EVALUATING AND BLENDING MULTIMEDIA MOBILE APPLICATIONS INTO TECHNICAL TRAINING

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This study in the aerospace ground equipment (AGE) apprentice course at Sheppard Air Force Base, Texas, examined the use of mobile digital devices to determine which device leveraged the best results and was most compatible with military technical training requirements. The sample consisted of 160 students who attended the course between January and June, 2010. Three devices loaded with course materials were issued to the students, who used the devices in the classroom and were encouraged to use the devices to enhance their study time after class.

Quantitative data were obtained by comparing block test scores to determine if any device produced a significant change in student learning. Qualitative data were collected from surveys administered to instructors and students to measure which device instructors and students found easiest to understand and use, and student satisfaction with the device.

An analysis of variance (ANOVA) revealed a statistically significant difference ($p < .05$) in the block test mean scores between groups using mobile devices and the students in the control group that had no device. Post hoc comparisons on each block showed that there was a statistically significant difference between students using the smartphone and students using the other devices, but no statistically significant difference in the block test mean scores between students using the iPod and the netbook. The netbook leveraged the best results, both in block test scores and student satisfaction. The greatest reported disadvantage of the smartphone and the iPod Touch was the small screen size.
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By

Billy R. Moore
ACKNOWLEDGEMENTS

I would like to thank Professor Jeff Allen as my major professor and committee chair for his motivation and encouragement as he kept me on track throughout the dissertation process. I also appreciate the editorial comments from my committee, Professors Mickey Wircenski, Jon Young, and Demetria Ennis-Cole.

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Thanks to all my colleagues at Sheppard Air Force Base who were a part of this study: Gina Johnson and Major Paul Abair, Ph.D., who oversaw the development of the initial proposal; Robby Wilson, who downloaded all the courseware onto the devices and trained the instructors and students; Michael Dow, the instructor supervisor for the AGE Course, Chris Cain, who assisted with planning the study and developing the surveys; the instructors of the AGE Apprentice Course, who are dedicated to providing quality instruction to their students; and to the students who voluntarily allowed me to use their grade data and gave honest feedback on their surveys.

And last, but certainly not least, my gratitude goes to my loving wife of 41 years, who gave me her support, encouragement, and “gentle” nudges to complete this doctoral program.
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Introduction

The United States Air Force (USAF) recognizes the importance of education and has instituted numerous programs to satisfy the educational needs of the Air Force and its personnel. The Air Force has initiated training at all levels, from the basic recruit to the officer corps; from the lowest ranking airman to senior leadership. Air University (AU), established in 1946, serves both the officer and enlisted corps, offering degree programs and professional continuing education for officers and professional military education (PME) to all Air Force members. AU serves the enlisted community through the Community College of the Air Force (CCAF). The CCAF was accredited by the Southern Association of Colleges and Schools on December 12, 1973, and is the only 2-year institution exclusively serving enlisted personnel. It offers enlisted personnel the associate in applied science (AAS) degree in programs designed for Air Force specialties. Since the CCAF awarded its first associate of applied science (AAS) degree in April 1977, the college has awarded more than 335,000 AAS degrees as of November 2009 (Air University, n.d.). Training for the enlisted force begins with basic military training (BMT) conducted at Lackland AFB, Texas. Upon graduation from BMT, the recruit continues Air Force specialty (AFS) training at one of the five Air Education and Training Command (AETC) centers which are located at Goodfellow AFB, Texas; Lackland AFB, Texas; Sheppard AFB, Texas; Keesler AFB, Mississippi; and Vandenburg AFB, California.

Background/Significance of the Study

According to the Air Force Personnel Center’s (AFPC) demographics as of September 30, 2010, the average age of the 263,437 enlisted personnel is 29; of these, 44% are below the age
Most enlisted personnel have a high school education (99.9%), 70.1% have some college, 19.3% have an associate’s degree or equivalent semester hours, 5.7% have a bachelor’s degree, 1% have a master’s degree, and 0.01% have a professional or doctoral degree (AFPC, n.d.). The mission of AETC is to “Develop America’s Airman today . . . for tomorrow” (AETC, n.d.). To fulfill this mission, AETC’s vision is to “deliver unrivaled air, space, and cyberspace education and training” (AETC, 2008b). The primary challenge for meeting this mission is how best to train today’s new recruits and at the same time bridge the generation gap between instructors (civilian and/or military) who are in the baby boomer generation (born from 1946 to 1964) or Generation-X (born from 1965 to 1979) and the recruits who are in the Millennial Generation (born from 1980 to 2001) (AETC, 2008a).

Air Force Manual 36-2236, Guidebook for Air Force Instructors (2003), offers practical guidelines for teaching adult learners, especially in a military environment. The manual states that successful teaching will result in a change in students’ behavior. It encourages creativity in the classroom and warns against instruction that is too traditional, “dry-as-dust presentations that are more like briefings than real teaching lectures” (Air Force Manual 36-2236, 2003, p, 22). AETC instructors are active duty personnel, individuals who have retired from the military, and other civilian personnel, ranging in age from the mid 20s to the mid 60s. Unfortunately, many of these instructors are from the Baby Boomer generation and some from Generation X. Prensky (2001a) calls these individuals “digital immigrants,” who find it difficult to speak the language of the digital natives, are reluctant to incorporate creativity into their presentations, assume that learners are the same as they always have been, and are more comfortable using traditional, stand-up lectures in their classroom.
The leadership of AETC realizes the need to find the right mix of live, virtual, and constructive courseware delivery methods to train today’s recruits. Because of the rapid advances in technology, Air Force leaders are encouraging the implementation of new technologies in the training environment. According to AETC (2008a), “to ensure future Airmen are prepared to meet future challenges, the Air Force must transform how it educates and trains” (p. 4). Although the Air Force has made great strides in implementing virtual reality trainers and simulators into training and has negotiated with developers of commercial flight simulator games to develop military versions (Prensky, 2001b), most of the instruction is via traditional methods, with lecture/discussion being the most common. At the present time, AETC has not established a standard mobile personal digital device that will provide blended delivery of materials in technical training. The primary purpose of this study was to compare three mobile devices to determine which device leveraged the best results and was most compatible with military technical training requirements.

Population and Sample

Subject-matter experts (SMEs) in the 82d Training Wing at Sheppard Air Force Base in Wichita Falls, Texas, believe that gains could be made in learning performance if emerging technologies were introduced to the classroom to blend delivery methods. In August 2009, the training wing submitted a proposal to Headquarters AETC to perform a study that implemented the use of mobile digital devices – the iPod Touch, the HTC Touch Pro Phone, and the ASUS Eee Netbook – into the training environment in the Aerospace Ground Equipment (AGE) Apprentice Course to determine their effectiveness on learning. The AGE Apprentice Course teaches aircraft maintenance personnel how to maintain and repair both powered (generators, etc.)
According to Headquarters United States Air Force Personnel Center Fiscal Year (FY) 2009 demographics, a total of 4,125 airmen are in the AGE career field. On average, 300 students attend the AGE Apprentice Course each year. In FY 07, the AGE Apprentice Course saw a high failure rate on end-of-block tests, which resulted in the students having to repeat failed blocks. This process is called “wash back.” In FY 07, the wash back rate was in excess of 30%. Repeated academic failures normally result in elimination from the course; students who are eliminated will either be retrained in another career field or may be separated from the Air Force. In 2010 the course’s training development element (TDE) personnel made numerous improvements to course materials and instructional delivery methodology, resulting in significantly reduced block test failure rates; however, certain blocks of instruction continue to drive higher than acceptable failure rates due to many students’ lack of background in the subject matter of AGE fundamentals and the complexity of the material in AGE electronic principles.

The 95-day AGE Apprentice Course is divided into 3 sections, referred to as CAT 1, CAT 2, and CAT 3. The portion of the course used for the study was CAT 1, which lasts 33 training days, consisting of 7 blocks of instruction, roughly 1 week per block. Blocks 1 through 4 consist of 144 hours (18 days) of instruction, providing instruction in general maintenance fundamentals to include career progression, operations security (OPSEC), supply discipline and hazardous materials and waste handling; general maintenance tasks to include wire maintenance, inspection and equipment forms, and maintenance data systems; and electrical fundamentals. Blocks 5 through 7 consist of 117.5 hours (15 days) of instruction that introduce maintenance of the diesel engine, ground heater, and the floodlight set. Learning objectives in
the first four blocks are primarily knowledge based; skill-based tasks are introduced in the next three blocks.

The research sample consisted of 16 classes of the AGE Apprentice Course between January and June 2010 at Sheppard Air Force Base, Texas. Classes are scheduled to begin every 5 days with a maximum class size of 12 students. However, there was an average of 10.9 students in each class, for a total sample of 160 students. Based on the outcome of this study, the 82d Training Wing at Sheppard AFB provided a recommendation to Air Education and Training Command as to which device showed the greatest learning improvements in the AGE Apprentice Course and which device is most preferred and sustainable for Air Force technical training.

Limitations

Several limitations may have affected the study. Prior to beginning the study, the research team suspected that instructor bias toward the devices used in the study could possibly skew the data. However, on the instructor pre-use survey, 50% of the instructors involved in the study rated their attitude toward the study as being good, 20% of the instructors rated their attitude as excellent, while 30% rated their attitude as fair. There was no correlation between instructor attitude toward the devices and instructors’ age range. Students and instructors also have varying skills with technology, which may have also affected the data. Prior to the study, it was assumed that the majority of the students would be digital natives and most instructors would be digital immigrants, as described by Prensky (2001a), which could have affected the outcome of the study. Because of security issues with Department of Defense computer networks, none of the devices could be connected via LAN to
any base network. The students using the iPod touch were not allowed to connect their devices to their personal computers to prevent damage or deletion of the course data loaded on the device during an iPod sync process. During the study, the students involved in the study were granted permission to carry their devices while in uniform because current regulations prohibit them from using cell phones while in uniform. The subscriber identity module (SIM) cards were removed from the iPod Touch and smartphones, which resulted in no phone capability on those devices. The students also had limited connectivity between devices due to inadequate wireless connectivity on Sheppard Air Force Base.

_Research Hypotheses_

H₀₁: There is no statistically significant difference in block test mean scores between the control group and FY09 6-month average baseline.

H₀₂: There is no statistically significant difference in the Block 1 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

H₀₃: There is no statistically significant difference in the Block 2 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

H₀₄: There is no statistically significant difference in the Block 3 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

H₀₅: There is no statistically significant difference in the Block 4 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

H₀₆: There is no statistically significant difference in the Block 5 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.
H₀₇: There is no statistically significant difference in the Block 6 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

H₀₈: There is no statistically significant difference in the Block 7 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

Methods

This study employed a quasi-experimental design using intact groups attending the AGE Apprentice Course. The groups were composed of students who had been selected to enter the AGE career field and were scheduled to attend the AGE Apprentice Course beginning with the class that started on January 7, 2010, and ending with the class that started on May 3, 2010. The majority of these students were active duty, non-prior service (NPS) Air Force personnel who had just completed BMT at Lackland AFB, Texas, while others were enlisted in the Air Force Reserve and the Air National Guard. Prior to the study, the research team decided the first 2 scheduled classes would receive the iPod Touch (Device 1/Group 1), the next 2 classes would receive the HTC Touch Pro Phone (Device 2/Group 2), the next 2 classes would receive the ASUS Eee Netbook (Device 3/Group 3), and the next 2 classes would be the control group and receive no device (Group 4). The process would then be repeated for a total of 4 classes in each group, 16 classes total. The independent variable in this study was the introduction of the mobile devices to students in the classroom. The dependent variables were the block test scores.

The principal method of instruction in the AGE Apprentice Course is instructor-led lecture/discussion. In Blocks 4-7, demonstration/performance methodology is added. Current course materials used by instructors include readings and PowerPoint slides, and some
objectives have instructor-facilitated Flash presentations embedded in PowerPoint for classroom use only. The only course materials students normally receive are the written study guide at the beginning of the course and handouts of electrical schematic diagrams which are issued at certain points in the course. For the study, the PowerPoint presentations used during classroom lectures, study guides, and handouts were reformatted and loaded onto the mobile devices to provide a blended delivery of the learning objectives. The students received the devices at the beginning of the course and were able to access course materials on the device both during and after class. At the conclusion of CAT 1 (Block 7), the students returned the devices to their instructor.

