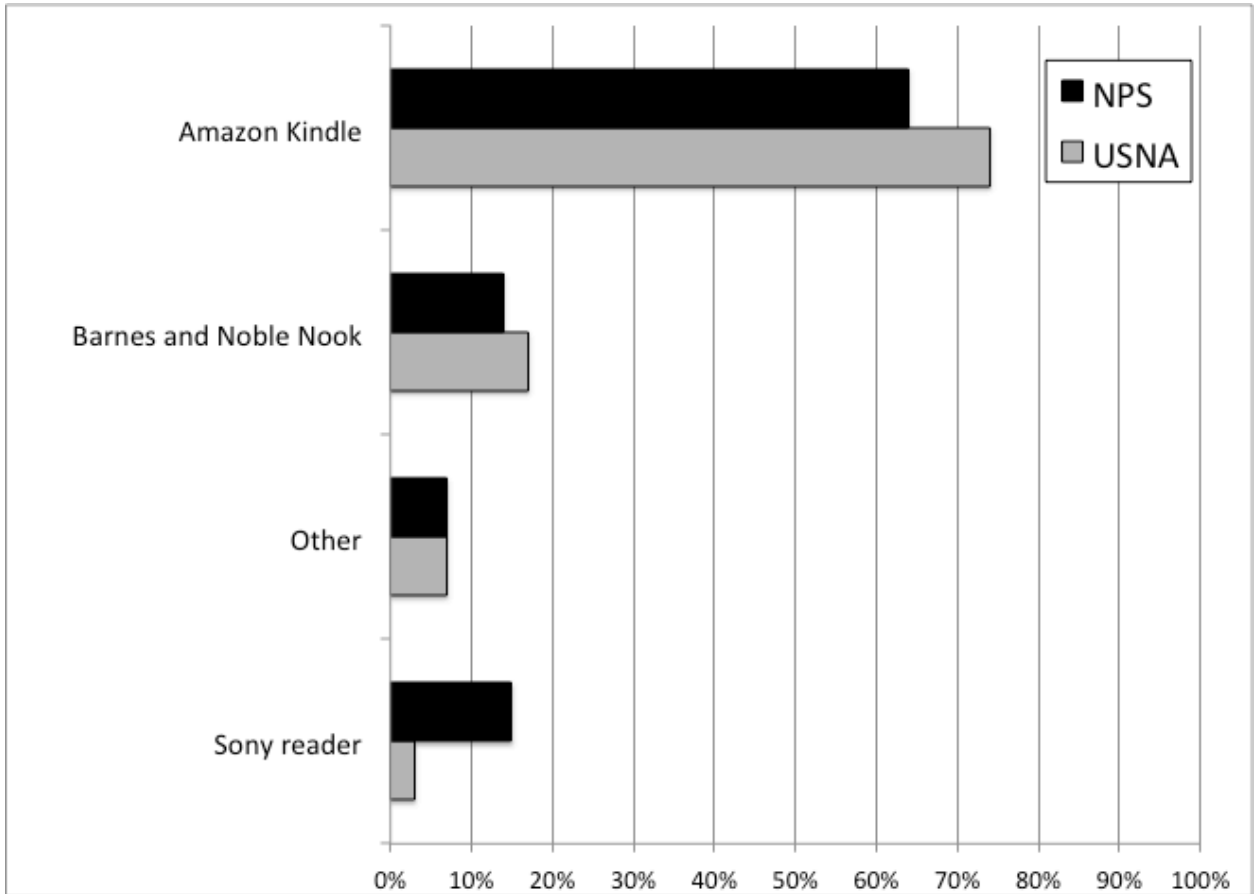


Figure 11: Of those who indicated owning an e-book reader, “Which type of e-book reader do you own?” The distribution NPS of students across all the categories was statistically different from that of USNA students.

