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Impact of Mobile Devices on Student Performance in an Agriscience Classroom

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Introduction

One to one computing (1:1), a scenario in which each student has an Internet connected computing device, has been deployed extensively in the past decade, with a belief that increased access to computer resources would result in an increase of student learning and improvement of teaching practices (Bebell & Kay, 2010; Cavanaugh, Dawson, & Ritzhaupt, 2011; Drayton, Falk, Stroud, Hobbs, & Hammerman, 2010; Gulek & Demirtas, 2005; Lei & Zhao, 2008; Penuel, 2006). Existing research indicates positive outcomes in regards to student engagement and student motivation when 1:1 access is provided in traditional classrooms. However, research is not as consistent in regards to the impact of 1:1 implementations on student achievement. Mixed results not only among studies, but also within individual studies, confounds and hints at the complex nature and unpredictability of 1:1 implementations on student achievement. Dunleavy and Heinecke (2008) note a lack of rigorous studies and emphasize the need for additional well developed scientific research that will measure the impact of 1:1 learning on student achievement. Through the research of the effects of a 1:1 implementation on high school agriscience student's posttest performance, this study adds to the existing research that can help educators and technology integrators make informed decisions regarding 1:1 computing.

Purpose of the Study

A search and analysis of current peer reviewed studies indicated that the majority of 1:1 computing studies are overwhelmingly conducted in middle schools and core content areas (The Abell Foundation, 2008; Dunleavy, Dexter, & Heinecke, 2007; Garthwait & Weller, 2005; Gulek & Demirtas, 2005; Swan, van t'Hooft, Kratcoski, & Unger, (2005). This makes it difficult to draw conclusions regarding the effects of 1:1 computing in high school elective classes. A possible limitation with research that focuses on required classes is that students may exhibit different intrinsic motivation within the different content areas because they are required to pass the class in order to move on to the next grade, potentially skewing student performance measurements (Ferrer-Caja & Weiss, 2002). Though agricultural science classes provide a unique opportunity for exploring the impact of 1:1 computing outside of core content areas, there is a dearth of research literature focused in this area. Therefore, the purpose of this study is to explore the effectiveness of 1:1 computing on posttest performance in a high school agricultural science classroom in a rural southeastern city.

Research Questions

The following research question guided this study: What is the difference between 1:1 computing and traditional instruction on plant identification posttest scores in a rural high school agricultural science classroom?

Significance of the Study

Agricultural science classes are often project based and involve hands on instruction in which the student is engaged in a learning activity; activities that may be considered engaging for a student. However, as students' interests change so do the activities that engage them. It is believed that technology can be used to engage today's student (Dawson, Cavanaugh, & Ritzhaupt, 2008; Penuel, 2006). It is expected that the use of a 1:1 based model for providing tablet devices to students, and the use of those devices in instruction, will provide insight into the impact of 1:1 computing on student posttest performance. This information can then be used to illuminate the role that 1:1 technology may have in an agriculture science class and provide research in an area where it is lacking, in addition to opening the conversation to include agriscience and the often forgotten elective classes.

With limited funding available to put into purchasing new technology, it is important that decision makers have an understanding of where the most impact can be made with available funding. This study provides insight into how 1:1 computing and mobile devices affect student performance in this school and this classroom. The information gleaned from this study can potentially be used to help guide funding allocation decisions by the teacher and school, particularly in regards to whether 1:1 computing is a viable solution for generating increases in student performance for agriscience students at this school.

Key Terms

- *Agriscience:* A High School, and occasionally 8th Grade Middle School, class that allows students to explore science topics within the field of agriculture. Course material contains elements of the scientific principles of soil, plants, animals and the environment; including the application of these scientific principles in agriculture.
- *Elective Class:* Elective classes are optional classes or courses within a required course of study that students enroll in. Elective classes focus on a particular area of study such as business, agriculture, art, or music that is chosen by the student. Though students must pass their elective classes, they are free to select an area of interest.
- *Electronic Portfolio:* "A portfolio is a collection of work developed across varied contexts over time. The portfolio can advance learning by providing students and/or faculty with a way to organize, archive and display pieces of work (Regis University Electronic Portfolio Project, n.d.)."
- *1:1 Computing:* 1:1 computing (1:1), a scenario in which each student has individual access to an Internet connected computing device. Policies may differ on whether students are allowed to take the devices home (Penuel, 2006). In this study "1:1" is used and also written as "1:1."

Review of Literature

Agricultural science teachers are not immune to the need of integrating technology into the classroom and see their roles expanding to include technology integration (Anderson & Williams, 2012). Integrating technology into the educational process allows the instructor to think outside the classroom and develop new experiences to meet learning goals (Williams, 2006). One way that technology can be integrated into the educational process is through the implementation of 1:1 computing devices. A number of studies have shown that 1:1 implementations have had a positive effect on student learning outcomes, though findings are inconsistent in regards to student achievement (Bebell & Kay, 2010; Lei & Zhao, 2008; Penuel, 2006). Implementation of 1:1 devices in an agriscience classroom has the potential to have a positive impact on student posttest performance due to easier access to information and increased student motivation. This review of literature examines studies that explore the effects of 1:1 implementations and their impact on student achievement, instructional practices, student engagement, and access.

Student Achievement

A number of factors influence student learning and instructional practices when implementing computer technology in the classroom, and it has been demonstrated that a correlation between increased computer usage and learning outcomes exists (Bebell & Kay, 2010). Though it has been demonstrated that 1:1 implementations and computer use have an effect on a variety of student outcomes; the central question, and ultimate measure for many educators, is: What is the impact on student achievement?

Cavanaugh, Dawson, and Ritzhaupt (2011) stated there are three key elements that influence the impact of laptop computing on student achievement. These include (a) systematic support, (b) professional development, and (c) changes in teaching practices. In their study, they examined the impact of laptop computing on teaching practices and student achievement in eleven Florida school districts over one school year. The study collected data from both urban and rural K-12 schools with no emphasis on content area or grade level. Data collection from observations, document analysis, interviews and teacher inquiry were used to develop an account of the 1:1 laptop implementation's impact. Findings from their study showed the impact of laptops on student achievement as being inconclusive, due to inconsistent performance results. Though most of the classes in the study showed positive impacts from laptop use, some classes had negative results, which were attributed to students not knowing how to use the laptops or being comfortable using them.