The study was based on a research effort sponsored by the Air Force Research Laboratory’s (AFRL) Logistics Readiness Branch that extended from July 13, 2007, to January 12, 2009. The focus of that research was to identify current and future trends in Air Force technical training and to assess their importance to formulating future vectors for technical training (Vincent, Pierce, Lindsey, Badler, & Green, 2009, p. 2). In one part of the research, Jill Lindsey from Wright State University conducted a pilot study in a selected group of courses at Sheppard Air Force Base to evaluate learning styles of students, teaching styles of instructors, and teaching methodologies used. One of the findings indicated that trainees preferred more technology use in training than did the instructors. Lindsey recommended additional access to technology in the classroom to engage trainees and improve training outcomes (Vincent et al., 2009, p. 55).

Recommendations from three teams of professionals supported the research – a technical team, course integration team, and research team. The technical team, composed of
members from 82d Training Wing Training Operations Section, did market research, comparing costs, applications available, and specifications of potential devices to be used for the study. They compared the iPod Touch to the Microsoft Zune HD MP3 Player and compared the Nokia N97 to the HTC Touch Pro touch screen phones. For netbooks, the team compared the ASUS Eee PC Touch T91, ASUS Eee PC 1005HA-PU1X-BK, Acer Aspire One AO150-1577 Diamond Black, and the HP Mini 1101 - Atom N270 1.6 GHz - 10.1 TFT. Based on their comparison, the technical team chose the 32 GB iPod Touch, the HTC Touch Pro Phone, and the ASUS Eee Netbook for this study. HQ AETC approved the use of these devices and provided funding for the study. Table 1 shows a comparison of the specifications on the three devices chosen for the study, and Table 2 shows a comparison of the different features on the devices.

Table 1

Comparison of Device Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>iPod</th>
<th>Touch Screen Phone</th>
<th>Netbook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>iPod Touch</td>
<td>HTC Touch Pro</td>
<td>ASUS Eee PC 1005HA-PU1X-BK</td>
</tr>
<tr>
<td>Screen Size</td>
<td>3.5”</td>
<td>2.8”</td>
<td>10.3”</td>
</tr>
<tr>
<td>Battery Life</td>
<td>36 hrs music/6 hrs video</td>
<td>7 hrs (talk time)</td>
<td>10.5 hrs</td>
</tr>
<tr>
<td>Memory</td>
<td>No RAM/ROM</td>
<td>ROM: 512 MB</td>
<td>RAM: 1GB DDR2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RAM: 288 MB</td>
<td>1 x SODIMM Slot, 2GB Max</td>
</tr>
<tr>
<td>Storage</td>
<td>32 GB</td>
<td>SD 2.0 Expansion Slot</td>
<td>160 GB HD, 2-in-1 MMC, SD(SDHC) flash card slot</td>
</tr>
<tr>
<td>Operating System</td>
<td>iPod Touch OS</td>
<td>Windows Mobile 6.1</td>
<td>Microsoft Windows XP</td>
</tr>
<tr>
<td>Input/Output</td>
<td>1 x Dock connector</td>
<td>1 x mini USB</td>
<td>1 x VGA connector</td>
</tr>
<tr>
<td></td>
<td>1 x 3.5-mm stereo</td>
<td>1 x audio jack</td>
<td>1 x Headphone</td>
</tr>
<tr>
<td></td>
<td>headphone jack</td>
<td></td>
<td>1 x Mic-in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 x LAN RJ-45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 x audio jacks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 x USB 2.0 ports</td>
</tr>
<tr>
<td>Audio Input</td>
<td>No direct recording</td>
<td>Speaker, Microphone</td>
<td>Stereo Speakers, High-Definition Audio CODEC, Digital Array Microphones</td>
</tr>
<tr>
<td>Camera</td>
<td>No</td>
<td>3.2 M Pixels</td>
<td>1.3 M Pixels</td>
</tr>
<tr>
<td>Weight</td>
<td>4.05 oz</td>
<td>5.8 oz</td>
<td>2.8 lbs</td>
</tr>
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Table 2

Comparison of Device Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>iPod</th>
<th>Touch Screen Phone</th>
<th>Netbook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wi Fi/WLan (802.11 b/g)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bluetooth</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>PDF</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>PowerPoint</td>
<td>X</td>
<td>X</td>
<td>X *</td>
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<tr>
<td>Flash</td>
<td>X</td>
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</tr>
<tr>
<td>Word</td>
<td>X</td>
<td>X</td>
<td>X *</td>
</tr>
<tr>
<td>Video</td>
<td>X</td>
<td>x</td>
<td>X</td>
</tr>
<tr>
<td>Touch Screen</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Keyboard</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

* With Microsoft Office installed

After procurement of the devices, the technical team reformatted the course study guide, PowerPoint presentations, and handout as needed and loaded them on the devices. They maintained journals to chronicle milestones and challenges encountered during the study and maintained/serviced the devices as needed during the study. Prior to issuing the devices to the students, the technical team provided training to the instructors who were scheduled to use the devices in class. Spares were available to replace any device that was lost or broken; however, during the study, only one netbook suffered damage.

The course integration team consisted of the instructor supervisor and instructors who taught the course, administered the surveys, documented all test scores in the Technical Training Management System (TTMS), and provided data to the research team. They maintained journals on resources used to deploy, manage, and sustain the devices and compiled and requested technical support from the technical team as needed. The research team performed a literature review of similar studies; compiled and analyzed the qualitative and quantitative measurements for the study; and constructed data collection, compilation,
and analysis tools. The research team also compiled the report sent to HQ AETC with results of the study.

After the technical team loaded the devices with a course material, the iPod Touch was issued to two classes of students on the first day of Block 1, the HTC Touch Pro Smartphone was issued to the next two classes, and the Asus Eee Netbook was issued to the next two classes. A member of the technical team met with each new class to issue the devices and provide training on how to use the devices and how to access the materials loaded on the devices. Students were allowed to use the devices in the classroom and were encouraged to use the devices to enhance their study time after class. These students utilized the same device until the end of Block 7, at which time they turned the device in to the instructor. The fourth set of two classes was the control group; these classes were not issued any device. The cycle began again, issuing the first device to the next two classes and so on. Table 3 shows how the devices were deployed in the study. The Personnel Data System Class (PDSCLASS) number, composed of the 15-digit Course ID plus the class number – 2-digit FY and 3-digit one-up class number – is the class number the course training manager uses when scheduling classes. The shortened version of the PDSCLASS number is shown in Table 3, followed by the device the class used and the number of students in that class.

Table 3

<table>
<thead>
<tr>
<th>PDSCLASS</th>
<th>iPod Touch</th>
<th>HTC Touch Pro Smartphone</th>
<th>ASUS Eee Netbook</th>
<th>Control group</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>10012</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>10013</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>10014</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

*(table continues)*
Table 3 (continued).

<table>
<thead>
<tr>
<th>Device Used</th>
<th>iPod Touch</th>
<th>HTC Touch Pro Smartphone</th>
<th>ASUS Eee Netbook</th>
<th>Control group</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDSCLASS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10015</td>
<td></td>
<td>X</td>
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<td>11</td>
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<tr>
<td>10017</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>10018</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>10</td>
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<td>10019</td>
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<td></td>
<td></td>
<td>X</td>
<td>11</td>
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<tr>
<td>10020</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>10</td>
</tr>
<tr>
<td>10021</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>11</td>
</tr>
<tr>
<td>10022</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>10023</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>9</td>
</tr>
<tr>
<td>10024</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>10</td>
</tr>
<tr>
<td>10025</td>
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<td></td>
<td>X</td>
<td>11</td>
</tr>
<tr>
<td>10026</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>11</td>
</tr>
<tr>
<td>10027</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>160</td>
</tr>
</tbody>
</table>

During the study, 15 students were washed back, including 9 because of academic failures, 5 for medical reasons, and 1 for administrative reasons. Of the 15 students who were washed back, 3 were subsequently eliminated from the course, including 2 because of multiple academic failures and 1 because of medical issues. The scores for these 15 students were not included in the final analysis of block test scores. The total sample that was considered for analysis was 145 students. Table 4 shows the break-out of class composition for each Training Requester Quota Identifier (TRQI) for the 145 students who completed the study (AJ10 = non-prior service [NPS] enlisted; RR10 = Air Force Reserve; CC10 = Air National Guard).

Table 4

Sample by TRQI

<table>
<thead>
<tr>
<th>Group</th>
<th>AJ10</th>
<th>RR10</th>
<th>CC10</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPod</td>
<td>34</td>
<td>3</td>
<td></td>
<td>37</td>
</tr>
<tr>
<td>Smartphone</td>
<td>27</td>
<td>5</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>Netbook</td>
<td>27</td>
<td>4</td>
<td>7</td>
<td>38</td>
</tr>
<tr>
<td>Control</td>
<td>25</td>
<td>4</td>
<td>6</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>113</td>
<td>11</td>
<td>12</td>
<td>145</td>
</tr>
</tbody>
</table>
Quantitative Data

Block test scores were the source of quantitative data for the study. Subject-matter experts from the 361st Training Squadron, Sheppard AFB, Texas, developed two tests for each block of the AGE Apprentice Course using Questionmark. Students take a block test at the conclusion of each block to measure their attainment of the objectives in the block. Block test reliability is determined by administering each version of each test three times and then comparing the mean scores for each version to ensure agreement within 5%. The block tests for the AGE Apprentice Course have been administered to over 600 students since they were validated. All tests are further analyzed quarterly to ensure continued reliability, noting high-miss items (questions missed by more than 50% of the class). If a question is deemed to be invalid, the question is rewritten.

For this study the research team initially established a baseline by compiling the block test scores of students over a 6-month period prior to the study and compared the baseline scores to the control group’s scores to determine whether the control group was representative of the baseline. Then a comparison of the block test scores was made among the groups using the three devices to determine whether any device produced any significant change in student learning as shown on block test scores. Finally, the scores of the groups using the mobile devices were compared to the scores of the control group.

Qualitative Data

Qualitative data were collected from surveys administered to both instructors and students during the study to measure which device instructors and students found easiest to understand, navigate, and use. The research team initially brainstormed to list potential
variables that might affect the outcome of the study. From the list of variables, the team developed five surveys which were formatted by HQ AETC’s Occupational Analysis Division (OAD) using their specialized software, Task Inventory Analysis Requirements Application (TIARA). TIARA was developed specifically to prepare and administer occupational surveys to Air Force members. It formats surveys for Web-accessibility, including computer access card (CAC)-enabled logon, item branching that avoids questions not applicable to a respondent, and immediate data capture. The software verifies survey respondents' eligibility using a CAC-based login; however, personal data are not captured or stored unless they are relevant to analysis of the survey. A recent (Nov. 2009) upgrade made the application more user-friendly and efficient in producing Web-ready surveys. The OAD maintained the survey database, compiled results at the end of the survey, and provided data to the research team. Following is a description of each survey. The surveys are located in Appendix B.

Survey 1.1. Instructors Pre-Use

All instructors teaching the classes involved in the study completed this survey prior to conducting the class to determine the instructor’s familiarity with and biases for/against using mobile devices in Air Force technical training. The survey identified which class and which device the instructor taught. Because the literature review indicates that there is a generation gap in learning/teaching styles between the generations (Levin & Arafah, 2002), the only demographic requested was the age range of the instructor. This factor was compared to generation differences as discussed in the literature review. The next section of the survey determined how frequently the instructor uses computers or other devices and how the instructor would rate the use of computers by students. To determine whether there was an
instructor bias for or against using mobile training devices in the military technical training environment, the third part of the survey asked the instructor’s opinion of how well current course materials and delivery methods prepare the student for the AGE career field and what the instructor’s attitude was toward this study.

Survey 1.2. Instructor Post-Use

Instructors completed this survey at the end of CAT 1. They rated how interested the students were in the device and if the device correlated with learning activities. They were also asked to rate their satisfaction with the device and were given the opportunity to provide any suggestions for improving the study.

Survey 2.1. Student Pre-Use

Students completed this survey at the beginning of class on the first day of training. This survey was similar to Survey 1.1. in that it identified the class number, the mobile device being tested, and the student’s age range. Part 2 of this survey asked how frequently the student uses computers and/or mobile devices for both personal and academic use. Because established study habits, satisfaction rate with the Air Force and the career field, mechanical background, use of computers for educational purposes, and the student’s educational level were variables that could affect the outcome of the study, Part 3 of the survey asked questions related to these variables.