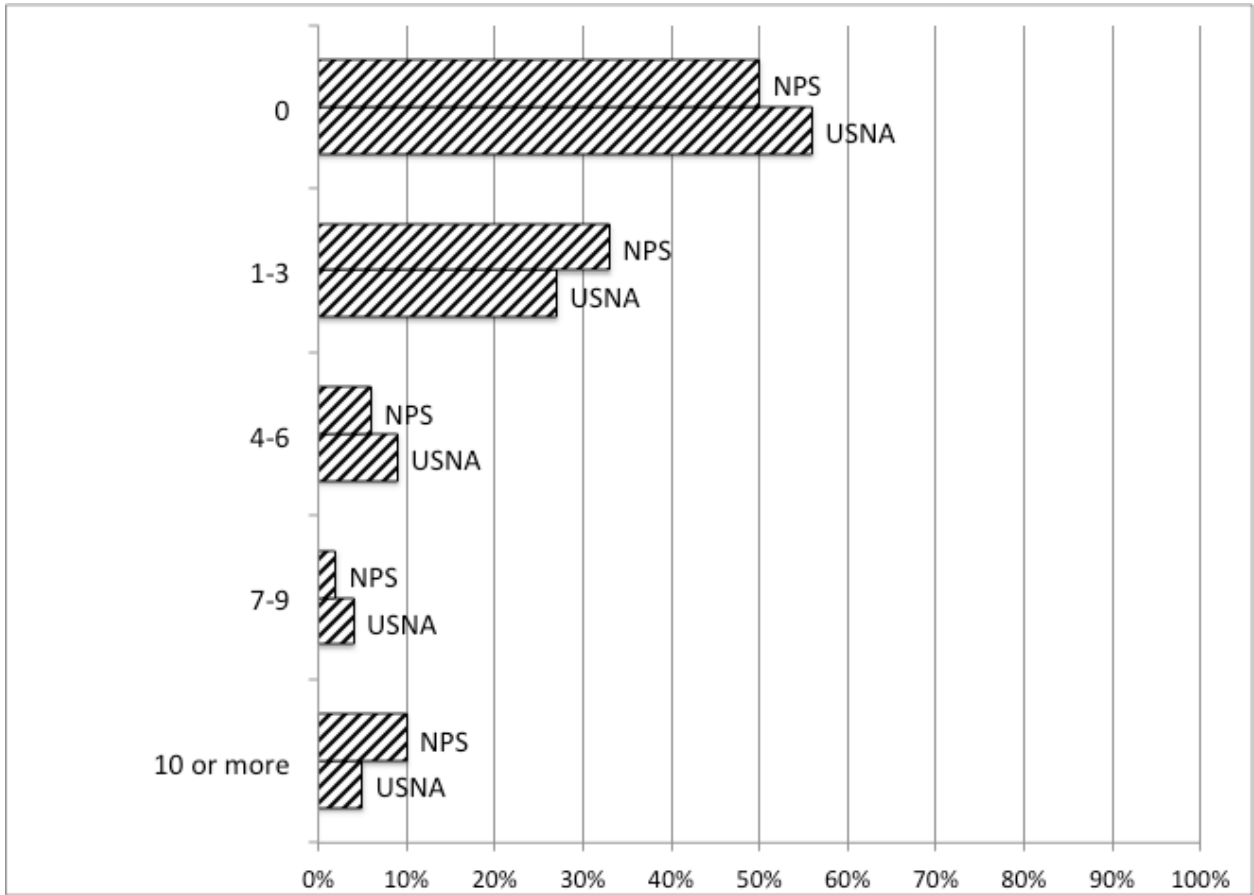


Figure 12: “On average, how many newspapers and magazines *related to your curriculum* do you download using your e-book reader per semester?”

Cross-hatching indicates the distribution NPS of students across categories was not different with statistical significance from that of USNA students.