Cavanaugh, Dawson, and Ritzhaupt's (2011) work underscores how laptops were seen as a tool to facilitate change in teaching practices, which in turn impacted student achievement. Their study also identified two other factors for a positive 1:1 implementation, systematic support and professional development. This suggests that varying degrees of implementation levels for these three factors could potentially impact future studies. In order to reduce the impact of these factors on this study, the researcher took steps to ensure that support was available for the devices used and they were working each day as planned. Additional steps were taken to ensure that the teacher was adequately prepared to use the technology, including guidance and training for using the devices and software required to create the digital plant portfolios. Unfortunately, one element that was identified by Cavanaugh, Dawson, and Ritzhaupt's (2011) study that could affect research regarding 1:1 implementations is the impact of student comfort with technology. This is a potential limitation with many 1:1 studies and has been identified by other researchers as impactful on student computer usage (Anderson &

Williams, 2012; Hsiao, Tu, & Chung, 2012). Because studies are often short in duration, typically occurring only over a one to two year period, their findings may be influenced by the novelty factor of new technology and limitations in user comfort with the technology.

In other research, Bebell and Kay (2010) used a standardized test known as the Massachusetts Comprehensive Assessment System (MCAS) as one of the quantitative assessments to help determine the impact of the 1:1 implementation on student achievement. Their study was conducted over a three-year period and focused on five middle schools during the implementation of a 1:1 wireless laptop solution. Two schools of similar size and demographics, and did not implement a 1:1 solution, were used as a comparison group. The research focused on teaching and learning in the 1:1 environment. Both quantitative and qualitative data collection methods were used to document the success of the initiative based on four outcomes: (a) enhanced student achievement, (b) improved student engagement, (c) fundamental changes in teaching practices, and (d) enhanced capabilities among students to conduct independent research and collaborate with peers. Quantitative data collection methods included teacher surveys, student surveys, and analysis of existing school records and test scores. Among the qualitative data collection methods used were selected teacher interviews, student drawings, classroom observations, and principal interviews as well as school level and district level leadership interviews. As a whole, the data gathered from these methods indicated the implementation of 1:1 technology had a significant positive impact on all four of the measured outcomes and was a positive experience for both students and teachers. Their study demonstrates a positive correlation between increased computer usage and these four outcomes. Though all of the other data collection methods indicated positive results, the results from the MCAS standardized test indicated there was not a very significant correlation between the 1:1

computer use and student MCAS test scores. Bebell and Kay (2010) acknowledged limitations of the MCAS as an assessment tool by stating, "the educational technology literature and the models themselves suggest that perhaps the MCAS may not be the most sensitive or appropriate measure of student achievement in the 1:1 settings" (p. 44). In addition to the MCAS test, a randomized computer writing test was conducted to measure student achievement. This test showed a substantial increase in both topic development and the number of words used in student essays, suggesting the computer based writing test more accurately measured the computer based writing skills of the students. This raises the question as to why one measure of student achievement can indicate positive changes while another measure indicates little to no significant changes in student achievement. Do the changes in classroom instructional methods that come about from 1:1 technology integration facilitate a higher order of learning that standardized tests do not accurately capture? Or are there content areas in which the way that technology is being implemented is not conducive to learning, and as such, does it require a complete instructional redesign?

As Bebell and Kay (2010) pointed out, their study created as many questions as it did find answers. The study demonstrated a correlation between increased computer usage and learning outcomes. It also suggested that a number of factors influenced student learning and instructional practices when implementing computer technology in the classroom. In particular, teacher training, access to technical support, comfort levels, teacher pedagogy, and instructional design were influential on their study’s outcomes. The central question, and ultimate measure for many educators, is: What is the impact on student achievement? It is the researcher’s belief that the MCAS gives future researchers reason to look at how the technology is being used, as opposed to just the accessibility of that technology. It goes without saying that technology must be accessible in order to be widely utilized; however, it would seem that the most direct correlation between student achievement and technology use is more closely related to how the technology transforms the student learning experience.

In a similar study, Suhr, Hernandez, Grimes, and Warschauer (2010) found that student laptop use had a small positive effect on student performance. Their study used a quasi-experimental design involving three schools with various levels of 1:1 laptop integration to see if participation in 1:1 programs can be used to predict changes in English and Language Arts scores. One school did not implement 1:1 laptop technologies and was used as the control group. The second school consisted of 1/3 of the participants using assigned laptops, and the third school consisted of all participants being issued a laptop as part of a 1:1 implementation. The study was conducted over the course of two years and followed the same students during that time frame. The findings indicated that the laptops did have a small positive effect on student performance, though the authors suggest the traditional format of writing tests, in which students use pencil and paper, may have put students using laptops for writing at a disadvantage.

Suhr et al.'s research (2010) once again underscores the importance of designing and implementing accurate assessment methods for student performance measurements. The students that used a laptop for their writing are creating, editing and working in a different format than students that used pen and paper. The laptop is a great tool for revising content, getting timely feedback, and organizing ideas. Students that are using this tool to do their work are then handicapped when the tool is removed. The design of this study requires students to use their 1:1 tablets to look up plant information and create a digital leaf notebook that they will use to practice identifying the plants. This is in contrast to the slower traditional methods in which students would look up pictures of plants in a book and create a leaf notebook using actual plant leaf samples. After reviewing the findings of Suhr et al.'s (2010) work, the researcher determined it would be important to create an atmosphere in which participation in this study would introduce a helpful tool and not take one away. In order to accomplish this, students in the control group were told that they would be given an opportunity to use the mobile devices at the conclusion of the initial four week study period, ensuring they felt there would be an opportunity for equal access to this technology.

This study focused on the effects that 1:1 computing had on student performance. However, the inclusion of technology in the classroom has the potential to transform the educational setting in a variety of ways, including a) instructional practices, (b) student engagement, and (c) student access. Any of these factors may have contributed to changes in student performance, and as such, those topics should also be discussed.

Instructional Practices

Agricultural science teachers indicated that information technologies with broader implications, such as the World Wide Web, were more positively viewed; whereas specific technology applications such as online forms, though positively viewed, received lower attitudinal scores (Anderson & Williams, 2012). The purpose of that study was to determine if a relationship existed between teacher demographics and their attitudes towards information technology. That study also sought to access the attitudes of the agricultural science teachers towards technology adoption and at what stage in the adoption process they conformed to. In order for a teacher to more fully adopt and integrate technology, he or she must see a relevance to how that technology will affect student performance. This suggests the need for instructional practices to integrate technology as part of the learning process, and not merely replace a worksheet with a digital version.