Survey 2.2. Student Mid-Term and Survey 2.3. Student Post-Use

Because Blocks 1 through 4 are primarily knowledge-based and Blocks 5 through 7 add performance-based objectives, the researcher chose to administer surveys at the midpoint, that is, at the end of Block 4 (Day 18) and at the end of the study, that is, at the end of block 7
(Day 33). The same questions were asked on both surveys, primarily to compare the students’ satisfaction with the device at the midpoint with their satisfaction at the end of the study. The students were asked to list the applications they used the most on the device on both surveys. The students were also asked to rate their satisfaction with the Air Force and squadron (dorm) life both at the midpoint and at the end of the study, since satisfaction with the Air Force and squadron life could affect performance positively or negatively. On the post-use survey, the students listed factors they felt were good and bad about the device and were given an opportunity to suggest any improvements or new applications that could be added. The mid-term and post-use surveys were then compared to determine whether there was a difference between the use of the devices for knowledge objectives and performance objectives.

Results

Results of Qualitative Data

AETC’s Occupational Analysis Division collected the data from the surveys in their TIARA database and provided the data to the researcher in an Excel spreadsheet. The surveys provided demographic and device usage data and also gave instructors and students the opportunity to present comments concerning positive and negative qualities of the devices. The pre-use student surveys revealed that 95% of the subjects were digital natives, less than 28 years of age (Prensky, 2001a). When asked about how frequently they used computers, smartphones, and console games, 35% of the students reported that they used computers and console games 1-5 hours/week; 30% used computers more than 12 hours/week, and 17% reported using console games more than 12 hours/week. Nine instructors participated in this study. Of these, two were between 20-29 years of age (in the Millennial generation), five
instructors were between 30-44 years of age (Generation-X’ers), and two of the instructors (one was the instructor supervisor) were 45 years old and older (Baby Boomer generation) (Oblinger & Oblinger, 2005). Seven of the instructors taught two or more classes. One instructor (age 30-44) taught one smartphone class. One instructor (age 30-44) taught two iPod classes. One instructor (age 20-29) taught two smartphone classes. One instructor (age 20-29), and another instructor (age 30-44) each taught two netbook classes. One instructor (age 30-44) taught two control classes. One instructor (age > 45) taught one iPod class and one control class, and one instructor (age 30-44) taught one iPod class, one smartphone class, and one control class. The instructor supervisor (age >45) taught periodically in all classes. The instructor sample size was too small to make any correlations between their age/generation and computer use. Additional qualitative results are presented along with discussion of the hypotheses.

Results of Quantitative Data

To test Hypothesis 1, the means of the block test scores of the control group ($n = 35$) was compared to the scores of the baseline group ($n = 253$) to determine whether the control group was representative of the previous 6 months of classes. The scores were analyzed using SPSS version 13 using an independent samples $t$ test.

$H_01$: There is no statistically significant difference in block test mean scores between the control group and FY09 6-month average baseline.

An independent samples $t$ test was conducted to compare the block test mean scores of the control group and the 6-month average baseline. The significance level for Levene’s test for equality of variances was greater than 0.05 for all blocks except Block 5; therefore, the
assumption of equal variances was not violated, and the values for equal variances assumed were used. For Block 5, the significance level of Levene’s test was 0.04; therefore, the data violated the assumption of equal variance, and the equal variances not assumed values were used. The overall results of the \( t \) test showed there was no statistically significant difference in block test scores for the control group and the baseline in Blocks 1, 2, 3, 5, 6, and 7. However, there was a statistically significant difference in the block test scores for the control group and the baseline in Block 4, but the effect size was small (.001). Therefore, except for Block 4, the results of the \( t \) test failed to reject the null hypothesis. The results of the \( t \) test are shown in Tables 5 and 6.

Table 5

*Control Group versus Baseline Group Means and Standard Deviation*

<table>
<thead>
<tr>
<th>Block</th>
<th>Group</th>
<th>( n )</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>35</td>
<td>84.71</td>
<td>9.54</td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>253</td>
<td>86.87</td>
<td>9.24</td>
</tr>
<tr>
<td>2</td>
<td>Control</td>
<td>35</td>
<td>88.29</td>
<td>8.13</td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>253</td>
<td>91.54</td>
<td>55.46</td>
</tr>
<tr>
<td>3</td>
<td>Control</td>
<td>35</td>
<td>85.00</td>
<td>10.92</td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>253</td>
<td>86.36</td>
<td>9.66</td>
</tr>
<tr>
<td>4</td>
<td>Control</td>
<td>35</td>
<td>82.14</td>
<td>9.57</td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>253</td>
<td>85.38</td>
<td>9.22</td>
</tr>
<tr>
<td>5</td>
<td>Control</td>
<td>35</td>
<td>88.71</td>
<td>8.08</td>
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<tr>
<td></td>
<td>Baseline</td>
<td>253</td>
<td>87.87</td>
<td>9.53</td>
</tr>
<tr>
<td>6</td>
<td>Control</td>
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<td>87.71</td>
<td>11.65</td>
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<tr>
<td></td>
<td>Baseline</td>
<td>253</td>
<td>87.55</td>
<td>10.91</td>
</tr>
<tr>
<td>7</td>
<td>Control</td>
<td>35</td>
<td>86.57</td>
<td>8.02</td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>253</td>
<td>86.90</td>
<td>8.73</td>
</tr>
</tbody>
</table>
Table 6

One Sample t test Control Group vs. Baseline Group

<table>
<thead>
<tr>
<th>Block</th>
<th>F</th>
<th>Sig</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean difference</th>
<th>Lower</th>
<th>Upper</th>
<th>95% Confidence interval of the difference</th>
<th>( \mu^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.13</td>
<td>.71</td>
<td>-1.29</td>
<td>286</td>
<td>.20</td>
<td>-2.15</td>
<td>-5.44</td>
<td>1.14</td>
<td>-5.44 to 1.14</td>
<td>0.006</td>
</tr>
<tr>
<td>2</td>
<td>.17</td>
<td>.68</td>
<td>-.35</td>
<td>286</td>
<td>.73</td>
<td>-3.25</td>
<td>-21.76</td>
<td>15.25</td>
<td>-21.76 to 15.25</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
<td>.82</td>
<td>.37</td>
<td>-.77</td>
<td>286</td>
<td>.44</td>
<td>-1.36</td>
<td>-4.85</td>
<td>2.12</td>
<td>-4.85 to 2.12</td>
<td>0.002</td>
</tr>
<tr>
<td>4</td>
<td>.26</td>
<td>.61</td>
<td>-1.94</td>
<td>286</td>
<td>.05</td>
<td>-3.23</td>
<td>-6.52</td>
<td>0.06</td>
<td>-6.52 to 0.06</td>
<td>0.013</td>
</tr>
<tr>
<td>5</td>
<td>4.16</td>
<td>.04</td>
<td>.57</td>
<td>48.13</td>
<td>.57</td>
<td>.87</td>
<td>-2.15</td>
<td>3.85</td>
<td>-2.15 to 3.85</td>
<td>0.001</td>
</tr>
<tr>
<td>6</td>
<td>.29</td>
<td>.59</td>
<td>.08</td>
<td>286</td>
<td>.93</td>
<td>.17</td>
<td>-3.74</td>
<td>4.07</td>
<td>-3.74 to 4.07</td>
<td>0.000</td>
</tr>
<tr>
<td>7</td>
<td>1.46</td>
<td>.23</td>
<td>-.21</td>
<td>286</td>
<td>.84</td>
<td>-.33</td>
<td>-3.40</td>
<td>2.74</td>
<td>-3.40 to 2.74</td>
<td>0.000</td>
</tr>
</tbody>
</table>

In Block 1, there was no statistically significant difference in scores for the control group \((M = 35, SD = 9.54)\) and the baseline \((M = 253, SD = 9.24)\); \(t(288) = -1.29, p = .20\) (two-tailed).

The magnitude of the differences in the means (mean difference = 2.15, 95% CI: -5.44 to 1.14) was small (eta squared \(\mu^2\) = .002). Cohen (1988) presents an effect size of .01 as being a small effect. In Block 2, there was no statistically significant difference in scores for the control group \((M = 35, SD = 8.13)\) and the baseline \((M = 253, SD = 55.46)\); \(t(288) = -0.35, p = .73\) (two-tailed).

The magnitude of the differences in the means (mean difference = -3.25, 95% CI: -21.76 to 15.25) was small \(\mu^2 = .001\). In Block 3, there was no statistically significant difference in scores for the control group and the baseline; \(t(288) = -0.77, p = .44\) (two-tailed). The magnitude of the differences in the means (mean difference = -1.36, 95% CI: -4.85 to 2.12) was small \(\mu^2 = .001\). In Block 4, there was a statistically significant difference in scores for the control group \((M = 35, SD = 9.57)\) and the baseline \((M = 253, SD = 9.22)\); \(t(288) = -1.94, p = .05\) (two-tailed).

The magnitude of the differences in the means (mean difference = -3.23, 95% CI: -6.52 to .06)
was small ($\mu^2 = .001$). In Block 5, there was no statistically significant difference in scores for the control group and the baseline; $t(288) = .50, p = .62$ (two-tailed). The magnitude of the differences in the means (mean difference = .85, 95% CI: -2.48 to 4.18) was small ($\mu^2 = .000$). In Block 6, there was no statistically significant difference in scores for the control group and the baseline; $t(288) = .08, p = .930$ (two-tailed). The magnitude of the differences in the means (mean difference = .17, 95% CI: -3.74 to 4.07) was small ($\mu^2 = .001$). In Block 7, there was no statistically significant difference in scores for the control group and the baseline; $t(288) = -0.21, p = .84$ (two-tailed). The magnitude of the differences in the means (mean difference = -.33, 95% CI: -3.40 to 2.74) was small ($\mu^2 = .000$).

To test hypotheses $H_02$ through $H_08$, a one-way between-groups analysis of variance (ANOVA) was conducted to identify whether there was a difference in block test grades between the three groups using the mobile devices as a supplemental study aid and the control group. Then, a post hoc test, Tukey honestly significant difference (HSD) was used to identify any significant relationships between the block test scores of the four groups. The following paragraphs present the findings for each block of instruction; in the discussion, Group 1 = iPod; Group 2 = Smartphone; Group 3 = Netbook; and Group 4 = Control. Since the individual group sizes differed, a harmonic mean sample of 36.2 was used for computation.

$H_02$: There is no statistically significant difference in the Block 1 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

The analysis of Block 1 test scores showed a statistically significant difference between the groups using the mobile devices as a supplemental study aid and the control group: $F(3, 141) = 13.56, p < .05$. Since the $p$ value is less than .05, the null hypothesis is rejected. The
effect size, calculated using $\mu^2$, was .22. Cohen (1988) classifies .14 as a large effect. This analysis is shown in Table 7.

Table 7  
*Comparison of Block 1 Scores*

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>$F$</th>
<th>Sig.</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2788.04</td>
<td>3</td>
<td>929.35</td>
<td>13.56</td>
<td>.000</td>
<td>.22</td>
</tr>
<tr>
<td>Within Groups</td>
<td>9666.09</td>
<td>141</td>
<td>68.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>12454.14</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Having determined that there was a significant statistical difference somewhere between the groups, a post hoc comparison using the Tukey HSD test was made to determine where the difference was. Table 8 shows the post hoc comparisons between Block 1 test scores of the four groups.

Table 8  
*Block 1 Post Hoc Comparisons*

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference (I-J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>37</td>
<td>85.27</td>
<td>9.13</td>
<td>10.41 *</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>.01</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>.56</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>35</td>
<td>74.86</td>
<td>.85</td>
<td>-10.41 *</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-9.86 *</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>38</td>
<td>85.26</td>
<td>9.79</td>
<td>.55</td>
</tr>
</tbody>
</table>

*Note. The group sizes are unequal; the harmonic mean sample size 36.2 is used.  
* The mean difference is significant at the .05 level.*

The scores of Group 1 were compared with Groups 2, 3, and 4; scores of Group 2 were compared to Groups 1, 3, and 4, and so on. Column 1 of the table, labeled (I) Group, shows each of the four groups and column 2 of the table, labeled (J) Group, shows the groups to which the (I) Group is compared. Column 6 shows the difference between the means of the two
comparison groups. An asterisk beside the mean difference indicates that the two groups being compared are significantly different from each other at the \( p < .05 \) level. Post hoc comparisons on Block 1 scores indicated that the mean score for Group 1 \((M = 85.27, SD = 9.13)\) was significantly different from Group 2 \((M = 74.86, SD = .85)\) but was not significantly different from Groups 3 or 4. Group 2 \((M = 74.86, SD = .85)\) was significantly different from Group 3 \((M = 85.26, SD = 9.79)\) and Group 4 \((M = 84.71, SD = 9.54)\). There was no significant difference between Groups 3 and 4.

\[ H_{03} : \text{There is no statistically significant difference in the Block 2 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.} \]

The analysis of Block 2 test scores showed a statistically significant difference between the groups using the mobile devices as a supplemental study aid and the control group: \( F(3, 141) = 34.04, p < .05 \). Since the \( p \) value is less than .05, the null hypothesis is rejected. The effect size, calculated using \( \mu^2 \), was .42. Cohen (1988) classifies .14 as a large effect. This analysis is shown in Table 9.