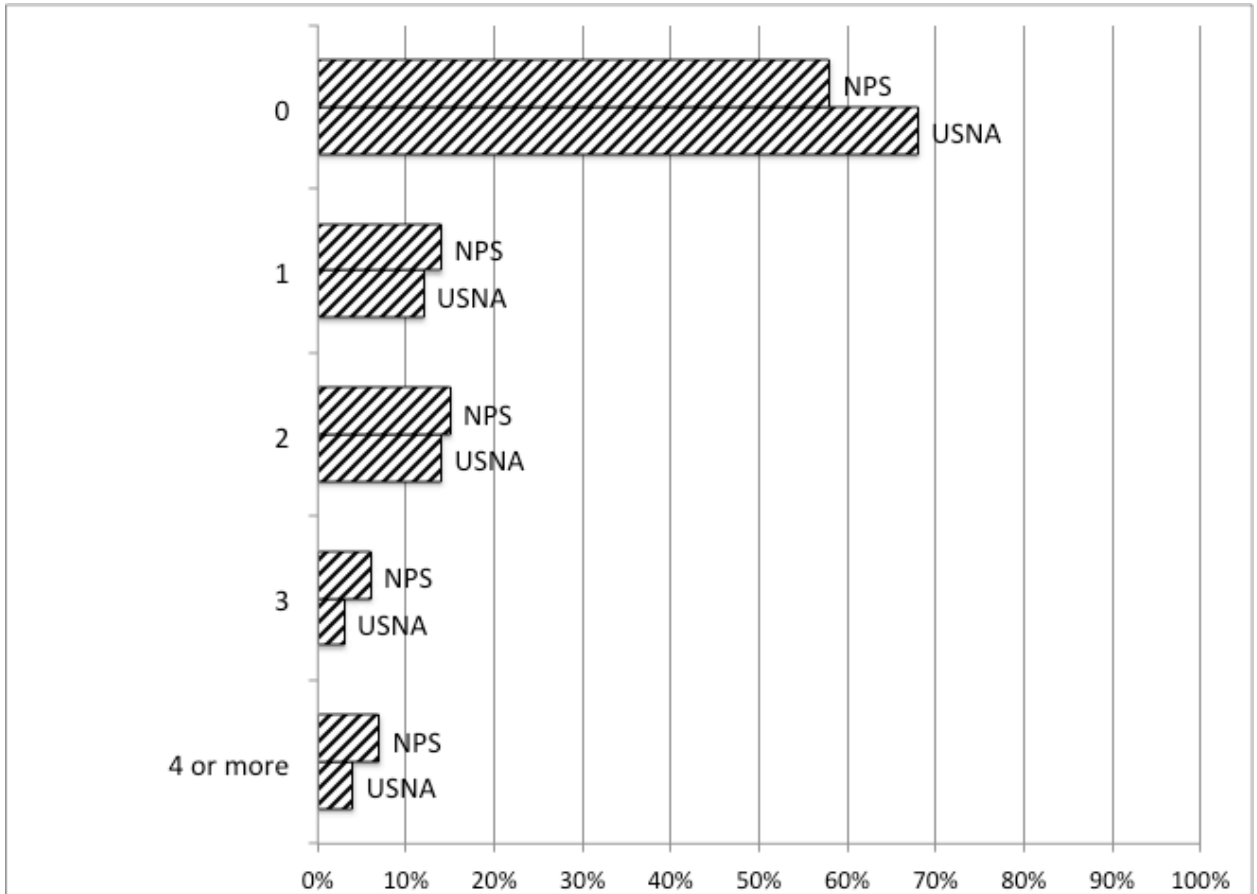


Figure 13: “On average, how many textbooks or other books *required for classes* you download using your e-book reader per semester?”

Cross-hatching indicates the distribution NPS of students across categories was not different with statistical significance from that of USNA students.