Teaching practices coupled with professional development have been shown to have an immediate impact on instructional practices (Dawson, Cavanaugh, & Ritzhaupt, 2008). Dawson, Cavanaugh and Ritzhaupt (2008) explored teaching practices after a 1:1 laptop implementation in over four hundred classrooms in more than fifty K-12 schools in Florida. Teachers were initially observed in the fall of the first year of the 1:1 implementation and a second observation was conducted in the spring of the same year. Teachers were provided with professional development throughout the school year in preparation for integrating the laptops into instruction. The observations were designed to measure school practices, not teacher practices specifically. A district profile was then created based on the resulting school practices so that districts could be compared and contrasted to help identify what kinds of technologies and professional development strategies had the most impact. The results of the study indicated that teaching practices coupled with professional development may have an immediate impact on instructional practices. The injection of laptop computing and professional development positively impacted teaching practices in at least three ways including (a) increased student-centered teaching, (b) increased tool-based teaching, and (c) increased amounts of meaningful uses of technology. That study identified a strong correlation between student engagement and student achievement, where increases in student engagement typically resulted in increases in student achievement. Contradictory findings to this were attributed to the lack of change in assessment practices.

Dawson, Cavanaugh & Ritzhaupt's (2008) work indicates that changes in instructional practices resulted in changes in student engagement and student achievement, two factors that this study explores. Their research emphasizes how stagnant assessment practices can affect measures of student achievement, further evidence that assessment methods must be re-evaluated to ensure that they are measuring students on what they are actually learning. The changes in teaching practices that are sought after from 1:1 implementations focus on using technology to develop critical thinking skills and higher order thinking. However, not all assessments provide an accurate means for measuring these new skills.

An alternative to traditional assessment methods are web-based learning portfolios (Chang & Wu, 2012). Chang and Wu (2012) concluded that the results of a teacher assessment of student performance using web-based portfolios are reliable when quality rubrics are created for student learning outcomes. Chang and Wu's research (2012) was conducted to determine if teacher assessment of web portfolios provide a reliable and valid method of assessment for student learning outcomes. As a non-traditional student performance assessment method, web portfolios provide benefits over traditional paper-based portfolios; however, teacher assessment of the portfolios may not be aligned with well-constructed scoring criteria, such as assessment rubrics. In order to determine the validity of these concerns, Chang and Wu's (2012) study consisted of teacher assessment, student self-assessment, and peer-assessment on a group of eleventh graders in a computer applications course. Students completed a web-portfolio and then took achievement tests that were aligned to the learning outcomes of the portfolio. A strong correlation was found between the scores, indicating the portfolio assessment was appropriate for reflecting learning achievements. Chang and Wu's research provides insight into different ways that student performance can be measured and possible methods for developing non-traditional assessment methods. This study measures student performance after introducing a 1:1 computing device for each student. Though a pretest posttest model was used to gather results for this study, consideration must be given to the potential role that the leaf notebook plays in the learning process and potentially the assessment process for students. The use of mobile devices allows teachers new methods of instruction and students new ways of demonstrating what they have learned. This opens the door to potentially more accurate student assessment instruments; however, as pointed out by Chang and Wu (2012) the web-based learning portfolios are limited by the quality of the rubric used to evaluate the student's work.

Cavanaugh, Dawson, and Ritzhaupt (2011) found that how teachers perceive the role of the computing device had an impact on instructional and learning outcomes. When the computing devices were seen as a tool to facilitate change in teaching practices then student achievement was positively impacted. Cavanaugh, Dawson, and Ritzhaupt (2011) also illustrated the need for professional development when implementing technology into instruction in order to ensure that changes in teaches practices could evolve from the integration of computers into the classroom. Lei and Zhao (2008) concluded that how the computers were being used in instruction had a greater positive impact than the amount of time spent using computers. In Lei and Zhao's study, the students and teachers had easy access to computer resources and wireless Internet access, both at school and home. Teachers were also provided convenient and efficient professional development, including access to a local university's resources. Surveys were administered to students, teachers, and parents in order to collect data on computer use and attitudes. Students took two surveys, one at the beginning of the year prior to receiving their laptops and the other at the end of the year, following instruction using the laptops. An interview process was also conducted on a subset of students and teachers to gauge perspectives on the impact the technology had on learning. From this data, the researchers concluded that how the computers were being used in instruction had a greater positive impact than the amount of time spent using computers. Mixed student achievement results were attributed to the inconsistent integration of computers into the curriculum and a need for better assessment methods for student achievement. Li and Zhao's (2008) work interestingly found that some parents and teachers were resistant to computer use in instruction. Some parents preferred students to use books and some teachers worried that students would not retain the ability to read and write with paper and pencil. Concerns among teachers included a fear of devaluing the traditional ways of learning that would occur as students replaced books, pen, and paper with laptops and software applications. Though not impactful on this study, it warrants some consideration as to the impact of teacher and parent perceptions of supplanting the plant identification practice of using real tangible plant samples with a digital representation.

Li and Zhao's (2008) work provides valuable insight into designing how the 1:1 devices will be integrated into instruction during this study. Their findings suggested the quality of computer integration into instruction is more important than ad hoc access for the sake of using the device. In order to take advantage of all that computers have to offer in the classroom, as many adoption barriers as possible must be identified. The fear of some parents and teachers regarding computer use indicates a lack of a sound and consistent implementation plan. People fear what they don't know and it is likely that the fear identified in teachers and parents comes from a lack of understanding how the devices are going to be used. Specific tasks will need to be developed to ensure that students are using the devices when it offers a potential advantage over traditional methods. Li and Zhao's (2008) research highlights what can happen when computers are thrown into the mix without proper or adequate planning. Based on the presupposition that complicated processes and uses of technology could muddy the waters in this study and make it difficult to make conclusions as to how the 1:1 implementation affected student performance; this study was developed with the intention of easy integration and specific use of the mobile devices so that they are used as a tool during the learning process.