### Table 9

**Comparison of Block 2 Scores**

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>( F )</th>
<th>Sig.</th>
<th>( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>7299.44</td>
<td>3</td>
<td>2433.15</td>
<td>34.04</td>
<td>0.000</td>
<td>.42</td>
</tr>
<tr>
<td>Within Groups</td>
<td>10077.12</td>
<td>141</td>
<td>71.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17376.55</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post hoc comparisons on Block 2 scores using the Tukey HSD test indicated that the mean score for Group 1 \((M = 86.89, SD = 10.37)\) was significantly different from Group 2 \((M = 70.71, SD = 4.23)\) but did not significantly differ from Groups 3 or 4. Group 2 \((M = 70.71, SD = 4.23)\) was also significantly different from Group 3 \((M = 86.58, SD = 9.52)\) and Group 4 \((M = 86.58, SD = 9.52)\).
88.29, $SD = 8.13$). There was no significant difference between Groups 3 and 4. Table 10 shows the post hoc comparisons among the four groups.

Table 10

*Block 2 Post Hoc Comparisons*

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>n</th>
<th>Mean</th>
<th>$SD$</th>
<th>Mean difference (I-J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>37</td>
<td>86.89</td>
<td>10.37</td>
<td>16.18 $^*$</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>.31</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-1.39</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>35</td>
<td>70.71</td>
<td>4.23</td>
<td>-15.87 $^*$</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-17.57 $^*$</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>38</td>
<td>86.58</td>
<td>9.523</td>
<td>-1.71</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>35</td>
<td>88.29</td>
<td>8.130</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* The group sizes are unequal; the harmonic mean sample size 36.2 is used.

* The mean difference is significant at the .05 level.

$H_0$: There is no statistically significant difference in the Block 3 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

The analysis of Block 3 test scores showed a statistically significant difference between the groups using the mobile devices as a supplemental study aid and the control group: $F (3, 141) = 6.79, p < .05$. Since the $p$ value is less than .05, the null hypothesis is rejected. The effect size, calculated using $\mu^2$, was .13. Cohen (1988) classifies .14 as a large effect. This analysis is shown in Table 11.

Table 11

*Comparison of Block 3 Scores*

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>$F$</th>
<th>Sig.</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1447.63</td>
<td>3</td>
<td>482.54</td>
<td>6.79</td>
<td>0.000</td>
<td>.13</td>
</tr>
<tr>
<td>Within Groups</td>
<td>10027.55</td>
<td>141</td>
<td>71.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11475.17</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Post hoc comparisons on Block 3 scores using the Tukey HSD test indicated that the mean score for Group 1 \((M = 87.43, SD = 7.32)\) was significantly different from Group 2 \((M = 80.57, SD = 3.38)\) but did not significantly differ from Groups 3 or 4. Group 2 \((M = 80.57, SD = 3.38)\) was also significantly different from Group 3 \((M = 88.95, SD = 9.94)\) but did not significantly differ from Group 4. There was no significant difference between Groups 3 and 4. Table 12 shows the post hoc comparisons among the four groups.

Table 12

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference (I-J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>37</td>
<td>87.43</td>
<td>7.32</td>
<td>6.86 *</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>-1.52</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>2.43</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>35</td>
<td>80.57</td>
<td>3.38</td>
<td>-8.38 *</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-4.43</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>38</td>
<td>88.95</td>
<td>9.94</td>
<td>3.95</td>
</tr>
</tbody>
</table>

Note. The group sizes are unequal; the harmonic mean sample size 36.2 is used. * The mean difference is significant at the .05 level.

H05: There is no statistically significant difference in the Block 4 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

The analysis of Block 4 test scores showed a statistically significant difference between the groups using the mobile devices as a supplemental study aid and the control group: \(F (3, 141) = 32.34, p < .05\). Since the \(p\) value is less than .05, the null hypothesis is rejected. The effect size, calculated using \(\mu^2\), was .41. Cohen (1988) classifies .14 as a large effect. This analysis is shown in Table 13.
Table 13

**Comparison of Block 4 Scores**

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig.</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>5635.55</td>
<td>3</td>
<td>1878.52</td>
<td>32.34</td>
<td>0.000</td>
<td>.41</td>
</tr>
<tr>
<td>Within Groups</td>
<td>8191.00</td>
<td>141</td>
<td>58.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13826.55</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post hoc comparisons on Block 4 scores using the Tukey HSD test indicated that the mean score for Group 1 ($M = 84.86$, $SD = 8.7$) was significantly different from Group 2 ($M = 70.57$, $SD = 3.38$) but did not significantly differ from Groups 3 or 4. Group 2 ($M = 70.57$, $SD = 3.38$) was also significantly different from Group 3 ($M = 86.71$, $SD = 7.29$) and Group 4 ($M = 82.14$, $SD = 9.57$). There was no significant difference between Groups 3 and 4. Table 14 shows the post hoc comparisons among the four groups.

Table 14

**Block 4 Post Hoc Comparisons**

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference (I-J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>37</td>
<td>84.86</td>
<td>8.70</td>
<td>14.29 *</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>-1.85</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>2.72</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>35</td>
<td>70.57</td>
<td>3.38</td>
<td>-16.13 *</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-11.57 *</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>38</td>
<td>86.71</td>
<td>7.29</td>
<td>4.57</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>35</td>
<td>82.14</td>
<td>9.57</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The group sizes are unequal; the harmonic mean sample size 36.2 is used. *The mean difference is significant at the .05 level.

$H_{06}$: There is no statistically significant difference in the Block 5 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

The analysis of Block 5 test scores showed a statistically significant difference between the groups using the mobile devices as a supplemental study aid and the control group: $F (3,$
\[ 141) = 41.86, p < .05. \] Since the \( p \) value is less than .05, the null hypothesis is rejected. The effect size, calculated using \( \mu^2 \), was .47. Cohen (1988) classifies .14 as a large effect. This analysis is shown in Table 15.

Table 15

*Comparison of Block 5 Scores*

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>( F )</th>
<th>Sig.</th>
<th>( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>8273.70</td>
<td>3</td>
<td>2757.90</td>
<td>41.86</td>
<td>0.000</td>
<td>.47</td>
</tr>
<tr>
<td>Within Groups</td>
<td>9290.10</td>
<td>141</td>
<td>65.89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17563.79</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post hoc comparisons on Block 5 scores using the Tukey HSD test indicated that the mean score for Group 1 (\( M = 84.86, SD = 10.64 \)) was significantly different from Group 2 (\( M = 70.86, SD = 5.07 \)) and Group 3 (\( M = 90.13, SD = 7.56 \)) but did not significantly differ from Group 4. Group 2 (\( M = 70.86, SD = 5.07 \)) was significantly different from Group 3 (\( M = 90.13, SD = 7.56 \)) and Group 4 (\( M = 88.71, SD = 8.08 \)). There was no significant difference between Groups 3 and 4. Table 16 shows the post hoc comparisons among the four groups.

Table 16

*Block 5 Post Hoc Comparisons*

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>( n )</th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference (I-J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>37</td>
<td>84.86</td>
<td>10.64</td>
<td>14.01 *</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>-5.27 *</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-3.85</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>35</td>
<td>70.86</td>
<td>5.07</td>
<td>-19.27 *</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-17.86 *</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>38</td>
<td>90.13</td>
<td>7.58</td>
<td>1.42</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>35</td>
<td>88.71</td>
<td>8.08</td>
<td></td>
</tr>
</tbody>
</table>

*Note. The group sizes are unequal; the harmonic mean sample size 36.2 is used. * The mean difference is significant at the .05 level.
H₀7: There is no statistically significant difference in the Block 6 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

The analysis of Block 6 test scores showed a statistically significant difference between the groups using the mobile devices as a supplemental study aid and the control group: \( F(3, 141) = 8.98, p < .05 \). Since the \( p \) value is less than .05, the null hypothesis is rejected. The effect size, calculated using \( \mu^2 \), was .16. Cohen (Cohen, 1988) classifies .14 as a large effect. This analysis is shown in Table 17.

Table 17

*Comparison of Block 6 Scores*

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>( F )</th>
<th>Sig.</th>
<th>( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2141.72</td>
<td>3</td>
<td>713.91</td>
<td>8.98</td>
<td>0.000</td>
<td>.16</td>
</tr>
<tr>
<td>Within Groups</td>
<td>11209.32</td>
<td>141</td>
<td>79.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13351.03</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post hoc comparisons on Block 6 scores using the Tukey HSD test indicated that the mean score for Group 1 (\( M = 86.62, SD = 9.43 \)) was significantly different from Group 2 (\( M = 80.00, SD = .00 \)) but did not significantly differ from Groups 3 or 4. Group 2 (\( M = 80.00, SD = .00 \)) was significantly different from Group 3 (\( M = 90.53, SD = 9.57 \)) and Group 4 (\( M = 87.71, SD = 11.65 \)). There was no significant difference between Groups 3 and 4. Table 18 shows the post hoc comparisons among the four groups.

Table 18

*Block 6 Post Hoc Comparisons*

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>( n )</th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference (I-J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>37</td>
<td>86.62</td>
<td>9.43</td>
<td>6.62 *</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>-3.91</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-1.09</td>
</tr>
</tbody>
</table>

* (table continues)
Table 18 (continued).

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference (I-J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
<td>35</td>
<td>80.00</td>
<td>.00</td>
<td>-10.53 *</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-7.71 *</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>38</td>
<td>90.53</td>
<td>9.57</td>
<td>2.81</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>87.71</td>
<td>11.65</td>
<td></td>
</tr>
</tbody>
</table>

Note. The group sizes are unequal; the harmonic mean sample size 36.2 is used.
* The mean difference is significant at the .05 level.

\(H_0:8\): There is no statistically significant difference in the Block 7 test mean scores between the groups using mobile devices as a supplemental study aid and the control group.

The analysis of Block 7 test scores showed no statistically significant difference between the groups using the mobile devices as a supplemental study aid and the control group: \(F(3, 141) = .70, p = .56\). Since the \(p\) value is greater than .05, the analysis failed to reject the null hypothesis. The effect size, calculated using \(\mu^2\), was .01. Cohen (Cohen, 1988) classifies .01 as a small effect. This analysis is shown in Table 19.

Table 19

Comparison of Block 7 Scores

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>(F)</th>
<th>Sig.</th>
<th>(\eta^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 7 Between Groups</td>
<td>158.14</td>
<td>3</td>
<td>52.72</td>
<td>0.70</td>
<td>0.556</td>
<td>.01</td>
</tr>
<tr>
<td>Within Groups</td>
<td>10675.65</td>
<td>141</td>
<td>75.71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10833.79</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post hoc comparisons on Block 7 scores using the Tukey HSD test indicated that the mean score for Group 1 was not significantly different from Groups 2, 3 or 4. Group 2 was not significantly different from Groups 3 or 4. There was no significant difference between Groups 3 and 4. Table 20 shows the post hoc comparisons among the four groups.
Table 20

Block 7 Post Hoc Comparisons

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference (I-J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>37</td>
<td>86.49</td>
<td>8.57</td>
<td>1.49</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>-1.94</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-0.09</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>35</td>
<td>85.57</td>
<td>8.89</td>
<td>-3.42</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>-1.57</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>38</td>
<td>88.42</td>
<td>9.24</td>
<td>1.85</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td></td>
<td>86.57</td>
<td>8.02</td>
<td></td>
</tr>
</tbody>
</table>

*Note. The group sizes are unequal; the harmonic mean sample size 36.2 is used.
* The mean difference is significant at the .05 level.