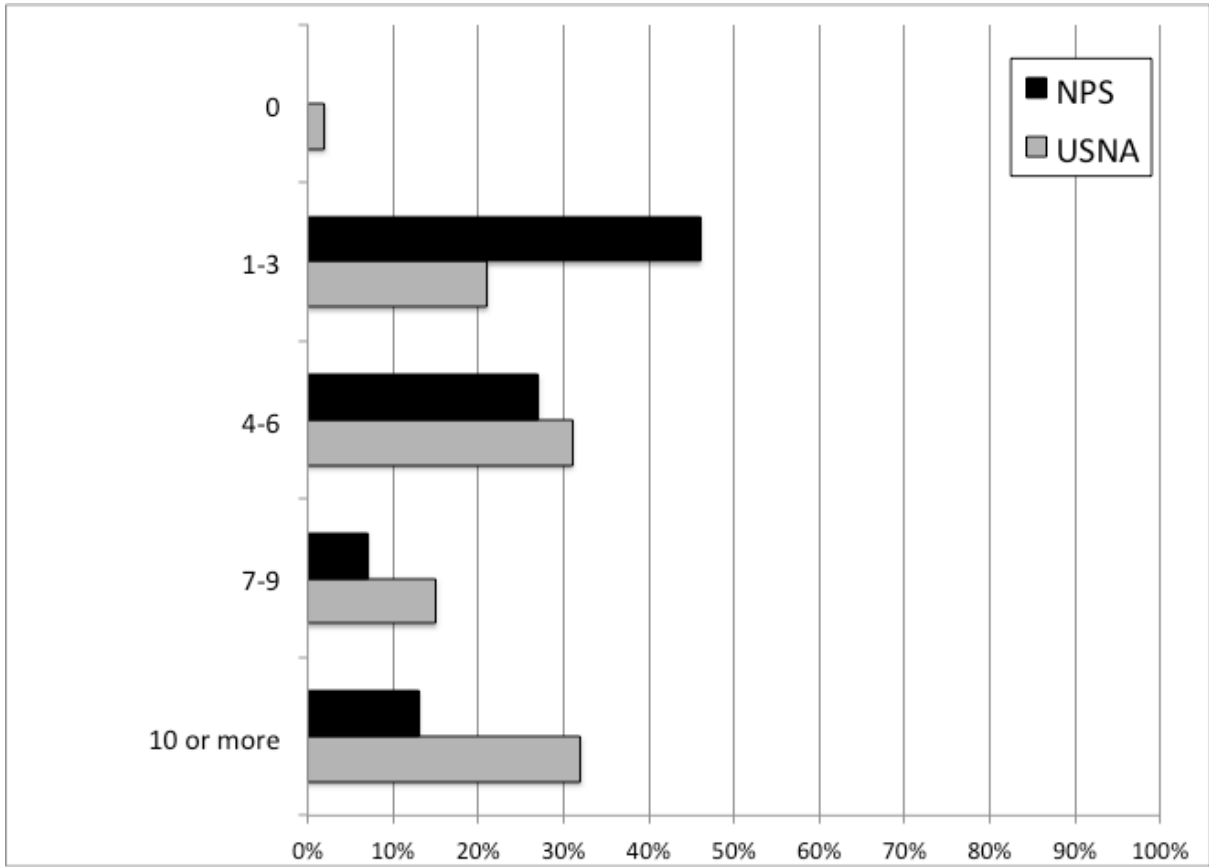


Figure 14: “On average, how many books for your *personal use* do you download using your e-book reader per semester?”