MacBride and Luehmann (2008) focused on a high school mathematics teacher and the outcomes from integrating blogging into his classroom. The participating teacher in that study was selected because he provided a rare example of a teacher deeply connected with the blogging technology and demonstrated its use in a variety of ways. Data collection methods included collecting student and teacher blog postings over a 27 day period and a final interview with the teacher. A qualitative data analysis was then conducted looking for aspects of teacher intent, classroom use, and perceived value. The results of the MacBride and Luehmann's (2008) research indicated blogging can be effective at increasing student engagement, collaboration and achievement. The researchers warned that their findings did not suggest blogging would produce the positive results seen but rather success may be contributed to how the teacher chose to structure the use of blogging in his classroom. Their research provided a very unique look at a classroom teacher facilitating learning with foremost, a sound pedagogy, and secondly, a tool that he is comfortable with and accomplishes his classroom goals. In their study, MacBride and Luehmann (2008) make a strong argument for blogging in the classroom. However, their study also suggests that the teacher's success is not exclusive to the integration of blogging. Some positive elements that appear to be attributed to classroom blogging include, a student centered learning environment, enrichment exercises, student reflection, relevance through a real audience, and students helping each other. Perhaps a similar positive result would have been found if those elements were introduced into a class sans blogging and a different mechanism was used to facilitate them. MacBride and Luehmann's (2008) study indicates that the teacher's success is attributable more to his teaching methods in general and less to classroom blogging in particular. The use of a classroom blog was merely a tool that a good teacher used to facilitate the learning process. That being said, there is one finding that provides support for an argument in which student success is linked to classroom blogging specifically. Blogging capitalizes on the cultural literacies of today's student. MacBride and Luehmann (2008) noted blogging provided a unique opportunity for the teacher to capitalize on his students' interest and knowledge with online communication. By using blogging, the teacher was able to tap into how students interact in their personal lives, providing a more familiar communication channel than through the traditional pen and paper. Exploration of students' cultural literacies should be studied further to see how if a correlation can be found between how a student naturally communicates and how he learns.

Student Engagement and Access

Contrary to most research, some findings indicated that increased access to technology does not lead to increased student engagement and adversely impacted student success at school (Donovan, Green & Hartley, 2010; Inal, Kelleci, & Canbulat, 2012). Inal, Kelleci, and Canbulat (2012) suggested that students' study time outside of class is an indicator of student performance and increases in Internet usage competes for that time. Off task behavior presents a hindrance to student engagement regardless of the level of technology integration, which has been found to be detrimental to student engagement. Donovan, Green and Hartley (2010) concluded that increased access to technology does not lead to an automatic increase in student engagement. Chrichton, Pegler and White (2012) found that high school students and teachers struggle to find educational uses for mobile computing devices and, contrary to commonly held beliefs, students and young teachers were not necessarily more comfortable with devices or more technologically savvy than their older counterparts. Chrichton, Pegler and White (2012) concluded that mobile devices offered several challenges for students and teachers in the form of (a) managing apps, (b) finding apps, (c) maintaining and managing the devices, and (d) submitting assignments. The research indicated multiple factors that affect student engagement and must be considered when implementing computer technology in the classroom.

Computer self-efficacy has a significant influence on computer use and how students use them (Hsiao, Tu, & Chung, 2012). Hsiao, Tu, and Chung's (2012) research suggested that the more comfortable a student is with a computer, the more he or she will use it. A desire to fit into social norms and parental influence to use computers provides an encouraging environment for students to use computers and as students use the computers they become more comfortable, increasing their computer self-efficacy. This general computer self-efficacy was found to play a more important role in student computer use than advanced computer competency.

Murphrey, Miller and Roberts's (2009) research noted that though schools provided access to many traditional computer technologies, very few offered teachers access to iPods or similar technologies. This is particularly true for devices that teachers would use during their non-working hours, such as an iPod. Students, in contrast, owned these types of devices and used them outside of the school environment, indicating that students are early adopters of the technology. In addition, student access to these devices was substantially greater than teacher access, with a majority of students owning an iPod or similar device. This suggests a cultural literacy may exist, in the form of learning through multi-media devices that could be leveraged by teachers to engage students in the learning process. Cultural literacies are not unique to just devices. Student blogging has shown that it can allow a teacher to tap into the cultural literacies of today's student and provided a unique opportunity for the teacher to capitalize on his students' interest and knowledge with online communication (MacBride & Luehmann, 2008). By using blogging, the teacher was able to interface with how students interact in their personal lives, providing a more familiar communication channel than through the traditional pen and paper. A

1:1 implementation provides the basis for students to begin using technology they are already familiar with as a tool used to enhance their ability to learn.

Owusu, Monney, Appiah, and Wilmot's (2010) research found that some student populations who receive traditional instruction performed better than those that received the same content through computer assisted instruction. That study found that low achieving students performed better when using the computer assisted instruction. Increased student engagement, clarity of presentation, and the ability to more easily review class material was suggested as possible reasons for the low achieving students increased performance. An inability to ask questions was identified as being an issue for students that received the computer-assisted instruction. Blended learning, in which some portion of class content and instruction is provided online through computing devices, has shown an increase in student achievement. Yapici and Akbayin (2012) suggested that the blended learning model contributes to higher student achievement in biology than the traditional instructional methods. Yapici and Akbayin's (2012) research indicated the blended model positively affected student achievement by (a) allowing students to prepare prior to class, (b) providing unlimited opportunities to make revisions to work, (c) expanding on concepts through activities such as videos and animations, (d) allowing students to self-test to determine their efficiency in content, (e) allowing communication outside of class time, and (f) giving students the opportunity to learn at their own pace (Yapici & Akbayin, 2012). These findings suggest that careful consideration must be given to how technology is integrated into the learning process. Technology opens the door to new methods of instruction and inquiry; however, it is necessary to ensure that the use of technology does not impede the learning process by creating unforeseen barriers. In particular, it is vital that the technology is not just more engaging; it must also be a useful tool in the learning and assessment process.

In sum, this review of literature demonstrates how entwined student achievement, instructional practices, student engagement, and computer access are when studying the effects of 1:1 computing. Each has a demonstrable effect on how a 1:1 implementation will affect student performance and therefore, each must be considered when studying the effects of 1:1 implementations. The challenge comes with attempting to determine the effect each of these components has on student performance so that instructors and researchers can gain new understandings and begin to develop a better "recipe" or model for 1:1 computing. A more accurate model for 1:1 computing will help guide implementation decisions and provide insight into the effects of 1:1 in an agriscience classroom. Reviewing the literature related to 1:1 computing and student performance helped the researcher identify overlapping themes from existing research that may have been impactful on the study. Themes that have been identified during a review of literature, and may have an impact on this study include (a) the need for a well-designed assessment methods to actually measure what students will be learning, (b) computing devices should serve as an extension of the learning process and serve the role of a tool, (c) getting students and teachers comfortable and familiar with their computing devices, (d) designing instructional practices to seamlessly integrate the computing devices into the curriculum, and (e) providing students and teachers with access to timely support. This insight provided by reviewing existing literature from previous research guided the design and conclusions of the study, which is detailed in the next sections.