Summary of Hypotheses

The comparison of the block test scores of the control group (Group 4) and the baseline group revealed that there was no statistically significant difference in the scores (H01), which indicated that the scores for the control group for the study were representative of the scores of students attending the course for 6 months prior to the study. The analysis failed to reject the null hypothesis. In the analysis of H02 through H07, the ANOVA revealed a statistically significant difference ($p < .05$) in the block test mean scores between the groups using mobile devices as a supplemental study aid and the control group in blocks 1 – 6. Not only was there a significant difference, the effect size in every block was large, ranging from .13 to .47. Therefore, for H02 through H07, the null hypothesis is rejected. The analysis of H08 revealed that there was not a significant difference in block test mean scores in Block 7 between groups using the mobile devices and the control group, which analysis failed to reject the null hypothesis. There was no apparent reason for the difference for Block 7 other than the fact that, of the three blocks in the study with performance objectives, Block 7 consists of more
hours of performance objectives than Blocks 5 and 6. On the post-use surveys, students in the iPod and smartphone groups indicated that by the end of Block 7 they were using the devices less than 1 hour per day outside of class; students in the netbook group were using the device up to 2 hours a day.

Discussion

The primary purpose of this study was to compare three mobile devices to determine which device leveraged the best results and was most compatible with military technical training requirements. Prior to the study, a baseline was established by downloading block test scores for students who attended the AGE Apprentice course during the 6 months prior to the beginning of the study. When the baseline scores \((n = 253)\) were compared to the scores of the control group \((n = 35)\) (see Null Hypothesis 1), the \(t\) test showed that there was no significant statistical difference between the baseline group’s block test scores and the control group’s scores, except for Block 4. There was no apparent reason for the difference in significance between Block 4 and the other blocks. However, Block 4 is a continuation of Electronic Fundamentals, which was first introduced in Block 3. Block 4 is also the longest block of the seven blocks (56 hours as compared to 28 – 45 hours for the other blocks). Therefore, except for Block 4, the control group was representative of all students attending the AGE Apprentice Course.

In a block-by-block analysis of scores, the mean scores remained stable for Group 1 (iPod), Group 3 (netbook), and the control group from block to block. The only statistically significant difference in scores was between the mean scores for Group 2 (smartphone) and the other groups. This finding supports the position of Cuban (2003), who believes that gains in
achievement are more likely to emerge from innovative teaching, to include individualized and
problem-based instruction, than from the deployment of laptop computers (Cuban, 2006a,
2006b). Figure 1 shows the mean scores by block for each device group. The following
paragraphs discuss differences between the groups.

\[\text{Figure 1. Means of scores by block/group.}\]

\textbf{Group 1 – iPod}

Although there were no significant statistical differences between the scores for the
students of Group 1 and the other groups, in Block 1 the mean scores for Group 1 were higher
than for Groups 2, 3, and 4. In Block 2, the mean scores for Group 1 were higher than for
Groups 2 and 3, but were lower than Group 4. In Block 3, the mean scores for Group 1 were
higher than Groups 2 and 4, but were lower than for Group 3. In Block 4, the mean scores for
Group 1 were higher than for Groups 2 and 4, but lower than Group 3. In Block 5, the mean
scores for Group 1 were higher than for Groups 2 and 4, but lower than Groups 3 and 4. In Block
6, the mean scores for Group 1 were higher than for Groups 2 and 3, but lower than Group 4. In Block
7, the mean scores for Group 1 were higher than for Group 2, but lower than Groups 3 and 4.
Since the iPod was issued to the first two classes, it was 2 weeks before the next device (smartphone) was issued. The students were excited to have a mobile device they could use as a study aid. This may have explained the higher scores for Block 1. The top five applications students used on the iPod were PowerPoint, the calculator, FileAid, Note Pad, and the videos. The students most liked the mobility of the device, the touch screen, and having courseware available at any time. They felt the PowerPoint presentations were beneficial, but at the same time, several students commented that they would have liked additional PowerPoint presentations to better explain the course material. Other negative comments about the iPod were that it was too small, could not run multiple applications, and had limited note-taking or editing capability. The students would have liked the availability of additional study materials and podcasts of lectures. On the mid-term survey, 83% of the students using the iPod reported using the device 1-2 hours outside of class; 11% reported using the device 2-3 hours outside of class. By the end of Block 7, the usage outside of class had dropped to less than 1 hour or less for 64% of the group. The difference in usage between the three devices is shown in Figures 2 and 3.

![Mid-Term](image1.png) ![Post-Use](image2.png)

*Figure 2. Device use in class.*
Figure 3. Device use outside of class.

Group 2 – Smartphone

The group that showed the greatest statistical difference in mean scores between the groups was Group 2 (smartphone). The block test scores for Group 2 were consistently lower than the block test scores for all other groups in all blocks. In Block 1 (Null Hypothesis 2), the mean score for Group 2 was 10.41 lower than Group 1 (iPod), 10.4 lower than Group 3 (netbook), and 9.86 lower than Group 4 (control). In Block 2 (Null Hypothesis 3), the mean score for Group 2 was 16.18 lower than Group 1; 15.87 lower than Group 3; and 17.57 lower than Group 4. In Block 3 (Null Hypothesis 4), the mean score for Group 2 was 6.86 lower than Group 1 and 8.38 lower than Group 4. In Block 4 (Null Hypothesis 5), the mean score for Group 2 was 14.29 lower than Group 1; 16.13 lower than Group 3; and 11.57 lower than Group 4. In Block 5 (Null Hypothesis 6), the mean score for Group 2 was 14.01 lower than Group 1; 19.27 lower than Group 3; and 17.86 lower than Group 4. The mean score for Group 1 was 5.27 lower than Group 3 and 3.85 lower than Group 4. In Block 6 (Null Hypothesis 7), the mean score for Group 2 was 6.62 lower than Group 1; 10.53 lower than Group 3; and 7.71 lower than
Group 4. In block 7 (Null Hypothesis 8) there was no significant statistical difference between any group. However, the mean score for Group 2 was lower than all other groups.

The top four applications used on the smartphone were PowerPoint, games, Flash videos, and the camera. Some students used the camera application to videotape lectures for review later. The students using the smartphones most liked having courseware available at all times and the PowerPoint presentations, although they would have liked having additional PowerPoint presentations to enhance learning. Another positive aspect was the mobility of the device. On the other hand, negative factors of the smartphone were the small screen size, limited battery life, and no Internet capability. On the mid-term survey, 78% of the students reported using the smartphones outside of class 1-2 hours, and 17% used the smartphone 2-3 hours. By the end of Block 7, 65% of the group was using the device less than an hour outside of class.

Researchers at the University of Birmingham, UK, found similar problems in a 2002-2003 study. Although the participants approved of the portability of the small-sized device, they were at the same time dissatisfied with the small size of the screen (Naismith, Lonsdale, Vavoula, & Sharples, 2004).

**Group 3 – Netbook**

Although there was no statistically significant difference between the mean scores for Group 3 and the mean scores of the other groups, the mean scores for Group 3 were higher than any other group in Blocks 3, 4, 5, and 7. The netbook also showed the most usage in class. On the mid-term survey, 23% of the class reported using the netbook in class more than 5 hours a day, as compared to 3% of the iPod usage in class and no student using the smartphone
in class for 5 hours or more. Outside of class, 51% of the students reported using the netbook 1-2 hours a day, and 37% reported using the netbook 2-3 hours a day. On the post-use survey, 21% of the students were using the netbook 1-2 hours a day, and 26% were using the netbook more than 5 hours a day. Outside of class, 40% of the students were still using the netbook up to 2 hours a day.

The students in Group 3 took advantage of the Microsoft Office applications Microsoft Word and PowerPoint. They also used the calculator, especially in Block 3, Electronic Principles, and Adobe Reader. The top four positive factors of the netbook as rated by the students were the ease of taking notes, PowerPoint presentations, mobility of the device, and its size/weight. The number one negative factor of the netbook was that there was no hard case. Students also rated the limited or no Internet access as a negative factor.

**Student Satisfaction Rates**

Students on the mid-term and post-use surveys were asked to rate their satisfaction with the technical and academic usefulness of the device on a scale of 1 to 5 with 1 being *not at all satisfied* and 5 being *extremely satisfied*. The satisfaction rates of the students using the iPod and the smartphone were similar. On the mid-term survey, 22.2% of the iPod users and 28.6% of smartphone users were not at all satisfied with the technical usefulness of the device, while 8.6% of the iPod users and 5.6% of the smartphone users rated technical usefulness as extremely satisfied. For the netbook users, none rated technical usefulness as not at all satisfied while 25.7% were extremely satisfied with the device. On the post-use survey, 40.5% of the iPod users and 26.5% of the smartphone users were not at all satisfied with the technical usefulness of the device, whereas 2.7% of the iPod users and 5.9% of the smartphone users
rated technical usefulness as extremely satisfied. These results are shown in Figure 4.

**Figure 4.** Technical usefulness satisfaction rate.

Academic satisfaction rates followed the same pattern. On the mid-term survey, 40% of the iPod users and 30.6% of smartphone users were not at all satisfied with the academic usefulness of the device, whereas 2.9% of the iPod users and none of the smartphone users were extremely satisfied. For the netbook users, none rated academic usefulness as not at all satisfied whereas 28.6% were extremely satisfied with the device. On the post-use survey, 40.5% of the iPod users and 32.4% of the smartphone users were not at all satisfied with the
device, whereas 2.7% of the iPod users and 5.9% of the smartphone users were extremely satisfied. For the netbook users, 2.6% rated academic usefulness as not at all satisfied and 21.1% of the iPod users were extremely satisfied with the device. These satisfaction rates are shown in Figure 5.

![Academic Usefulness Mid-Term](image1)

![Academic Usefulness Post-Use](image2)

**Figure 5.** Academic usefulness satisfaction rate.

A one-way ANOVA was done to determine differences in satisfaction with the technical and academic usefulness between the groups using the iPod, smartphone, and netbook on the
mid-term and post-use surveys. Table 21 shows the means and standard deviations for each of
the devices, using 1 as \textit{not at all satisfied} and 5 as \textit{extremely satisfied}.

Table 21

\textbf{Satisfaction With Usefulness}

\begin{tabular}{llllll}

 & Survey & Device & $n$ & Mean & SD & Mean & SD \\
\hline
 & Mid-Term & I-Pod Touch & 35 & 2.43 & 1.22 & 2.03 & 1.07 \\
 & & Smartphone & 36 & 2.47 & 1.13 & 2.28 & 1.06 \\
 & & Netbook & 35 & 3.63 & 1.06 & 3.69 & 1.05 \\
 & Post-Use & I-Pod Touch & 35 & 2.14 & 1.12 & 2.09 & 1.15 \\
 & & Smartphone & 34 & 2.47 & 1.24 & 2.26 & 1.21 \\
 & & Netbook & 37 & 3.73 & 0.96 & 3.78 & 0.98 \\
\end{tabular}

The netbook users rated their overall satisfaction higher than the iPod and smartphone
users. Overall satisfaction rates for netbook users ranged from a rating of 3\% for \textit{not at all}
satisfied to 29\% being \textit{extremely satisfied}. The overall satisfaction rate of the iPod and
smartphone users ranged from 35 – 41\% \textit{not at all satisfied} to 3 to 6\% \textit{extremely satisfied},
respectively. Table 22 shows the means and standard deviations for each of the devices, using
1 as \textit{not at all satisfied} and 5 as \textit{extremely satisfied}. Overall satisfaction rates are shown in
Figure 5.

Table 22

\textbf{Overall Satisfaction-Post Use}

\begin{tabular}{llll}

 & Device & $n$ & Mean & SD \\
\hline
 & I-Pod Touch & 35 & 2.11 & 1.16 \\
 & Smartphone & 36 & 2.38 & 1.28 \\
 & Netbook & 35 & 3.68 & 1.06 \\
\end{tabular}
Implications

The primary purpose of this study was to compare three mobile devices to determine which device leveraged the best results and was most compatible with military technical training requirements. This study showed that the introduction of mobile devices into the classroom failed to result in any overwhelming improvement of test scores, as borne out by previous research (Cuban, 2006a). However, the researcher could make recommendations to HQ AETC based on the analysis of the data. During this study, the device that produced the poorest results was the smartphone. The block test scores for group of students using the smartphone were the lowest of all groups in four out of seven blocks of instruction. The smartphone also received the lowest marks in student satisfaction rates, with 41% of the students being not at all satisfied with both the academic and technical usefulness of the device as well as their overall satisfaction with the device. The overwhelming negative factor cited by a majority of the students was the small screen size. Student comments on the iPod Touch were similar—the screen size of the device was too small, making the electronic schematic diagrams difficult to read. The satisfaction rates for the iPod Touch were the same as for the

---

Figure 6. Overall satisfaction rate.
smartphone. Although students creatively used the iPod Touch and smartphone capabilities—using the video capability of the devices to videotape instructor presentations for review after class, taking advantage of the mobility of the devices to study course materials without having to carry bulky study guides—the groups using these two devices indicated the negative factors of the small screens and limited battery life outweighed the positive factors.