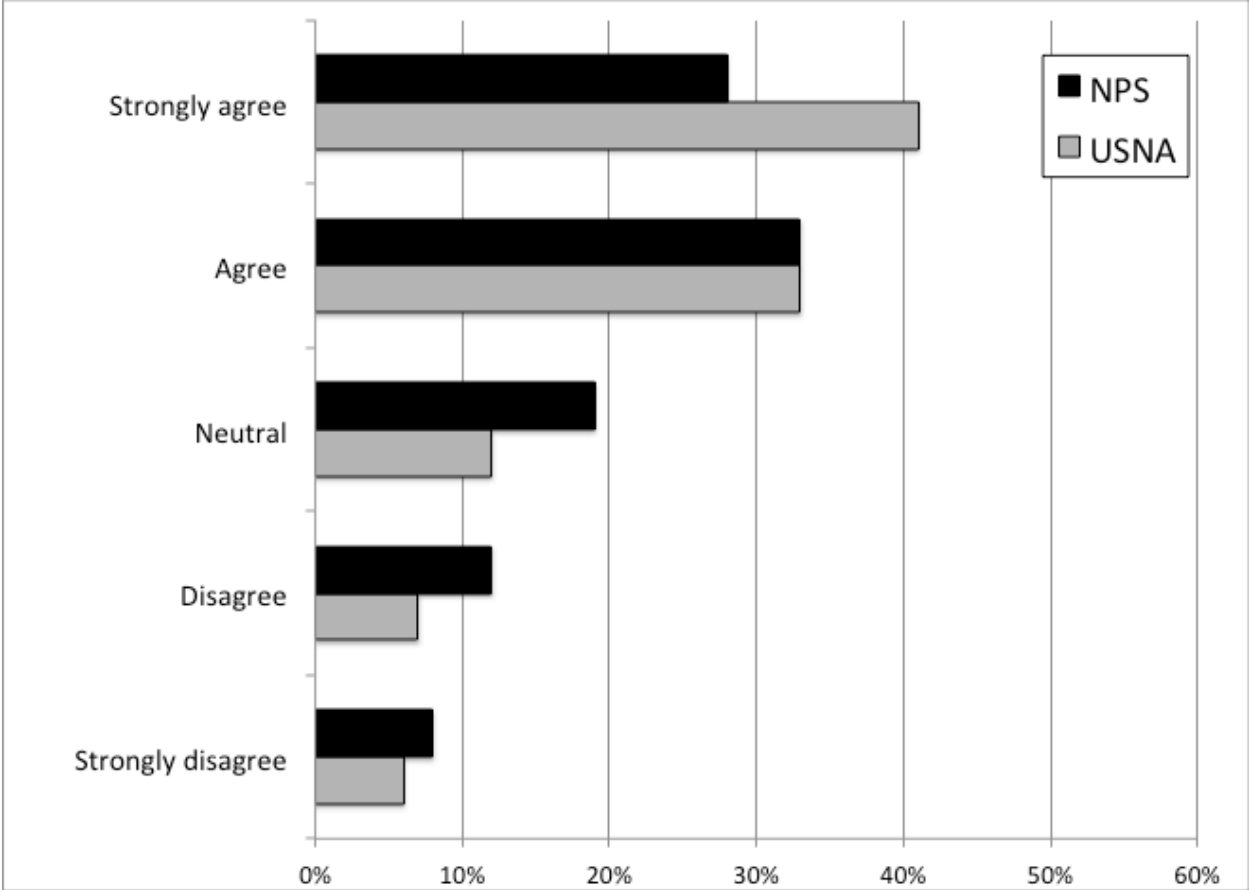


Figure 15: Response to, “I would use mobile learning on my hand-held device if it were available in my curriculum.” The distribution NPS of students across all the categories was statistically different from that of USNA students.