Method

Most studies on student performance have focused on measuring student engagement, student motivation, and student performance concurrently (Bebell & Kay, 2010). However, where student engagement and student motivation have shown a generally positive increase with 1:1 computing implementations; student performance findings are inconsistent, with some findings indicating student performance is positively impacted (Gulek & Demirtas, 2005; Penuel, 2006) and others indicating a negative impact (Inal, Kelleci, & Canbulat, 2012; Penuel, 2006). Research by Dunleavy and Heinecke (2008) found increases in student achievement in science after implementation of a 1:1 program; however, math achievement in the same study did not show any significant effects from the 1:1 program. A potential limitation with these studies is they are overwhelmingly conducted in K-8 core content areas. Therefore, students may exhibit different motivation and interest levels within the different content areas because they are required to pass the class in order to graduate, potentially skewing student performance measurements. Agricultural science classrooms often implement project based learning and because they are elective classes, provide an environment in which an approximately equivalent level of motivation and interest can be reasonably expected. This gap in research provided a motive to investigate the impact of 1:1 computing on student posttest performance in a high school agricultural science classroom. The following research question guided this study: What is the difference between 1:1 computing versus traditional instruction on plant identification posttest scores in a rural high school agricultural science classroom?

Research Design

This was a quasi-experimental study that used two intact classes and pretest posttest method to collect data. This method allowed for a quantitative comparison of scores between the control and experimental groups, providing insight into the use of 1:1 computing to teach plant identification in the agricultural science classroom. The study was designed to determine the effect of a treatment on an experimental group (class one) using a control group (class two) for comparison. The two classes were approximately equivalent in demographics, though their sizes differed. The classes also received the same content, except for the treatment that is received, thus providing confidence that differences in outcomes can be attributed to the treatment (Keppel, 1991).

The independent variable in this study was how the students completed their project (traditional or with 1:1 device). The dependent variable was the plant identification (Appendix A) posttest scores. Confounding variables were the amount of time that students spend off topic with the mobile devices, the amount of time that students use the mobile devices outside of the school setting, and home Internet access. Efforts were made to allow students access to the mobile devices outside of school hours. Classroom instruction and the plants required for identification were the same for both groups as well as the time allowed to work on their plant identification notebook or portfolio.

Participant Population and Recruitment

The school in this study was a rural public high school in the southeastern United States. Public demographic information collected from the state Department of Education indicated that the school consisted of 402 students, 52% of which are African American, 39% Caucasian, 4% Hispanic, and 4% are Multiracial. The demographics for each class are displayed in Table 1 labeled “Class Demographics”.

Table 1

Class Demographics

	Class 1 (control)	Class 2 (treatment)
Gender		
Male	19	23
Female	4	8
Ethnicity		
African American	7	12
Asian	1	0
Caucasian	12	16
Hispanic	2	2
Multi-Racial	1	1
Grade		
9th	18	26
10th	3	4
11th	0	0
12th	2	1

The agriscience teacher, Mr. X has a Master's degree in Agriculture Education and 14 years teaching experience. The researcher has a personal relationship with the Agriculture teacher who agreed to cooperate with the study and signed a pledge of confidentiality form (Appendix B). In addition, the school principal allowed the study to be conducted in this class (Appendix C).

All students in the agriscience classes were invited to participate in the study. Because the students were considered minors, all students in both classes were required to take home a parental consent form that was signed by a parent (Appendix D). The students were also required to sign a minor assent form as well (Appendix E). Both forms were required in order for the student's data to be considered in the study. All 54 students and parents consented to participate in the study and the study was approved by the Institutional Review Board.

Data Collection

A plant identification pretest posttest was used to collect data for this study. Details of the testing protocol are outlined in the "Instrumentation" section that follows. This method allowed for a quantitative comparison of scores between the control and experimental groups. The study was conducted over four weeks and consisted of two groups, a control group and a treatment group. One intact agriscience class was randomly assigned to the control group and the other intact agriscience class was assigned to the treatment group. The agriscience teacher served as a facilitator as students learned to identify different plants and collected samples for either their plant notebook or plant portfolio.

After the random assignment, the groups were given a pretest consisting of forty plants and asked to identify them using a fill in the blank test format with a word bank (Appendix A). The identification of these forty plants was part of the regular curriculum. The posttest was used to assess the students' ability to correctly identify a group of live landscape plants and the plant notebook was a tool used by students to facilitate that ability. Both groups received the same classroom instruction and access to live plants; however, the control group collected physical samples and created a traditional "plant notebook" in which control group members mount the leaf sample onto paper in a three-ring binder and enter identifying information. The treatment group used their mobile devices to collect images of the plants and upload them to a "plant portfolio." Students in the treatment group also used web resources and images to create the portfolio. Each group used their plant notebook or plant portfolio to prepare for the plant identification posttest. In order to provide a level of equality and quell student concerns of fairness, the groups were swapped after the study was completed, which provided all students the opportunity to use the mobile devices and create both types of notebooks.

The instructor provided differentiated instruction and resources for creating each of the two notebook types. There were no other instructional differences related to class content or material covered on the pretest or posttest. The only instructional differences were related directly to the specifics of how to create their respective “notebook” and “portfolio.” Identifying information, plant usage, and plant characteristics were provided verbally by the teacher as part of the class content. In addition to the teachers lecture, control group members could use plant identification books as a reference and resource for identifying the plants. The experimental group used their assigned mobile device to take pictures of the plants and store them in a web-based portfolio that was used for practicing identifying plants. Additionally, this group was encouraged to use Internet based resources to help with plant identification and creating their “plant portfolio.” At the end of the four weeks, the students took a posttest identical to the pretest to access their ability to identify this group of plants and the scores were recorded.

Instrumentation

The pretest-posttest method that was used for collecting data consisted of forty live plants in containers. The plants were distributed in the school greenhouse and labeled with a number from one to forty. Students were given a listing of plants, including the common and scientific names, which served as a word bank. Students were given a second paper that had forty blank lines. Students wrote the common and scientific name of each plant in the plant’s corresponding number on the test sheet. All of the names from the word bank were used on the test, and no plant was used more than once. No books, computers, or other information source were used during the testing protocol. The test began with each student being assigned to a number. The number represented the starting point for that student. The teacher kept track of the time and every thirty seconds students were told to rotate to the next sequential number. This ensured that every student had an equal amount of time with each plant. The teacher rotated the students through the cycle two times so that each student had two thirty second opportunities to identify each plant. In order to ensure that students could not share answers, either verbally or written, the instructor spaced the plants to alleviate crowding. The teacher also maintained a view of all students during the testing process. The instructor provided all pertinent information prior to testing and questions were not to be allowed during the test. Students were not allowed to touch or reposition any of the plants.