Many proponents of m-learning see value in using smartphone technology because of the proliferation of mobile phones/smartphones in society today. At the same time, they are aware of the disadvantages of the small screen size, poor input methods, and limited battery life. In spite of these disadvantages, the mobile phone can be successfully used for m-learning if the following principles are considered. Because of the screen size, little continuous text should be used; content should be delivered in short “nuggets” instead of large units of information (Cranshaw, M., Parsons, D., & Ryu, H., 2007). Other kinds of media are recommended, including images, videos, and audio text. Holzinger, Nischelwitzer, and Meisenberger (2005) present an approach they call “mobile interactive learning objects” (MILOs). To achieve maximum results, the learning content of MILOs should be constructed in small and homogeneous information chunks to enable the user to stop the learning process abruptly and continue later.

The netbook fared much better than the other two devices. Although there was no statistical significance in block test scores between the group using the netbook and the other groups, the scores of students using the netbook were higher in four out of seven blocks than the groups using the iPod Touch and the smartphone, as well as the control group. During the study, the researcher observed classes in session. Students who had been issued the iPod and
the smartphone tended to use the devices only sporadically in class, but the students with the
netbooks without fail were actively using the device to take notes and follow along with the
instructor’s PowerPoint presentation. The netbook group found the device more user-friendly
and was able to use more applications for study than students in the other device groups. In
addition, the satisfaction rate with academic and technical usefulness and for overall
satisfaction for the netbook was higher than for any other device. When all factors were
considered, the netbook was deemed to leverage the best results and to be the most
compatible with military technical training requirements.

If this study were generalized to other populations, the results could prove to be
entirely different, depending on who performed the study, the population involved, and how
the devices were used. This study was accomplished in a military technical training
environment, with an emphasis on aircraft maintenance. This would most closely compare
with a vocational training center that concentrates on some type of maintenance training—for
example, automotive maintenance. If the study were replicated in a vocational training center
or another AETC training center without using all the capabilities of the devices, it is anticipated
that the results would prove to be the same. But the limitations encountered in our
environment, including existing regulations concerning Department of Defense computer
networks and the inability to use the devices to their full capabilities, would not be a factor in
the civilian sector. The ability to add wi-fi and/or Internet capability to the devices would
undoubtedly change the results of the study.

Recommendations for Future Studies

AETC (2008a) leadership recognizes the importance of precision learning, defined as
delivering the “appropriate education, training, or experience at the right time and format, to generate the right effect” (p. 13). One way to accomplish this goal is by utilizing mobile learning. Other branches of the military, especially the Army and U.S. Coast Guard, are already delivering learning modules using mobile devices (Kallmeyer, 2008; Lopez, C. T., 2009; Northrup, & Harrison, W., n.d.). It is imperative that the U.S. Air Force continue to research the best methods of delivering the right training at the right time in the most effective way possible.

As we consider recommendations for future studies, we should take a cue from Prensky (2005) and “listen to the natives.” In his article by the same name, Prensky states,

As educators, we must take our cues from our students' 21st century innovations and behaviors, abandoning, in many cases, our own pre-digital instincts and comfort zones. Teachers must practice putting engagement before content when teaching. They need to laugh at their own digital immigrant accents, pay attention to how their students learn, and value and honor what their students know. They must remember that they are teaching in the 21st century. (p. 2).

The focus of this study was to compare the delivery and use of mobile training devices in the military technical training classroom. Future studies should incorporate content delivery on the devices. Students in all device groups stated they liked using the PowerPoint presentations that were loaded on the devices for review and study, but expressed a desire for more information on the PowerPoint presentations, interactive study materials, and more information to facilitate study. Some students admitted that they enjoyed playing games on the devices, using them to relieve boredom. Instructors use Jeopardy-type games in class for
reviewing course materials. Similar games could be developed for use on mobile devices.

Prensky (2001b) advocated digital game-based learning in 2001, citing the military's use of videogame-like simulators. The researcher recommends that training materials be developed that are device-agnostic, student-focused, self-paced, interactive peer-to-peer course-related gaming, audio and video recording with playback capability, simulations, and other emerging applications that can be delivered on mobile devices.

A recurring suggestion for improvement from students using the netbook was a ruggedized or hard case. Students carried the mobile devices to and from class in their duffel bags which also contained physical training gear; this made the netbook subject to damage. For future studies, any netbook selected should have a ruggedized case.

One of the most common requests from the students was to be able to access the Internet on the devices. The on-base computer network restrictions did not allow any device to be connected to the Internet, and wireless service is available only in limited areas on the base. Students wanted the ability to use the Internet for additional research and the capability to collaborate with other students via an instant messaging/chat application or Skype. The 82 TRW Training Operations office should continue to explore options for wireless infrastructure and establish servers or repositories where course materials can be maintained via CAC-enabled devices. Now that social networking opportunities are available on base, students should be encouraged to take advantage of these opportunities for group study, interactive chat sessions, and collaboration. According to Parsons et al. (2007), collaboration between two individuals or groups is an important aspect of mobile learning. Naismith et al. (2004) maintained that the “most successful learning comes when the learner is in control of
the activity, able to test ideas by performing experiments, ask questions, collaborate with other people, seek out new knowledge, and plan new actions” (p. 15).

Several students asked for video capability so they could videotape classroom presentations or take videos of fellow classmates for studying course material after class. There were a number of requests for the ability to download podcasts of course materials. A couple of the students in the smartphone group videotaped the instructor’s lecture, much to the instructor’s surprise. During the study, some instructors expressed reluctance to having a video made of their classroom presentation; however, other instructors had no problem with the idea. The researcher recommends that all classroom presentations be videotaped and made available for download to students who want additional exposure to the lessons. This would also be useful to students who must miss class due to medical or other appointments.

Toward the end of the study, a team from Hq AETC, Randolph AFB, Texas, interviewed students and instructors who had participated in the study. The team interviewed one class of students for each device, asking the same questions of each class. They also interviewed one control group class. Based on these interviews, the device that students showed the most affinity towards was the netbook. The interviewers asked, “If you had the capability to use your own mobile device rather than one issued to you, would you do so?” The answer from the students was a resounding, “Yes!” The majority of the students felt that using mobile devices would help improve their class performance. All students in the control group who were interviewed felt that the netbook would be the device they would choose because of the ability to take notes for reviewing after class. One student stated, “Typing puts the words into my head better.” Mobile devices have the ability to display animations or videos, which are more
stimulating than a printed study guide. At the same time, the students realized that having a mobile device to use as a supplemental study aid is beneficial only if the student uses the device.

Educators and trainers for the U.S. Air Force students should heed the final statement from AETC (2008a):

We must begin now to make those key investments in learning capabilities and processes that will enable tomorrow’s Airmen to effectively deal with any adversary or challenge and preserve in these Airmen their decisive will to win. The faster we commit to achieving this vision, the sooner we can begin to “Develop America’s Airmen Today ... for Tomorrow.” (p. 20).

Reference List


How does learning occur in humans? Why do people learn in different ways? What is the best method to use to train airmen in the U.S. Air Force today? These and other questions have perplexed educators through the years. Some would define learning as merely a change in behavior as a result of experience, while others see learning as something more difficult to measure, which involves changes in the way a student thinks. Many researchers have studied human learning from various perspectives and promoted their theories of how learning takes place. Some of these theories have similarities, some overlap, and some are unique.

Educators generally recognize that people process information in different ways, and psychologists have proposed various learning style models. A study done by a team from the University of Newcastle upon Tyne revealed 71 different learning style theories (Coffield, Moseley, Hall, & Ecclestone, 2004). A group of theorists, sponsored by the National Association of Secondary School Principals, defined “learning styles” as “the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment” (J. Keefe, as cited in Griggs, 1991). Dunn and Dunn (1993) define learning style as the way individuals concentrate on, process, internalize, and remember new and difficult academic information or skills. Factors that may affect learning styles include age, level of achievement, and culture (Stevenson & Dunn, 2001). The Department of the Air Force (2003) states that, although there is disagreement among psychologists as to which is the best learning style theory, most theorists agree that learning is best explained by a combination of two learning theories: behaviorism and cognitive theory. The manual recommends training be developed based on cognitive outcomes, and determine achievement of the outcomes by measuring and
interpreting behavioral (Air Force Manual 36-2236, 2003, p. 25). Historically, the Air Force has
developed training in cognitive, affective, and psychomotor learning skills based on the
cognitive taxonomy by Benjamin Bloom (see Table A.1) and the affective taxonomy by David R.

Table A.1.

*Bloom’s Levels of Knowledge and Understanding*

<table>
<thead>
<tr>
<th>Levels of learning</th>
<th>Mental activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation</td>
<td>Exercise of learned judgment</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Create New Relationships</td>
</tr>
<tr>
<td>Analysis</td>
<td>Determine Relationships</td>
</tr>
<tr>
<td>Application</td>
<td>Use of generalizations in specific instances</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Translate, interpret, and extrapolate</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Recall and recognition</td>
</tr>
</tbody>
</table>


Table A.2.

*Krathwohl’s Levels of Attitude and Values*

<table>
<thead>
<tr>
<th>Levels of learning</th>
<th>State of mind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization</td>
<td>Incorporates value into lifestyle</td>
</tr>
<tr>
<td>Organization</td>
<td>Rearrangement of value system</td>
</tr>
<tr>
<td>Valuing</td>
<td>Acceptance</td>
</tr>
<tr>
<td>Responding</td>
<td>Reacts voluntarily or complies</td>
</tr>
<tr>
<td>Receiving</td>
<td>Willingness to pay attention</td>
</tr>
</tbody>
</table>

Behaviorism

One of the goals of military technical training is to change the behavior of individuals. The process begins with 8 weeks of basic training in which a recruit is transformed from a civilian into a disciplined, military-minded individual. The process continues throughout technical training schools, which continue to mold the behavior of airmen. Air Force Manual 36-2236 (2003) states that “the only acceptable evidence that successful teaching has taken place comes from indications of change in student behavior” (p. 22).

The founder of the movement called behaviorism was John B. Watson, who conducted experiments with animals in maze learning in the early 1900s. Watson’s basic premise was that behaviorism is a stimulus-response psychology, dealing with the reactions of muscles and glands to stimuli. Behaviorism became more popular after World War I and through the 1950s. It was during this period that another noted behaviorist, B. F. Skinner, began researching the effects of reinforcement on behavior. His theory of operant conditioning demonstrates the relationship between behavior and consequences. Simply stated, Skinner said that behaviors that receive positive reinforcement are more likely to be repeated; behaviors that receive negative reinforcement are less likely to be repeated and may eventually become extinct. Skinner introduced “schedules of reinforcement” to study and manipulate behavior (“Behaviorism,” 1999). A basic tenet of behaviorism is that behavior is shaped by external stimuli. In the classroom, the instructor becomes the external stimulus; instructors can modify behaviors through providing rewards (positive reinforcement) or punishment (inhibiting behavior). (Air Force Manual 36-2236, 2003, p. 24). By the mid-1960s, the attention given to
behaviorism began to wane, and cognitive psychology became more popular (“Behaviorism,” 1999).

Cognitive Theory

The two decades from 1950 to 1970 saw the emergence of the cognitive theory. The cognitive revolution began when Noam Chomsky (1967) refuted B. F. Skinner’s arguments on verbal behavior in the 1959 journal *Language*. Chomsky, an American linguist and cognitive scientist, is professor emeritus of linguistics at the Massachusetts Institute of Technology (MIT Dept. of Linguistics, 2010). He is said to have remarked that defining psychology as the science of behavior was like defining physics as the science of meter reading (Miller, 2003). A number of researchers made contributions to cognitive theory. To the cognitive psychologist, learning is more than just a change in behavior; it is a change in how the learner thinks, performs, and feels (*Air Force Manual 36-2236*, 2003). Other noted cognitive theorists include Jean Piaget, known for his stages of cognitive development, and Howard Gardner, noted for his theory of multiple intelligence.