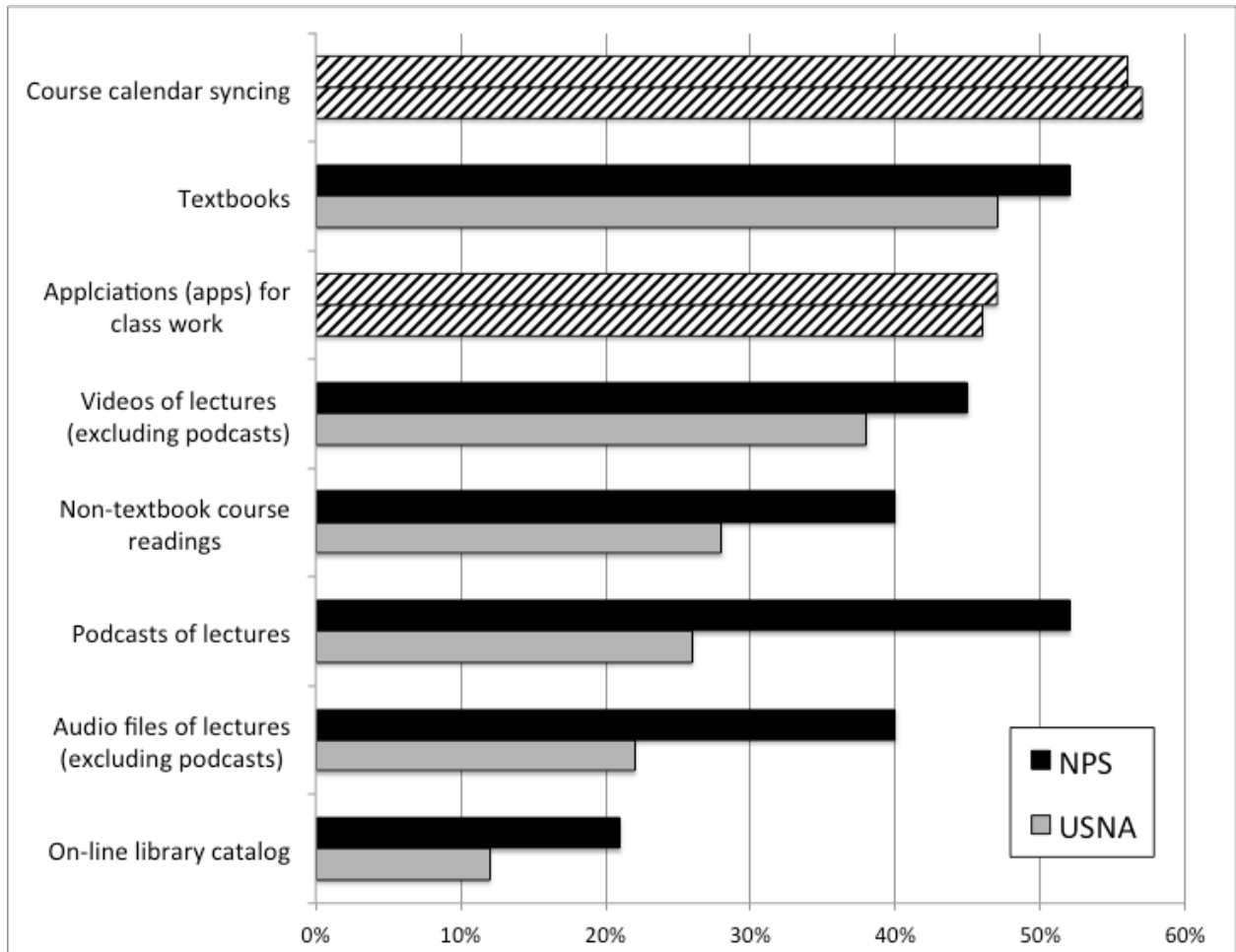


Figure 16: Response to, “Which educational material(s) would you like to access on your hand-held mobile device?” Cross-hatching indicates the difference was not statistically significant.