The content being taught is based on the agriscience teacher's implementation of Georgia State Standard AFNR-BAS-13 Element 13.5 "Identify important floriculture and nursery/landscape plants utilized in Georgia (Georgia State Standards, 2013)." In the teacher's expert analysis, he feels that the pretest posttest identification of these landscape plants meets the identified state standard. An analysis using the Statistical Package for the Social Sciences (SPSS) showed a Cronbach's Alpha internal consistency reliability of .958 for the pretest posttest used in this study. This value indicated that the test was internally consistent and there was a high degree of inter correlation between test items. The reliability test was performed in order to ensure that the pretest posttest would be an accurate assessment.

Data Analysis

The Statistical Package for the Social Sciences (SPSS) was used to conduct an Analysis of Covariance (ANCOVA) to determine if the posttest scores differed between the two groups based on the inclusion of 1:1 devices into the treatment group, while controlling for prior student knowledge, the pretest scores. Pretest scores were used as the covariate during data analysis to control for variations in the student's prior knowledge of the subject matter. Prior to conducting the ANCOVA test, an analysis of assumptions was completed including assumptions of linearity, homogeneity of regression slopes, equality of variance, and measurement of the covariate. Linearity of the dependent variable with the covariate was determined by a scatterplot of the estimated marginal means and showed a positive linear relationship, indicating that the covariate does have an effect on posttest scores. The homogeneity of regression slopes test showed a Sig value of .618, which is not significant, and indicates the assumption has been met. This ensures that the effect of the pretest (covariate) on the group is the same for both groups. Levene's test of equality was used to check for the homogeneity of variance. The assumption of homogeneity of variance is supported by Levene's test for equality of variances with F (1, 10) = 52 and a Sig value of .087. This indicates that the variance of the dependent variable is homogeneous across both groups. The assumption of independence of the covariate and independent variable was met by the random selection of and placement of the two intact classes into one of the two groups (control and treatment). The ANCOVA results shown in Table 1 labeled "Analysis of Covariance for Effect of 1:1 Devices on Student Posttest Performance" indicates the results of the pretest and posttest between the two groups is NOT statistically significant. As Table 2 illustrates, the Sig value .064 is not less than the alpha level of .05. Table 3 shows the adjusted means for the student's posttest scores. The adjusted means using the covariate (pretest scores) provides a control group value of 73.19 and a treatment group value of 86.50. The adjusted mean for each of the groups was very close to each groups posttest mean (74.57 and 85.48 respectively). The observed mean for each groups pretest and posttest is displayed in Table 4 labeled "Descriptive Statistics".

Table 2

Analysis of Covariance for Effect of 1:1 Devices on Student Posttest Performance

Source	SS	df	MS	F	P
Pretest	15654.59	1	15654.59	24.04	.000
Group	2329.11	1	2329.11	3.58	.064
Error	33208.80	51	651.15		
Total	403275.00	54			

a. R Squared = .231 (Adjusted R Squared = .190)

Table 3

Adjusted Means for Effect of 1:1 Devices on Student Posttest Performance

Group	Adjusted Mean	Std Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	73.19	5.33	62.49	83.89
Treatment	86.50	4.59	77.29	95.71

Table 4

Descriptive Statistics

Group	Pretest Observed Mean	Posttest Observed Mean
Control	13.48	74.57
Treatment	12.26	85.48

Discussion

The researcher analyzed the previously discussed data to come to several conclusions and explanations of the results. The next sections discuss those conclusions including the study's limitations, delimitations, validity, and future implications.

Summary

The focus of this study was to determine if a 1:1 computing solution with mobile devices would have an impact on student's posttest scores in an agriscience classroom. A review of existing literature was conducted in order to develop an understanding of the implications of 1:1 computing in an educational setting. From that literature review it became apparent to the researcher that a number of factors can affect the impact of 1:1 solutions with varying results. Armed with this information the researcher designed a pretest posttest protocol that spanned a four week period and was conducted on two intact classes. The pretest and posttest were identical and required students to identify forty floriculture and landscape plants. A random selection from a hat determined which class would be the control group and which class would receive the treatment. The treatment group was provided mobile devices in order to complete a digital leaf notebook for purposes of learning how to identify floriculture and landscape plants, while the control group used the traditional method of creating a plant sample notebook. The pretest was used as a covariant in order to control any variations in student pretest measurements. The results of the pretest and posttest were reported and analyzed using the SPSS program.

The findings suggested that the treatment group did not score higher on the posttest than the control group, though there was some indication that the data was trending towards high scores for the treatment group. The proposed research question was: What is the difference between 1:1 computing and traditional instruction on plant identification posttest scores in a rural high school agricultural science classroom? The lack of a statistically significant increase in posttest scores by the treatment group suggests that the implementation of 1:1 computing did not have a positive or negative impact on plant identification scores in this setting. However, the difference between the adjusted means of the two classes was large, contradicting the Sig value that was calculated, and potentially indicating that there was an increase in the posttest scores of the treatment group compared to the control group. The large difference between the adjusted means of the two classes is attributed to the effect of different sample sizes where the first class consisted of 23 students (n=23) and the second class consisted of 31 students (n=31). This made inferences from the difference between the adjusted means questionable.

Limitations, Delimitations, and Validity

Though efforts will be made to minimize limitations, there are two factors that may have had an impact on the findings of this study. First, the researcher was not able to directly observe the class. Without direct supervision, it is possible that the teacher differed in his instruction methods, potentially skewing the results of the study. Second, it was not possible to adjust the class size or class makeup. Students elect to enroll in the class freely and are in high school, which consists of 14 to 18-year-olds. Therefore, it is not possible to ensure age, gender or racial diversity within the class. The difference is class sizes may have been instrumental in the confusing data results, in which a statistically significant difference was not found between the two groups, yet a rather large difference of adjusted means did exist. The unequal sample sizes created a scenario in which outliers in the smaller sample had a more profound effect on the mean.