The U. S. Air Force encourages courseware developers to consider a combination of the behavioristic and cognitive theories by planning for cognitive learning but using behavioral evidence to measure the learning. The challenge facing the U.S. Air Force today is how best to train its recruits of today for the needs and missions of tomorrow. With the explosion of technology, skills that are trained today may be obsolete within a few years. These advances in technology will revolutionize the way airmen access and share knowledge. The increased use of smartphones, MP3 players, and other portable devices should allow the Air Force to provide opportunities to gain access to knowledge at the right place and right time. Air Force
leadership is realizing the need to optimize delivery of training content and incorporate the use of new technologies to supplement and, where appropriate, replace “hands-on” learning for today’s recruits (AETC, 2008a).

This generation of recruits is known as, among other terms, “the Net generation,” “net natives,” “digital natives,” and “millennials” (Barzilai-Nahon, Lou, & Mason, 2007). At the same time, many Air Force instructors are from the Baby Boomer generation and Generation-X. “An essential component of facilitating learning is understanding learners” (Oblinger, 2003, p. 37). There is often a gap between students’ use of technology and faculty members’ use of technology. Because of the integration of technology in public schools, students today have expectations of what institutions and faculty should offer (McGee & Dias, 2007). Researchers Levin and Arafeh (2002) present a number of reasons for the learning gap: (a) School administrators, not teachers, set the tone for Internet usage at schools; (b) even in well-connected schools, there is a wide variation in teacher policies about Internet usage in and outside of class; (c) the quality of Internet-based assignments is poor; and (d) some students and teachers have limited computer skills. Another reason for the gap is simply found in the differences between the generations. Following is a summary of the learning differences between the different generations.

Generational Differences in Learners

Baby Boomers

The Baby Boomers, born between 1946 and 1964 (Oblinger & Oblinger, 2005), grew up with the space race, civil rights movement, Viet Nam, and Watergate (Oblinger, 2003). They learn best via formal classroom instruction and printed texts (Wagner, 2009). Their primary
learning style is tactile/kinesthetic, and they prefer hands-on learning activities (Cambiano, De Vore, & Harvey, 2001). Technology for the Baby Boomers included transistor radios, mainframe computers, 33 and 45 rpm records, and touchtone phones. They are optimistic and process-oriented (Oblinger & Oblinger, 2005).

Generation X

Generation X, born between 1965 and 1982, were the first “latch key” generation (Oblinger & Oblinger, 2005). They saw the fall of the Berlin Wall, the explosion of the space shuttle Challenger, and the emergence of the Worldwide Web (Oblinger, 2003). Generation X learners learn best in a structured environment where they know parameters of all lessons and step-by-step sequencing of all assignments (Cambiano, et al. 2001). The prevailing technology for Generation X’ers was hand-held calculators (Kapp, 2009), CDs, personal computers, and electronic mail (Oblinger & Oblinger, 2005).

Millennial Generation (Generation Y)

The Millennials, or Net Generation, were born in 1982 or afterward (Oblinger, 2003). They are the children of the late Baby Boomers and early Generation Xers and are self-reliant and social (Hart, 2008). This generation is very goal- and education-oriented (Barnes, Marateo, & Ferris, 2007) and prefers to learn by doing rather than being told what to do; they are a social generation and learn by working in teams. Statistics from 2005 showed that over 70% of teenagers use instant messaging (IM) for keeping in touch with friends and relatives. Most teenagers say the main reason they use the Internet is to get “new information” (Oblinger & Oblinger, 2005). An important part of the Net Generation lifestyle is multitasking. It is not
uncommon for a Net Gener to use multiple media simultaneously, including video games, music, and phone (Barnes et al., 2007).

In 2001, Marc Prensky coined a term for these individuals who grew up in the digital age, calling them “digital natives.” Prensky stated that students from this generation have grown up surrounded by tools of the digital age to include computers, digital games, video cams, and cell phones. He estimated that by the time they reach college age, they will have spent over 10,000 hours playing video games, sent and received over 200,000 emails and instant messages, and spent over 10,000 hours talking on cell phones (Barzilai-Nahon et al., 2007). He refers to Baby Boomers and individuals from Generation-X as “digital immigrants” (Prensky, 2001a).

E-Learning Initiatives

For a number of years, schools from K-12 and colleges have introduced laptops and other computer technologies into the classroom, with varying results. In 2006, two educational consultants, Hayes Connection and the Greaves Group, conducted a study of 2,500 of the nation’s largest high schools and found that one fourth of the schools had one-on-one computing initiatives, and they expected that half of the schools would have them by 2011. However, the Liverpool Central School District, just outside of Syracuse, New York, has suspended the laptop program due to a number of factors. School officials have stated that the laptops had no impact on learning, scores of computers break down monthly, and students routinely used the computers to cheat on tests, download pornography, and hack into businesses. The cost for repairs also was a factor. Many other school districts have suspended their laptop programs for the same reasons (Hu, 2007).
A similar scenario was noted in the Wichita Falls Independent School District, Wichita Falls, Texas. Casey Hunter, tech insertion manager for WFISD, cited comparable problems during a 5-year period. The school district received a grant for inserting laptops into grades 6-10. Although no definitive research was done during the 5-year period, at the end of the program, the administration saw minor gains in TAKS English scores and large gains in technical expertise of the students. But the initiative ultimately failed because there was not enough time given to adequately train the staff, which led to inequities in usage between classes. In addition, the cost of maintaining the laptops became a burden for the school district. The computers reached the end-of-life stage, and there was no funding to replace the laptops (C. Hunter, personal communication, October 13, 2009).

Mobile Learning Initiatives in Higher Education

The advent of wireless technology and mobile computing has opened up a new arena in the educational world, both in the corporate and academic areas. While several terms have been applied to this learning environment, the most common is mobile learning, or m-learning (Alexander, 2004). M-learning is a juxtaposition of e-learning and mobile computing (Holzinger, Nischelwitzer, & Meisenberger, n.d.) The tools of this environment include cell phones, personal digital assistants (PDAs), laptops, MP3 players, and portable game devices (Corbeil & Valdez-Corbeil, 2007). In their Mobile Learning Update, Brown and Metcalf (2008) cite market research conducted by Ambient Insight, LLC., estimating that “corporate and business expenditures for mobile learning products and services in the US alone will reach over $246.9 million by 2011” (p. 1). The corporate community recognizes the need for just-in-time training and is exploring mobile options. Corporations that are incorporating m-learning into their
training programs include Merrill Lynch, Sun Learning Services, Chrysler, Microsoft, 3Com, and Valero Energy, using BlackBerry, mobile phones and wireless PDA devices, and other mobile devices (Brown & Metcalf, 2008).

A number of universities have implemented mobile learning strategies into their curriculum. Two of these initiatives are discussed here: the use of mobile devices at Duke University, Durham, North Carolina, and Abilene Christian University, Abilene, Texas.

Duke University iPod Initiative

In August 2004, Duke University issued 20GB Apple iPod devices to entering first-year students; at least 628 students in 15 fall courses and over 600 students in 33 spring courses incorporated iPod use. The Center for Instructional Technology (CIT) obtained an additional 150 iPods to support faculty and non-first-year students enrolled in supported courses. The iPod devices were used to disseminate course content via the Duke iPod server and iTunes Music Store, to record academic lectures, to capture field notes, to use as a study support tool, and use for file storage and transfer. The device was especially suited for languages, music, and other courses with listening comprehension or performance-based components, using the iPod’s “playlist” feature. Some of the challenges and barriers included the lack of ability to purchase bulk licenses of commercial .mp3 content for academic use, inherent limitations of the device, and limited preexisting documentation and training resources (Belanger, 2005).

In 2006 the distribution process was modified by the fact that students were encouraged to purchase their own iPod for a subsidized price through the Duke computer store. By Fall 2007, a total of 105 courses (1,450 total students) incorporated iPod use, compared to Spring 2006, when 1,424 students from 72 courses used the devices. Some of the
barriers with using iPods noted by faculty included technical problems with individual devices or integration, inadequate student skills/training, constraints on faculty time, and issues with copyrighted material. The CIT report for Fall 2006 noted an increased consumption of podcasts and use of iPods to watch video clips (Belanger, 2007). In addition to iPods, tablet PCs were added in 2006 and Flip video cameras and Web cameras were added in 2008. Faculty feedback on the iPod, Flip phones, and tablet programs was consistently positive (Belanger, 2008).

Although faculty and student feedback on the Duke initiative is mostly positive, research on the impact on learning is sparse.

**Abilene Christian University iPod/iPhone Initiative**

In Fall 2008, Abilene Christian University (ACU) became the first university to distribute both Apple iPhones and iPod touches to the entire incoming freshman class. ACU distributed 957 devices to incoming freshmen, 169 to faculty and 182 to staff. The freshmen were allowed to choose either the iPod or iPhone or none. All incoming students accepted one or the other, with about 36% choosing the iPod over the iPhone. The philosophy behind issuing the devices was simple: The device became the students’ own, and their use as social and entertainment devices was unrestricted (Terpstra, 2009). The students used the iPods and iPhones to receive homework alerts, answer surveys and quizzes in class, get campus directions, and check on account balances through the ACU Mobile portal (ACU Mobile Learning, n.d.). In the 6 months preceding the kickoff of the iPod project, ACU faculty and technology staff researched opportunities for using handheld devices in higher education, focusing on over 30 projects that explored mobile learning strategies to improve the campus environment (“ACU First University,” 2008).
After the first year of iPod/iPhone use, results were mixed. In the 2008-2009 *ACU Mobile-Learning Report*, Scott Perkins, Professor of Psychology and Director of Research, stated that data from student and faculty surveys show that faculty and student satisfaction with the program is high. He also indicated that iPhones outperformed iPods because the students were more likely to carry the iPhones into the classroom and reported higher utilization and satisfaction rates on the surveys. Cynthia Powell, a chemistry professor at ACU, substituted podcasts for a class of incoming freshmen instead of the traditionally taught sessions. A comparison of the grades between students who used mobile devices and students in traditional settings showed a slight advantage for students using iPod/iTouch; however, the results were not statistically significant (*ACU Mobile-Learning Report*, n.d.). Lt Col. Denhard, Peter Joffe, and Marlon Gardley from AETC SAS attended the ACU conference on mobile learning in February 2009. They reported that at the conference, Scott Perkins, Director of Research at ACU, stated that ACU does not have any statistical comparisons of course grades comparing ACU freshmen who used iPods to those who did not. However, based on the popularity of the devices, the high satisfaction rate with the devices, ACU plans to expand its program.

**Mobile-Learning Initiatives in the Military and Government Sectors**

The U. S. Army is targeting tech-savvy young soldiers by offering them mobile devices that fit in their pockets to help them keep in touch and access the Army Knowledge Online (AKO) Portal, which is a part of a broader service, Defense Knowledge Online (DKO). In October 2009, the Army approved an initial set of smartphones to access the AKO for online information, distance learning, and e-mail for 2.6 million Army users. In addition to
smartphones, the Army’s Go Mobile devices include video goggles, a battery-powered pocket projector that allows users to project presentations on any surface, a thermal printer, and a mini solar charger (Walsh, 2009). Using the Go Mobile system will enable soldiers to access the Internet and authenticate to the AKO/DKO via the smartphone’s cellular data services wherever they can find a signal. The entire system can easily fit into the soldier’s backpack (C. T. Lopez, 2009).

One of the largest continuing education programs worldwide is the Department of Defense’s off-duty, voluntary education program, which enrolls approximately 300,000 service members in postsecondary courses. These courses result in the award of associate, bachelors, masters, and doctorate degrees. Tuition for college courses is significantly reduced by tuition assistance (Department of Defense, 2003). Completing an educational program is often difficult for military members faced with permanent change of station (PCS) moves, temporary duty (TDY) assignments, or deployments. To help meet the need, a partnership between the University of West Florida and the U.S. Coast Guard Institute and two community colleges, Florida Community College at Jacksonville, Florida, and Coastline Community College in Fountain Valley, California, developed and tested college-level courses delivered via a personal digital assistant (PDA). The community courses offered general education courses, and the UWF offered graduate-level courses (Northrup & Harrison, n.d.). The test began in 2006 but was discontinued in 2009 because the approximately 40 students who had used the PDAs found the screens too small to comfortably use screens. A similar initiative was offered to Navy SEALs on Navy-supplied PDAs by Saint Leo University in Florida in Fall 2008, but the SEALs found the presentation “too dry” and preferred viewing materials on a larger screen. A PDA program
from Coastline Community College in Southern California has fared somewhat better, delivering 10 courses containing an average of 13 hours of video each, on SD cards for use in PDAs. The target audience is Special Operations Forces (SOF) personnel who are unable to attend on-campus courses (Bollag, 2010).