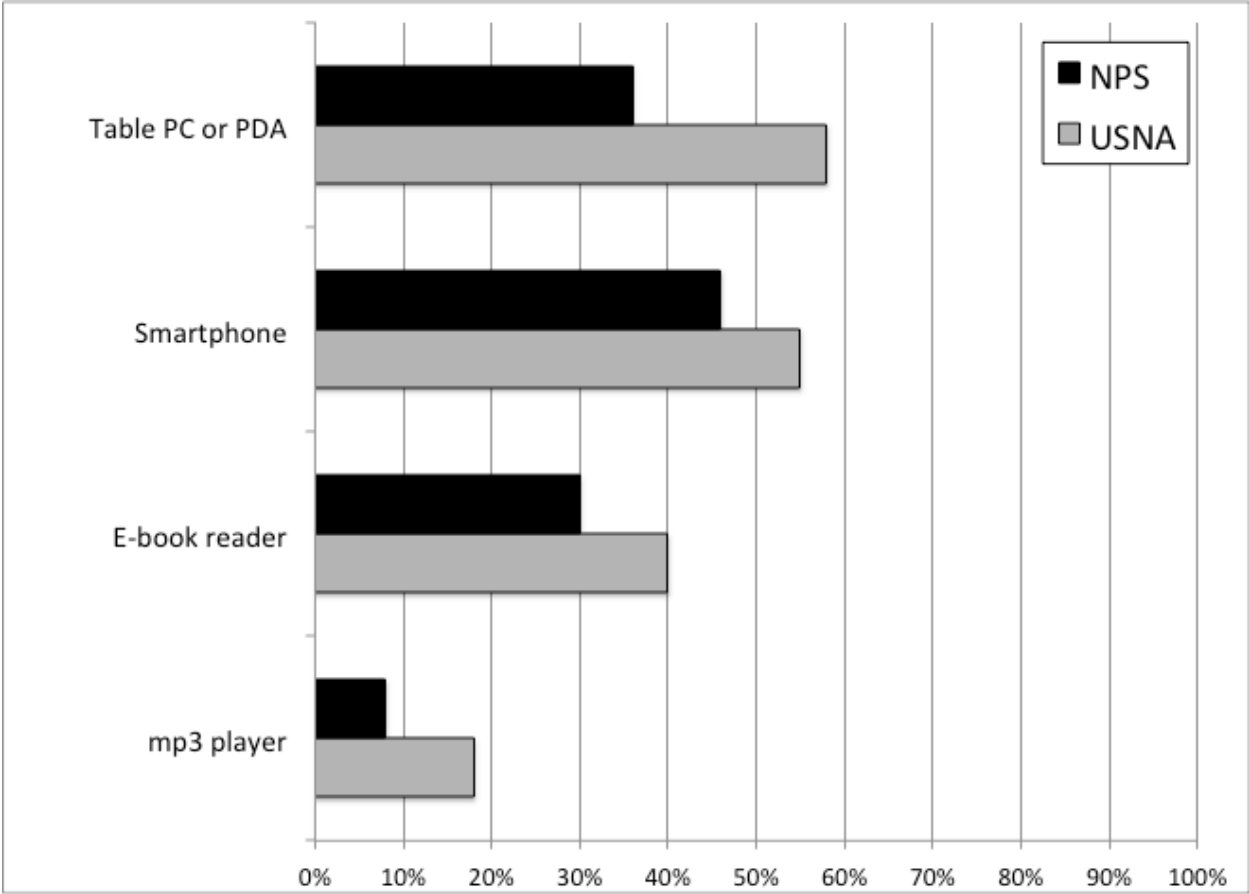


Figure 17: Response to, “If USNA/NPS educational tools were available for mobile learning, which hand-held device(s) would you be interested in purchasing or upgrading to?”

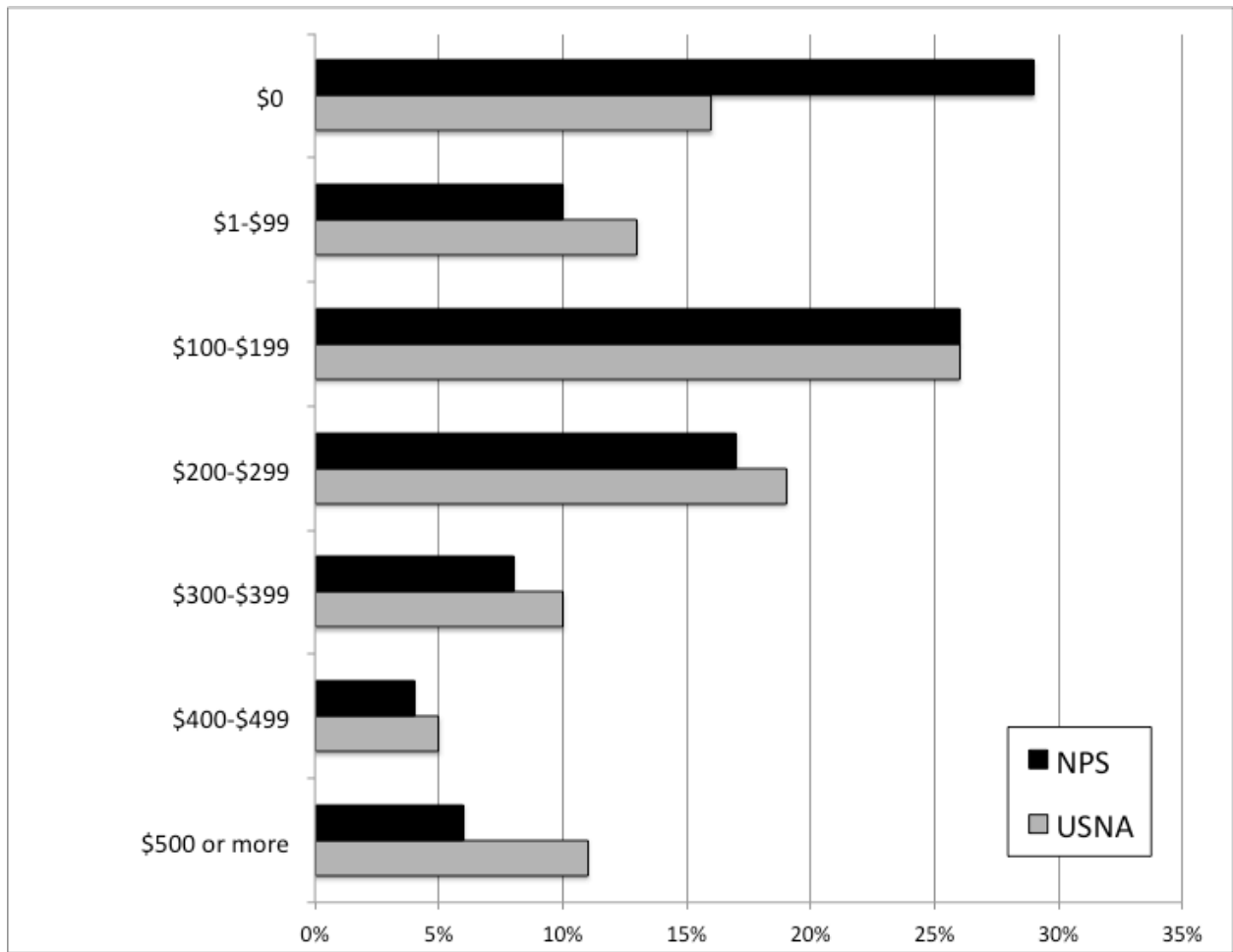


Figure 18: Response to, “How much are you willing to spend on hand-held mobile devices to access USNA/NPS educational materials?”