In addition, there are a few delimitations that limited the scope of the study. One of these is that the study was conducted at only one high school in the only two agricultural science classes that were available. This limited the sample size of the study. A sample size that is too small may amplify the results, potentially leading to conclusions that do not hold up in a larger population. A larger sample size would imply the confidence intervals are narrower which indicates the conclusions are more reliable (de Winter, 2013). Also, the alternative instruction only models a 1:1 computer implementation, and was not a full 1:1 implementation in which students have some level of ownership and unlimited access to the mobile devices. Students had full access to a mobile device during class time and the devices were available for checkout, as opposed to keeping the device with them outside of instructional time. Studies have shown that increased access to devices leads to increases in student outcomes, including student achievement (Penuel, 2006; Russell, Bebell, & Higgins, 2004). Requiring students to checkout devices, instead of allowing students to keep the devices, may have limited student access by acting as a deterrent to use. Students may not have had the time, or desire, to return to the agriscience teacher and complete the checkout process. This decrease in access may have limited the potential impact that 1:1 devices have on student posttest performance in this study.

One internal threat to this study is that the students were aware they were participating in the study, and it is probable that student interaction outside of class made it evident that one group had access to mobile devices. This could have led to jealousy between the two groups and affected the performance of either.

Conclusion

Considering the mixed results of previous 1:1 studies, it is not surprising that this study did not find a statistically significant difference in posttest scores of high school agriscience students after a 1:1 implementation, though there are indications that the data was trending that way (adjusted means). Previous research shows a number of factors that may affect student performance during a 1:1 implementation, making it a challenge for researchers to isolate the ideal setting and instructional methods that consistently provide positive effects from a 1:1 implementation (Bebell & Kay, 2010; Dawson, Cavanaugh, & Ritzhaupt, 2008; Donovan, Green, & Hartley, 2010; Lei & Zhao, 2008; Penuel, 2006). Though an analysis of the scores did not show a statistical difference between the two groups, a substantial difference in the adjusted means did exist. This, coupled with the limited sample size, leads this researcher to believe that further investigation into the 1:1 model is warranted. Additional consideration should be given to the limitation of the type of 1:1 implementation used in this study. Some of the benefits of 1:1 computing could not be fully realized due to the limited funding and access to devices, such as increased student study time and access to class content.

Implications

The results suggest that the 1:1 implementation had a non-significant effect on high school agriscience students' posttest performance. The school system was looking for ways to directly impact student performance and 1:1 offers some hope for that goal. It was the desire of this researcher to gain a more precise understanding of the feasibility and effects of 1:1 computing. Additional research using more classes of equal size and a more fully integrated 1:1 implementation, may lead to a different set of findings. The lack of funding to purchase a device for each student to take home makes it unlikely that a true 1:1 scenario will be achieved by this school in the near future. This means that this study focused on the most likely real world scenario that the school system could reasonably achieve, not necessarily the most optimal 1:1 scenario. If future studies do show increases in student posttest performance using a full 1:1 implementation, then the school will have cause to re-evaluate the economic feasibility of a full 1:1 implementation.

Previous research has demonstrated that low achieving students perform better when using computer assisted instruction, possibly due to increased student engagement when using technology (Owusu, Money, Appiah, & Wilmot, 2010). An imbalance in the number of students identified as low achieving could influence the findings, particularly with small sample sizes such as the ones used for this study. Future studies would benefit from larger sample sizes that are more equivalent in size and composition. Additionally, future research should give consideration to whether increased access to computers provides increased study time, a factor that has been shown to be an indicator of student performance increases, or are the devices a distraction that serves to hinder student engagement, as suggested by Inal, Kelleci, and Canbulat (2012).

The researcher is compelled point out that the class content and assessment instrument used in this study is not the most desirable for measuring critical thinking or higher order learning skills. As Bebell and Kay's (2010) research indicated, it is vital that the assessment instrument is properly aligned with what the technology is enabling, if a correlation is going to be seen between computer usage and student achievement. The content being learned by the students represents “prerequisite” knowledge that students must acquire before moving further along into the class content. As such, the content is simple and does not require much more than memorization skills. This has led to a simplistic and perhaps unauthentic assessment of what students are really learning. Though previous research has indicated some modicum of usefulness of computers for this type of learning, it is not where the most profound results will be found. More applicable content that requires higher order learning skills and a well aligned assessment tool for future research could provide more significant results. Overall, the results may have shown more significance had the technology implementation been more transformative of the student’s learning experience as suggested by Bebell and Kay (2010).

One important element of successful 1:1 implementation and computer integration is the changes in teaching practices that come about by using technology in the classroom (Cavanaugh, Dawson, & Ritzhaupt, 2011; MacBride & Luehmann, 2008; Penuel, 2006). The study did not focus on how the teacher taught, or the role of the teacher in the classroom. Though the teacher required students in the treatment group to use mobile devices to complete their projects, the teacher did not significantly change the way he taught. His role was still that of a lecturer, not a facilitator. The transition to a student centered classroom has been shown to lead to increases in student performance, yet that element was missing from this study (Cavanaugh, Dawson, & Ritzhaupt, 2011; MacBride & Luehmann, 2008; Penuel, 2006). Future studies that focus on the teacher’s role and how it can affect student performance in a 1:1 scenario may provide additional insight.

Though the results of this study did not provide conclusive evidence that 1:1 computing has an effect on student performance, it did provide some insight into the confounding variables that can influence future studies. It is the desire of the researcher that this study will open dialog among school officials, teachers, and instructional technology leaders to the potential impact of 1:1 computing and the necessary changes to effectively change instructional practices. This researcher suggests a long term study, on a larger sample, with a full 1:1 implementation to more accurately measure the effects of 1:1 computing in this school system.

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Appendices

Appendix A

Landscape Plant Identification List

1. Azalea / Rhododendron
2. Benjamin Fig / Ficus benjamina ‘Exotica’
3. Boston Fern / Nephrolepis exaltata
4. Cactus / Opuntia tribe cv.
5. Cone Flower / Echinacea purpurea
6. Foxglove / Digitalis purpurea
7. Heartleaf Philodendron / Philodendron oxycardium
8. Jade Plant / Crassula argentea
9. Lantana / Lantana spp
10. Pansy / Viola x wittrockiana
11. Poinsettia / Euphorbia.pulcherrima cv
12. Pothos / Epipremnum aurens
13. Shasta Daisy / Chryanthemum x superbum
14. Snake Plant / Sansevieria trifasciata
15. Snapdragon / Antirrhimum majus
16. Spider Plant / Chlorophytum commosum
17. Wandering Jew / Zebrina pendula
18. Coleus / Solenostemon scutellarioides
19. Thanksgiving Cactus / Schlumbergia truncata
20. African Violet / Saintpaulia ionantha
21. Boxwood */ Buxus species*
22. Butterfly bush */ Buddleia davidii*
23. Camellia */ Camellia japonica cv.*
24. Daylily */ Hemerocallis species and cv.*
25. Hawthorn, Indian */ Raphiolepis indica*
26. Holly, Carissa */ Ilex cornuta ‘Carissa’*
27. Holly, Dwarf Yaupon */ Ilex vomitoria ‘Nana=*
28. Holly, Helleri */ Illex crenata ‘Helleri’*
29. Ivy, English */ Hedera helix*
30. Juniper, Blue Rug */ Juniperus horizontalis ‘Wiltoni’*
31. Juniper, Shore */Juniperus conferta*
32. Juniper, Andorra */ Juniperus horizontalis ‘Plumosa’*
33. Liriope */ Liriope muscari cv.*
34. Loropetalum */ Loropetalum chinese*
35. Nandina, Dwarf */ Nandina domestica (dwarf cv.s)*
36. Osmanthus, Fortunes */ Osmanthus fortunei*
37. Pittosporum, Japanese */ Pittosporum tobia*
38. Privet Hedge, Varigated */ Ligustrum sinense*
39. Rosemary */ Rosmarinus officinalis*
40. Sedum */ Sedum spurium*