The Environmental Protection Agency has modified its Web site, tailored to load easily on mobile phones and other devices. The goal is to offer the public life-saving content, such as environmental alerts or storm warnings from the National Weather Service. Technicians at EPA develop their news releases using HTML codes that are compatible with a wide range of devices, from high-end 3G phones to modest handhelds that run on slower cellular networks. The EPA Web manager solicited inputs from outside users and staff members to determine what content would be used on the mobile site. Viewers can both find agency contact information and use that information to report environmental emergencies. The EPA has created a mobile version of their UV Index to allow visitors to verify the risk level of being exposed to damaging ultraviolet rays in a particular area (Joch, 2009).

Summary

There are numerous theories and models of learning; although each theorist thinks his or her model is the best, many educational psychologists are critical of the dearth of evidence on how effective the models are. The U. S. Air Force recognizes the contributions of both behaviorists and cognitive psychologists; technical training courseware is written to the cognitive level but often measured in behavioral terms. The challenge facing educators today, both in public schools and in the military technical training environment, is how best to train the Millennial generation, especially when instructors are Baby Boomers or Generation X’ers.
The literature review discusses a couple of recent e-learning initiatives in the public schools, then explores m-learning initiatives at two major universities—Duke University and Abilene Christian University. The literature review concludes with a brief discussion of the use of mobile devices in the military and government sectors. While using mobile devices is attractive and popular, there are many obstacles to overcome—challenges with device screen size, bandwidth, and how best to format the learning activities used on the devices.
APPENDIX B

SURVEYS
### Pre-Use Survey for Instructors

1. **What is your PDSCLASS number?**

2. **What is your age range?**

   - 20-29
   - 30-44
   - 45-54
   - 55 or older

3. **Which mobile device are you testing?**

   - I-Pod Touch
   - Smartphone
   - Netbook
   - None

4. **How frequently do you use:**

   a. a computer at work?
      - Never
      - 1-5 hrs/wk
      - 6-12 hrs/wk
      - More than 12 hrs/wk

   b. a computer outside work?
      - Never
      - 1-5 hrs/wk
      - 6-12 hrs/wk
      - More than 12 hrs/wk

   c. a smartphone/ PDA?
      - Never
      - 1-5 hrs/wk
      - 6-12 hrs/wk
      - More than 12 hrs/wk

   d. other portable devices?
      - Never
      - 1-5 hrs/wk
      - 6-12 hrs/wk
      - More than 12 hrs/wk

   List other mobile devices used

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5. How would you rate the usefulness of the following:
   a. computer use by students outside classroom?
      - Not at all useful
      - Slightly useful
      - Moderately useful
      - Very useful
   b. computer use by students inside classroom?
      - Not at all useful
      - Slightly useful
      - Moderately useful
      - Very useful
   c. general use of computers in education?
      - Not at all useful
      - Slightly useful
      - Moderately useful
      - Very useful

6. How would you rate your past experiences with tech support at Sheppard Air Force Base?
   - Very poor
   - Poor
   - Fair
   - Good
   - Excellent

7. In your opinion, how well does the current course material prepare students for the AGE career field?
   - Not at all
to some degree
to moderate degree
to large degree

8. How suitable are the current course delivery methods to the materials being presented?
   - Very unsuitable
   - Unsuitable
   - Suitable
   - Very suitable

9. How well do block tests measure course objectives?
   - Very poor
   - Poor
   - Fair
   - Good
   - Excellent

10. What is your overall attitude towards this demonstration?
    - Very poor
    - Poor
    - Fair
    - Good
    - Excellent

11. Have you ever used smartphones, PDAs, or laptops in personal education pursuits?
    - Yes
    - No
Survey 1.2. Instructor Post-Use

Post-Use Survey for Instructors

1. What was your PDSCLASS number? ____________________________________________

2. Which mobile device were you testing?
   - I-Pod Touch
   - Smartphone
   - Notebook
   - None (Note: if “None,” branch to question #8)

3. In your opinion, how interested were the students in using the mobile device?
   - No interest
   - Little interest
   - Moderate interest
   - Strong interest

4. How well did the device correlate to learning activities?
   - No correlation
   - Little correlation
   - Moderate correlation
   - Strong correlation

5. Based on your experiences, was the mobile device more of a useful or distracting influence in the classroom?
   - Mostly useful
   - More useful than distracting
   - Neutral
   - More distracting than useful
   - Mostly distracting

6. How satisfied are you with the usefulness of device?
   - Not at all satisfied
   - Slightly satisfied
   - Moderately Satisfied
   - Very Satisfied
   - Extremely Satisfied

7. Do you have any suggestions for improvements/new applications/methodologies that could be added in future demonstrations?
   Comment

   ____________________________________________
### Pre-Use Survey for Students

1. What is your PDSCLASS number?  

2. What is your age range?  
   - 17-20  
   - 21-24  
   - 25-28  
   - 29 or older

3. Which mobile device are you testing?  
   - I-Pod Touch  
   - Smartphone  
   - Notebook  
   - None

4. How frequently do you use  
   a. computers?  
      - Never  
      - 1-5 hrs/wk  
      - 6-12 hrs/wk  
      - More than 12 hrs/wk  
   b. smartphone/PDA?  
      - Never  
      - 1-5 hrs/wk  
      - 6-12 hrs/wk  
      - More than 12 hrs/wk  
   c. console games?  
      - Never  
      - 1-5 hrs/wk  
      - 6-12 hrs/wk  
      - More than 12 hrs/wk

5. How frequently have you used  
   a. computers in a classroom environment?  
      - Never  
      - 1-2 courses  
      - 3-5 courses  
      - More than 5 courses  
   b. computers in support of class activities?  
      - Never  
      - 1-2 courses  
      - 3-5 courses  
      - More than 5 courses

6. How much time did you dedicate to study daily prior to joining the Air Force?  
   - Less than 30 min  
   - 30 min – 1 hr  
   - 1 – 2 hrs  
   - 2 – 3 hrs  
   - More than 3 hrs
7. How would you rate your satisfaction towards
   a. your career field?
      - Not at all satisfied
      - Slightly satisfied
      - Moderately satisfied
      - Very satisfied

   b. the Air Force?
      - Not at all satisfied
      - Slightly satisfied
      - Moderately satisfied
      - Very satisfied

8. How would you rate your mechanical background prior to joining the Air Force?
   - No background
   - Slight background
   - Moderate background
   - Extensive background

9. Have you ever used smartphones, PDAs, or laptops in personal education pursuits?
   - Yes
   - No

10. What is your educational level?
    - High School only
    - Some college, no degree
    - Associate’s Degree
    - Bachelor’s Degree
    - Other
# Mid-Term Survey for Students

1. What is your PDSCLASS number?  

2. Which mobile device are you testing?  
   - I-Pod Touch  
   - Smartphone  
   - Netbook  
   - None (Note: if “None,” branch to question #7)

3. How much time do you use the mobile device in class?  
   - 1 – 2 hrs  
   - 2 – 3 hrs  
   - 3 – 4 hrs  
   - 4-5 hrs  
   - More than 5 hrs

4. How much time do you dedicate to study daily with the mobile device outside of class?  
   - 1 – 2 hrs  
   - 2 – 3 hrs  
   - 3 – 4 hrs  
   - 4-5 hrs  
   - More than 5 hrs

5. How would you rate your satisfaction towards  
   a. the academic usefulness of the mobile device?  
      - Not at all satisfied  
      - Slightly satisfied  
      - Moderately Satisfied  
      - Very Satisfied  
      - Extremely Satisfied  
   b. the technical usefulness of the mobile device?  
      - Not at all satisfied  
      - Slightly satisfied  
      - Moderately Satisfied  
      - Very Satisfied  
      - Extremely Satisfied  
   c. the instructor promotion of the mobile device?  
      - Not at all satisfied  
      - Slightly satisfied  
      - Moderately Satisfied  
      - Very Satisfied  
      - Extremely Satisfied

6. Which application(s) on the mobile device did you use the most?  
   Comment

7. How much time do you dedicate to study daily with traditional materials outside the classroom?  
   - Less than 30 min  
   - 30 min – 1 hr  
   - 1 – 2 hrs  
   - 2 – 3 hrs  
   - More than 3 hrs
8. How would you rate your satisfaction towards
   a. the Air Force?

   Not at all satisfied  Slightly satisfied  Moderately Satisfied  Very Satisfied  Extremely Satisfied

   b. squadron (dorm) life?

   Not at all satisfied  Slightly satisfied  Moderately Satisfied  Very Satisfied  Extremely Satisfied

9. What do you wish the device could do that would significantly improve your performance in this course?

   Comment
Survey 2.3. Student Post-Use

**Post-Use Survey for Students**

1. What is your PDSCLASS number?  

2. Which mobile device were you testing?  
   - I-Pod Touch  
   - Smartphone  
   - Netbook  
   - None (Note: if “None,” branch to question #11)

3. On average, how much time did you use the mobile device daily **in class**?  
   - 1 – 2 hrs  
   - 2 – 3 hrs  
   - 3 – 4 hrs  
   - 4-5 hrs  
   - 5 – 6 hrs

4. On average, how much time did you use the mobile device to study daily **outside of class**?  
   - Less than 30 min  
   - 30 min – 1 hr  
   - 1 – 2 hrs  
   - 2 – 3 hrs  
   - More than 3 hrs

5. How would you rate your satisfaction towards  
   a. the academic usefulness of the mobile device?  
      - Not at all satisfied  
      - Slightly satisfied  
      - Moderately Satisfied  
      - Very Satisfied  
      - Extremely Satisfied
   
   b. the technical usefulness of the mobile device?  
      - Not at all satisfied  
      - Slightly satisfied  
      - Moderately Satisfied  
      - Very Satisfied  
      - Extremely Satisfied
   
   c. the instructor promotion of the mobile device?  
      - Not at all satisfied  
      - Slightly satisfied  
      - Moderately Satisfied  
      - Very Satisfied  
      - Extremely Satisfied

6. Which application(s) on the mobile device did you use the most?  
   
   Comment

7. Rate your overall satisfaction with the mobile device.  
   - Not at all satisfied  
   - Slightly satisfied  
   - Moderately Satisfied  
   - Very Satisfied  
   - Extremely Satisfied
8. What was good about the device?

Comment

9. What was bad about the device?

Comment

10. Please give suggestions for improvement/new applications that could be added.

Comment

11. How much time do you dedicate to study daily with traditional materials outside the classroom?

- Less than 30 min
- 30 min – 1 hr
- 1 – 2 hrs
- 2 – 3 hrs
- More than 3 hrs

12. How would you rate your satisfaction towards

a. the Air Force?

- Not at all satisfied
- Slightly satisfied
- Moderately Satisfied
- Very Satisfied
- Extremely Satisfied

b. squadron (dorm) life?

- Not at all satisfied
- Slightly satisfied
- Moderately Satisfied
- Very Satisfied
- Extremely Satisfied
Aerospace ground equipment (AGE) – includes powered and non-powered equipment used around aircraft. Examples of powered AGE include generators, air conditioners and heaters, air compressors, and bomb loaders; non-powered AGE includes various types of maintenance stands.

Air Force specialty – refers to a career field within the U. S. Air Force. Each career field is identified by an Air Force Specialty Code (AFSC).

Aircraft maintenance apprentice – Air Force maintenance personnel who have attained the apprentice (trainee) level of aircraft knowledge and troubleshooting skills.

Block – a module of instruction consisting of one or more units of related subjects or tasks.

Block test – a test given at the end of each block of instruction. The written block tests are presented in multiple choice format. Normally, each question has four possible choices, with one choice being the most correct answer.

PDSCLASS – Personnel Data System class number used in scheduling class dates, consisting of the course number, a 2-digit fiscal year, and a 3-digit one-up number.

Technology insertion – an interactive multimedia instructional media designed to be inserted into a lesson. The Technology Insertion may be instructor-controlled, student-controlled, or both.

TRQI – Training Requester Quota Identifier, a four-character communication code used to convey training requirements and student-tracking information.

Wash back – placing a student in another class of the same course to allow repetition of a block due to inability to attain acceptable standards.


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