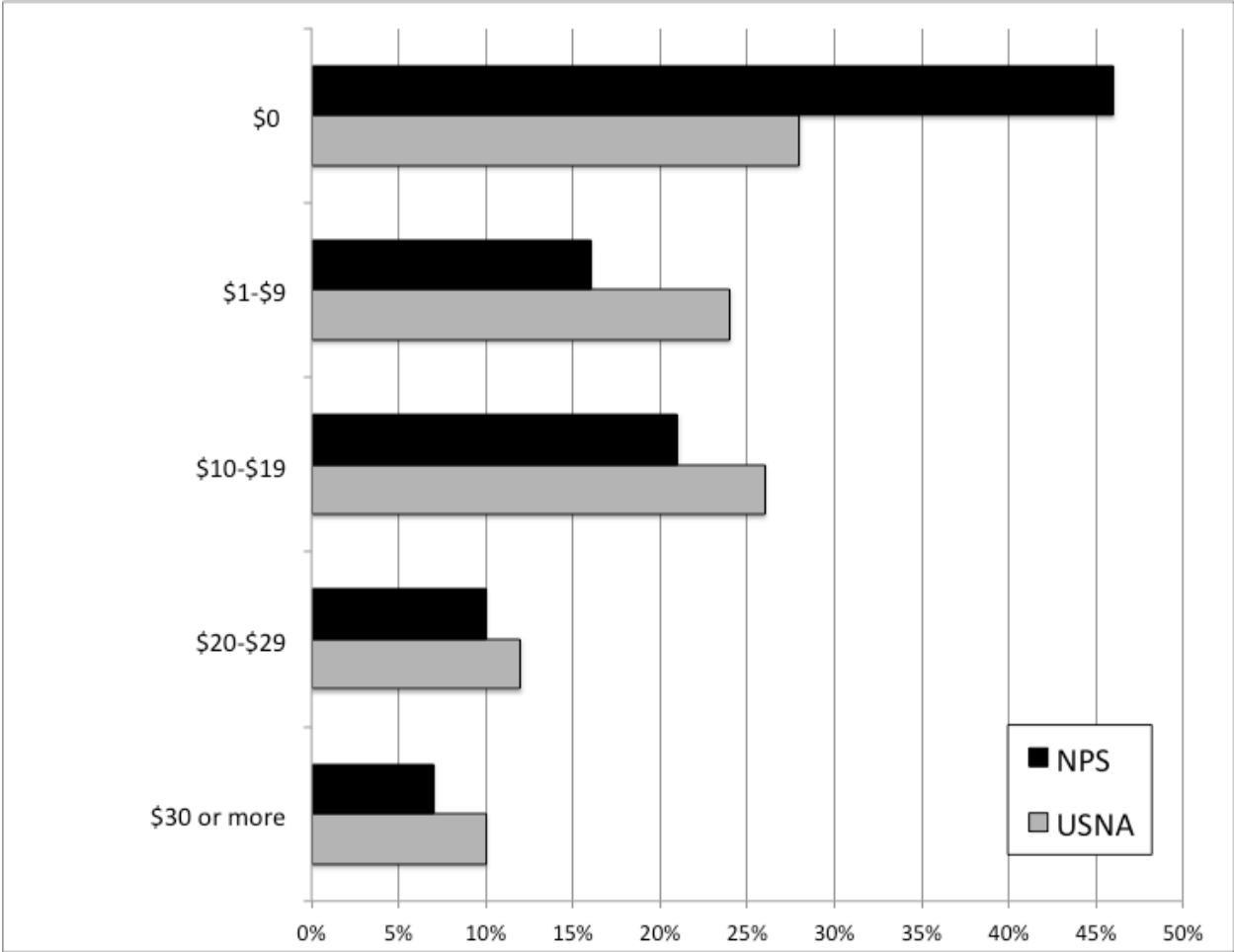


Figure 19: Response to, “How much are you willing to spend on adding/upgrading your data package to access USNA/NPS educational tools per month?”