Appendix B

Pledge of Confidentiality

For the purposes of data collection, I understand that I will be privy to research information in order to give data to the researcher for analysis and interpretation. The information presented and collected has been revealed by research participants who participated in this project on good faith that their identity, demographic information and research data would remain confidential. I understand that I have a responsibility to honor this confidentially agreement. I hereby agree not to share any information revealed to me with anyone except the primary researcher of this project. Any violation of this agreement would constitute a serious breach of ethical standards, and I pledge not to do so.

Name____

Signature____

Date______________________________

Appendix C

Letter of Cooperation

Human Subjects - Institutional Review Board
Georgia Southern University
P.O. Box 8005
Statesboro, GA 30461

To Whom It May Concern:

Burt Carter has requested permission to collect research data from ___________ agriscience classroom at the _________________________through a project entitled "Impact of Mobile Devices on Student Performance in an Agriscience Classroom". I have been informed of the purposes of the study and the nature of the research procedures. I have also been given an opportunity to ask questions of the researcher.

The data requested including student test scores can be provided to the researcher with parental permission under our ____________ Family Educational Rights and Privacy Act (FERPA) policy. The data will be provided to the researcher without student names, id numbers or other identifiers.

As a representative of ______________, I am authorized to grant permission to have the researcher recruit research participants from our school. Burt Carter is also permitted to collect research data during school hours at our school. The researcher has agreed to the following restrictions: None.

If you have any questions, please contact me at____________.

Sincerely,

Appendix D

Study Description for Participants and Parental Consent Form

Title: Impact of Mobile Devices on Student Performance in an Agriscience Classroom

Who I am and why this research.

My name is Burt Carter and I am the ____________________ and a graduate student at Georgia Southern University. As part of my graduate program, I am the Principal Investigator in this study where I would like to research the use of 1:1 mobile devices in a high school agricultural science classroom to teach and assess landscape plant identification. Your child is invited to participate in this 4-week-long research study by completing landscape plant identification activities and assessments within the regular course of study in your child's regularly assigned classroom. These activities and assessments will be directed by the Agriculture Education Teacher,____________________.

What does your child's involvement entail?

If you agree for your child to take part in this study, he/she will participate in learning activities and assessments in his/her regularly assigned classroom. He/she will not be asked to do anything beyond the regular procedures of his/her classroom. A pretest and posttest will be giving prior to and after four weeks of classroom instruction. Their scores will be used for data analysis to determine the impact of the enhanced instruction versus traditional instruction. Copies of your child's assessment data will be made available to you at your request. Written consent for participation will be obtained from your child as well.

Risks to your child during this research.

This research has minimal risk. I, the researcher, do not expect any harm to come to your child

_________ Participant's Parent's Initials (page 1) because of his/her participation in this research. All data will be kept in a locked file cabinet in the teacher's classroom. All electronic data will be password protected and all students will be randomly assigned a random number combination to protect their identity in the data. Any identifiable information will be kept separately so that your child's participation will not be identifiable.

Will you benefit from your participation?

There are no direct benefits from participation in this research. Your child's participation is voluntary. You may stop your child's participation at any time for any reason. Your child's participation will begin only after you have reviewed and signed the Consent Form and received the answers to any questions you may have for the Principal Investigator.

All research remains confidential.

All data materials remain confidential, and your name or your child's name will not be attached to any data. Pseudonyms will be used for all people, proper nouns, and identifiable events. No references will be made which could link participants to the research. All data will be kept in a locked file cabinet in the teacher's office and all electronic data will be password protected.

Contact Information

Please contact Burt Carter, Principal Investigator, by phone at__________, or by email at _______________at any time during the study if you should have any questions or concerns. My advisor, Dr. Randy Carlson in Instructional Technology Department at Georgia Southern University can be contacted as well at 912-478-5260, or by email at rcarlson@georgiasouthern.edu

_________ Participant's Parent's Initials (page 2)

CONSENT

I have read the above information and I have received a copy of this form. I agree for my child to participate in this study.

Participant's Parent's signature ________________________________ Date __________

Investigator's signature ____________________________ Date __________

Appendix E

Minor's Assent

Hello,

Hello,

I am Burt Carter, a graduate student at Georgia Southern University and I am conducting a study on the impact of mobile devices on student performance in an agriscience classroom.

You are being asked to participate in a project that will be used to learn about how mobile devices can help students perform better. If you agree to be part of the project, you will be assigned a mobile device to help you complete your plant notebook and prepare for the plant identification test. You will take two identical tests during this project. The first test will be administered on the first day before you have received any instruction to determine what you already know. The second will occur on the last day of the project to see what you have learned. This project will last for four weeks.

You do not have to do this project. You can stop whenever you want. If you do not want to use the mobile devices, it is ok, and you can continue with your usual classwork, and nothing bad will happen. You can refuse to do the project even if your parents have said you can.

Only your agriscience teacher will know what you make on the tests. All of the answers that you give me will be kept in a locked cabinet in ___________ room, and only I or ____________will see your answers. We are not going to put your name on the answers that you give us, so no one will be able to know which answers were yours.

If you or your parent/guardian has any questions about this form or the project, please email me at ________________or my advisor, Dr. Randy Carlson, at rcarlson@georgiasouthern.edu. Thank you!

If you understand the information above and want to do the project, please sign your name on the line below:

If you understand the information above and want to do the project, please sign your name on the line below:

Yes, I will participate in this project: ___________________________________

Minor's Name: ____

Investigator's Signature: ____

Date: _______________